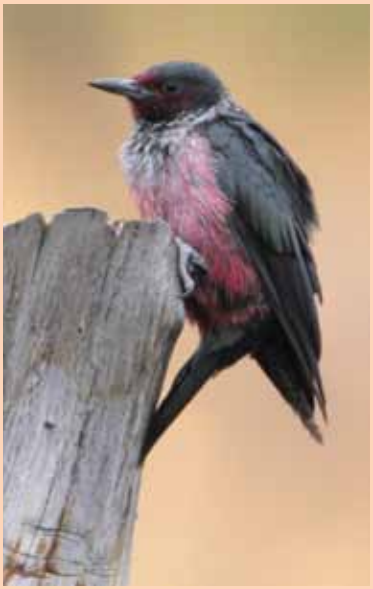
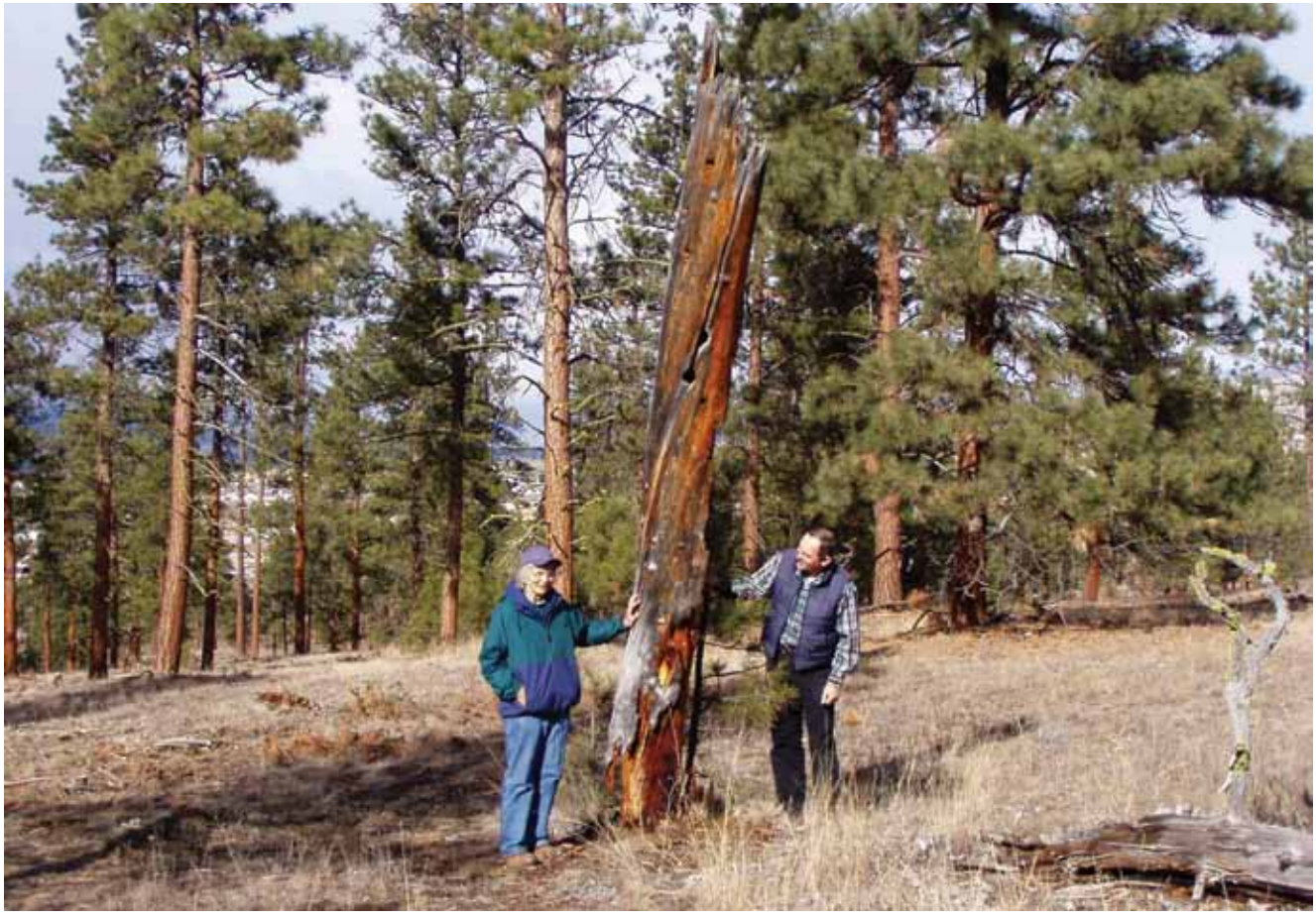
Snags, Bark Beetles, and Cavity-Nesting Birds:

