Creating Snags and Wildlife Trees in Commercial Forest Landscapes

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ABSTRACT. *Conversion of original older forests to second-growth stands has resulted in the loss of snag and wildlife tree habitat in the Pacific Northwest. Because many species require these habitat features, habitat managers have attempted to create snags and wildlife trees. From written contracts and contractor interviews, I summarized information about currently used snag and wildlife tree creation techniques including operation specifications, cost-effectiveness, safety considerations, and numbers of trees created. Removing the top of a tree with a chainsaw (~$35 per tree) or explosives (~$45 per tree) was commonly used to create snags and wildlife trees. Girdling in or near the base of the crown ($20–30 per tree) has also been used extensively. Cavity creation ($34–50 per tree), fungal inoculation ($23–33 per tree), and limbing (~$32 per tree) have been used to create or enhance snags and wildlife trees and cost less when used in conjunction with topping or girdling. These techniques have shown some success at providing suitable habitat for cavity- and snag-using wildlife; however, they have been used with the assumption that they will be successful. More in-depth research and monitoring are required to assess their effectiveness at meeting wildlife-habitat and forestry objectives. West. J. Appl. For. 13(3):97–101.*

During the 20th century, commercial forestry has converted large areas of unmanaged forests in the Pacific Northwest to younger, second-growth plantations (Harris 1984, Thomas et al 1990). This conversion emphasized the growth of timber for harvest, typically on a short rotation, and little attention was given to retention of snags and wildlife trees (Hansen et al 1991). Snags and wildlife trees were typically removed during timber harvest to comply with worker safety laws, increase operational efficiency, and reduce fire hazards. Consequently, second-growth forests often lack the snag and wildlife tree habitats required by a great number of species (Thomas et al. 1979, Raphael and White 1984, Neitro et al. 1985, Ohmann et al. 1994).

A snag is defined as a standing dead tree in some stage of decay that may have biological and structural attributes usable by wildlife. Examples of these attributes include cavities, insect infestations, cracks in sapwood, loose bark, rotting heartwood, and hollow limbs or trunks. A wildlife tree is a living tree with some of these same attributes.

With the advent of habitat conservation planning as outlined in Section 10 of the Endangered Species Act, nonfederal landowners and resource management agencies have undertaken efforts to provide snags and wildlife trees in forest environments. Although the characteristics of snags and wildlife trees used by cavity-dependent wildlife have been reported, less is known about creating suitable snags and wildlife trees in managed forests where they are uncommon or rare, particularly in the larger size classes (Ohmann et al. 1994). Effective wildlife conservation requires implementing strategies that provide suitable snags and wildlife trees in managed landscapes over time. A means of accomplishing this may be to create snags and wildlife trees.

Few descriptions of the specific techniques for creating snags and wildlife trees are available. Early attempts to create snags to certain specifications were operationally successful. With the assumption that suitable habitat would result from snag creation efforts, independent contractors have been employed to create snags and wildlife trees on commercial forest landscapes. In this paper I summarize published and unpublished information on snag and wildlife tree creation techniques. Although the success of most techniques at providing suitable habitat has not been adequately evaluated, several techniques are being used extensively as a means of

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providing habitat My objective is to compare and explain currently used techniques and their costs to forest managers charged with managing habitat for wildlife in commercial forests of the Pacific Northwest.

Collection of Information

I obtained copies and summaries of contract agreements for snag and wildlife tree creation conducted in forest landscapes in Washington. These documents contained information on techniques, operation specifications, costs, and the number of snags and wildlife trees created. I summarized this information and compared it with findings reported in the literature. Costs of program administration, project preparation, monitoring, or agency overhead were not included in evaluating the expense of creating snags and wildlife trees. These costs may equal or exceed the per-tree cost of creating a snag or wildlife tree (J. Estevez, USDA Forest Service, Trout Lake, WA, pers. comm.).

I also interviewed private contractors who provide snag and wildlife-tree creation services, as well as staff biologists of contracting agencies. During these interviews I obtained information about operations, safety, costs, and efficiency of various techniques employed by contractors and the contracting agencies.

Literature Overview

Experimentation with snag creation began in the late 1970s. Researchers have investigated the use of herbicides (Conner et al. 1981, McComb and Rumsey 1983), explosives (Bull et al. 1981), and fungal inoculation (Bull et al. 1981, Carey and Sanderson 1981, Conner et al. 1981, 1983, Baker et al. 1996, Parks et al. 1996) to create snags or to induce heart rot in snags and wildlife trees. Bull and Partridge (1986) evaluated six techniques for creating snags and wildlife trees in northeastern Oregon, which included topping by chainsaw or explosives, girdling, applications of herbicides or pheromones, and fungal inoculation. Others experimented with direct creation of cavities in living trees (Carey and Sanderson 1981, Carey and Gill 1983). Creating snag habitat by erecting downed logs and planting them vertically into the ground was also investigated (Caine and Marion 1991, Deal 1996). Artificial snags made of polystyrene have been shown to provide roosting and nesting habitat for several cavity-using birds (Peterson and Grubb 1983, Conner and Saenz 1996). While many experimental techniques have been investigated, few are currently used by contractors and contracting agencies.

Snag and Wildlife Tree Creation

Contractors I interviewed created snags by removing the crown of a live tree using either explosives or a chainsaw. Girdling was another commonly used technique; it involved removing a width of the living bark (cambium) around the circumference of the trunk with a hatchet or saw thereby interrupting the flow of nutrients between the roots and crown Partial crown removal, limbing, cavity creation, and inoculation of heart-rot fungi also were used by contractors to create or enhance wildlife trees.

These techniques can be used in stands of all ages. Trees that are large, widely scattered, or difficult to access, however, require more time and therefore cost more to convert into snags or wildlife trees. Techniques that require special expertise due to technical and safety considerations (e g , using explosives) can also be more costly. Contractors consider the more open stands and gentler terrain of environments east of the Cascade crest more cost-effective for snag and wildlife tree creation than those on the west side. Ponderosa pine (*Pinus ponderosa*), western larch (*Larix occidentalis*), Douglas-fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis*) are species typically targeted on the east side. Douglas-fir and western hemlock (*Tsuga heterophylla*) are often targeted in west-side environments.

Explosives

The use of explosives to remove the top of a live tree is a common snag-creation technique. Typically a contractor climbs the tree to a specified height, bores one or more holes in the bole, plants the explosive charge (one or more sticks of dynamite) within the bored holes, and attaches a detonating device that can be used once the climber has climbed down and moved a safe distance from the tree (Bull et al. 1981). The explosive charge severs the bole, removing all or part of the crown. The wound created at the top is ragged and natural-looking, like that created by wind-shear. Leaving some live branches below the severed point can prolong the life of the tree and therefore increase its value as a wildlife tree. When the objective is to create snags, however, all live limbs should be removed.

Blasting has been successful at creating ponderosa pine snags that are windfirm and suitable as habitat for wildlife (Bull et al. 1981, Bull and Partridge 1986). Blasting can be done in conjunction with fungal inoculation of the wound, limbing, and cavity creation, but at an increased cost. This technique and its use in conjunction with fungal inoculations and cavity creation have been employed by the USDA Forest Service in the Pacific Northwest.

Blasting can be done in stands of all ages; however, precautions may be required to protect adjacent trees from being damaged by or entangled with the severed top (Bull et al. 1981). It requires contractors licensed to use and transport explosives, and extensive safety precautions must be observed throughout operations. While contractors consider blasting a safe technique, contracting agencies may use saw-topping or girdling instead because of concerns and mandates to minimize disturbance to endangered species (e.g., spotted owl).

Bull and Partridge (1986) estimated the total cost of creating snags with explosives at $30 per tree for ponderosa pine in northeastern Oregon. Cost estimates summarized from written contracts and contractor interviews were approximately $45 per tree (Table 1), however contractors explained that cost varies substantially depending on a number of site- and job-specific factors (e.g., tree size, distance between target trees, accessibility to trees, terrain).

Table 1. Cost estimates (per tree) for techniques used to create snags and wildlife trees in Washington, 1987–1996

Technique	Written contracts[b] X̄	range	N	Contractor interviews X̄	range	N	Bull and Partridge (1986) ($)
	($)			($)			
Blasting	47.48	33.73–60.73	12	43.75	27.50–60.00	6	30.00
Saw-topping	34.78	21.73–90.00	23	36.83	25.00–45.00	6	18.95
Girdling[c]	27.43	15.00–53.00	13	19.58	17.50–30.00	6	3.13
Fungi inoculation	23.81		1	33.00	20.00–40.00	5	4.65
Fungi inoculation after blasting or saw-topping				12.75	5.00–20.00	4	
Cavity creation	34.12	25.00–100.00	3	50.62	27.50–60.00	4	
Cavity creation after blasting or saw-topping	15.00	15.00–15.00	2	17.50	10.00–25.00	5	
Limbing	32.01	28.79–52.00	2	32.00	29.00–35.00	2	

Estimates from[a]

[a] For written contract items ($n = 56$), cost estimates were based on 53 items contracted from 1990 to 1996, and three items contracted between 1987 and 1990. Means represent the total cost of all snag and wildlife tree creation for each technique divided by the total number of trees for that technique. Estimates from contractors were based on 1996 costs.

[b] The 12 blasting contracts included a total of 2723 trees. The 23 saw-topping contracts included 2263 trees. The 13 girdling contracts included 3216 trees. The 5 cavity creation contracts included 295 trees. The two limbing contracts included 72 trees.

[c] Cost estimates from contracts and interviewed contractors were based on crown girdling. The estimate from Bull and Partridge (1986) was based on basal girdling (i.e., no climbing cost).

Saw-Topping

Saw-topping involves sawyers climbing to a specified height in the tree and severing the bole with a chainsaw, removing some or all of the crown. Saw-topping can be done in conjunction with fungal inoculation, limbing, and cavity creation and can create snags and wildlife trees that are windfirm and provide suitable wildlife habitat (Bull and Partridge 1986, Chambers et al. 1996, M. Borysewicz, USDA Forest Service, Metaline Falls, WA, pers. comm.). Saw-topping does not leave the natural looking (i.e., wind-sheared) top that is left after blasting, but the sawyer can make a severed top look natural or alter it to provide a potential nesting site (Bull et al. 1997). A natural-looking top, with its increased surface area, may be more susceptible than a cross-cut top to natural fungal inoculation and heart rot.

Saw-topping is considered more dangerous than blasting because of the proximity of the climber-sawyer to the falling top. Tops can deflect off adjacent trees or become entangled with the sawyer or the sawyer's equipment. In addition, strong or gusting winds and their unpredictable effects on a falling top can create hazardous conditions for the climber-sawyer.

Estimates from written contracts, contractor interviews, and Bull and Partridge (1986) indicate that saw-topping costs less than blasting (Table 1). Contractors explained that saw-topping estimates, as with those for blasting, are variable depending on a number of site- and job-specific conditions. There was an inverse relationship between the cost per snag created and the number of trees saw-topped in a given operation ($r^2 = 0.20$, $P = 0.03$, df = 24; using linear regression on the contract data), which reflects the favorable economics of creating snags and wildlife trees in larger quantities (also see Chambers et al. 1996). This relationship was not observed with blasting ($P = 0.43$) or crown girdling ($P = 0.34$).

A variation of saw-topping has been to use a feller-buncher to top trees. The machine's use is limited to smaller trees (≤18 in. diameter where cut) on gentle terrain, however, and its maximum cutting height is about 20 ft, resulting in a relatively short snag (R. Wininger, Weyerhauser Corp., Springfield, OR, pers. comm.).

Girdling

Girdling can create a dead but intact top, providing a taller snag; however, this intact top makes a girdled tree more susceptible to wind-shear at the wound site. If girdling is done at breast height (basal girdling) and wind-shear breaks the tree at the wound site, little or no snag habitat will remain. Alternatively, girdling in or near the base of the crown (crown girdling) can preserve much of the bole if wind-shear breaks the snag at the wound site. Girdling can be done in conjunction with fungal inoculation and limbing, at increased cost. Girdling may result in a sap rot rather than a heart rot, potentially reducing the suitability of some snags as nesting habitat (Carey and Gill 1983, Neitro et al. 1985). Sap rots, however, can provide suitable excavating conditions in tree species with a wide layer of sap wood (e.g., ponderosa pine; Bull et al. 1997). Snag monitoring on the Colville National Forest has documented natural fungal infection, insect infestation, and wildlife use of crown-girdled trees (M. Borysewicz, USDA Forest Service, Metaline Falls, WA, pers. comm.). In New Mexico, Parks et al. (in prep.) found that most of 102 ponderosa pines killed by basal girdling were used by woodpeckers as foraging substrate and that 20% contained woodpecker nest cavities <10 yr after being girdled.

Girdling is the safest and least expensive of the commonly used snag-creation techniques. Cost estimates from written contracts and contractor interviews were based on climbing and crown girdling (Table 1).

Inoculating Trees with Heart Rot Fungi

Inoculating trees with heart rot fungi may be a relatively inexpensive way to create a wildlife tree, and potentially, a snag (Table 1). Climbers bore holes into the heartwood and insert wooden dowels infected with a heart-rot fungi (Conner et al. 1983, Parks et al. 1996). The fungi may produce a heart rot conducive to excavation by primary cavity nesters. Heart rot can eventually lead to the formation of hollow limbs and trunks suitable for nesting, denning, resting, and roosting by wildlife (Bull et al 1997, Parks et al 1997)

Boring and inoculating have been successful in creating heart rots in some hardwoods (Conner et al. 1983), and are currently the subject of several conifer-habitat studies in the Pacific Northwest (Helton and Bednarz 1996, Parks et al. 1996). Parks et al. (1996) documented cavity excavations in 8 of 10 inoculated western larch in one study stand 6.5 yr after treatment.

Shooting inoculum into trees with a rifle or shotgun has shown initial promise as a less expensive alternative to climbing and inoculating (Baker et al. 1996); however, further investigation into commercial application is needed. While relatively inexpensive as presently conducted by contractors, fungal inoculations are even more economical when done in conjunction with blasting, saw-topping, and girdling (Table 1).

Cavity Creation and Limbing

In the process of creating snags, biologists found that cavity creation and other improvements could increase the habitat value to wildlife. Carey and Gill (1983) experimented with cavity construction by excavating cavities with a chainsaw and covering them with a wooden faceplate with an entrance hole. They reported that created cavities were used extensively by birds. Routing holes into trees was an effective way to provide cavities for small mammals where the cavity did not callous over (Carey and Sanderson 1981). Carey and Sanderson (1981), however, found that some tree boles were weakened where cavities were created and broke at this point. Cavity creation can be costly, and costs may vary substantially depending on the individual contractor (Table 1). Cavity creation, however, is much less expensive when done in conjunction with blasting or saw-topping (Table 1).

Limbing reduces the number of branches left in the crown of a live tree. Limbing is often done to clear live branches below the point of blasting or saw-topping in order to reduce the potential for windthrow of a live tree or snag, to provide perches for wildlife, and to prevent a live limb from becoming a new leader and revitalizing the tree. Live limbs are often left intact well below the topping point. At this level, they can sustain a damaged wildlife tree but will not become new leaders. Limbing is relatively expensive (Table 1), but costs less when done in conjunction with blasting or saw-topping.

Safety Issues

Most snag creation techniques require climbing trees, which is dangerous (Walkowiak 1996) and generally requires training and experience before a contractor can become efficient and competitive in business. Adding the need to hoist and use chainsaws and other equipment in the canopy can increase the risks to the climber and the ground crew (Walkowiak 1996). Saw-topping may be the most dangerous technique because injury can result if the falling tree top becomes entangled with the climber or the climber's equipment.

Blasting would appear to be the most dangerous technique. Safety precautions observed during these operations, however, make this technique relatively safe. Blasters and support crew are required to be 500 and 700 ft, respectively, from the explosives at detonation. Also, the public is warned by signs and advised by the ground crew to avoid the blasting area. Specific requirements in government contracts mandate safe transport, storage, placement, and detonation of the explosives.

Girdling, fungi inoculation, limbing, and cavity creation require fewer safety measures than blasting and saw-topping Cavity creation may be somewhat more dangerous because the bole may break where the cavity is being made (Carey and Sanderson 1981).

Conclusions

Providing snag and wildlife tree habitat has numerical, spatial, and temporal considerations, as snags and wildlife trees have limited lifespans. Snag and wildlife tree creation can provide potential habitat in forest stands wherever and whenever suitable trees are present. Crown removal using explosives or a chainsaw, and crown mortality through girdling can provide considerable certainty as to where and when potential snag habitat will be available, as well as to the size and species of snag created. Forest managers are left with the task of designating an adequate spatial distribution and number of live trees to provide a sustained yield of snags and wildlife trees. The characteristics (e.g., dbh, species, height, decay stage, density) of snags and wildlife trees used by individual vertebrates have been summarized (see Thomas et al. 1979, Neitro et al. 1985), and can be used as specific habitat targets.

Creating snags and wildlife trees does not equate to providing habitat. Not all snags and wildlife trees are suitable for wildlife. Fungal inoculation, cavity creation, and limbing may increase the suitability of snags and wildlife trees for wildlife. Unfortunately, little information is available on the success of these techniques for providing snag and wildlife tree habitat. Research and monitoring are needed to evaluate wildlife use of created snags and wildlife trees, both at the individual snag/tree- and landscape-levels. Further, research and monitoring are needed to evaluate additional techniques on commercial forest landscapes and to develop recommendations that meet wildlife and forestry objectives.

A list of snag creation contractors available to forest managers in the Pacific Northwest can be obtained from the author.

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