Conservation and Management in Ponderosa Pine Forests of the Pacific Northwest





Restoration logger Craig Thomas and landowner Priscilla Antrim with a wildlife snag left during a prescriptive timber harvest on her Montana property, 2003. Photo: Dan Casey

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Cover photo credits (clockwise from top left): Mountain pine beetle: U.S. Forest Service; White-headed Woodpecker: Mac Knight; Lewis's Woodpecker: Greg Lavaty; created ponderosa pine snag: Darin Stringer, 2008.

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To some people, dead trees (snags) are unattractive, wasteful, and indicate unhealthy forest conditions. However, dead and dying trees are an essential component of natural forest ecosystems, providing invaluable wildlife habitat and a means for important nutrients to cycle back into the forest. While too many snags may indicate unhealthy conditions, a truly healthy forest always contains some amounts of diseased, dying, and dead trees.

In dry forests of the Pacific Northwest dominated by ponderosa pine, there is renewed interest in the importance of snags as part of forest restoration efforts. Snags are deficient in many of these forests, especially on private forest lands, and several bird species associated with snags have been documented to have declining populations. This brochure is intended to *enhance awareness* of the ecology of ponderosa pine forests, including the relationship between snags, bark beetles, and cavity-nesting birds, and to *promote actions* to achieve healthy forests that support adequate snag resources and the populations of birds that depend on them.

Ponderosa pine forest, 2002. Photo: Dan Casey

A truly healthy forest always contains some amounts of diseased, dying, and dead trees.

Williamson's Sapsucker (top). Photo: Greg Lavaty

Old-growth ponderosa pine forest typical of historical conditions near Bend, Oregon, 1909. Photo: Stu Garrett

A large ponderosa pine snag. Photo: Darin Stringer, 2008

Ponderosa Pine Snags: Past and Present

In ponderosa pine forests prior to Euro-American settlement, regular understory fires and bark beetles were the primary factors maintaining open forest understories with singular or small patches of snags. These snag patches in turn created canopy openings needed for tree regeneration. Thus, the periodic "disturbance" of fire and beetles ensured a healthy ponderosa pine forest with a continuous supply of snags over time, since the oldest trees were most susceptible to mortality, resulting in a forest with mostly large snags.

Fire and bark beetles are still influencing the ponderosa pine landscape, but the forest has changed, and with it the patterns of snag creation, persistence, and value. Throughout the region, past forest management policies and practices have contributed to unnatural tree densities. Fire suppression initiated in the early 20th Century was supposed to protect forests from a perceived enemy, but has actually succeeded in creating the perfect conditions for severe wildfires and beetle infestations. Fire suppression has resulted in crowded forests, more flammable material, and greater competition. This weakens tree growth and vigor and produces forests where younger trees dominate. Now, fires reach into the canopy and may kill large areas of forest. Likewise, beetles now cause mortality in larger patches of trees because the forest is so dense and overcrowded with stressed trees. However, the snags created by these circumstances are very dissimilar to historic conditions, with fewer of the large snags so important to birds.

Another difference between present and past conditions in ponderosa pine forests is that snags are often removed, especially on private lands. Finally, because many of the large, live trees have been harvested over previous decades, the snags that now occur are often smaller diameter and uncharacteristic of historic conditions, and of limited value to wildlife.

Bark Beetles and Snag Creation

The western pine beetle is typically the most common bark beetle in ponderosa pine, especially in mature forests. In younger ponderosa pine forests, mountain pine beetle is more common; it is also responsible for much of the widespread tree mortality in lodgepole pine forests covered in the news. Other bark beetles, such as the Ips beetle and red turpentine beetle, typically cause less severe tree mortality, but still play important roles in producing snags in these forests.

In healthy ponderosa pine forests, these native bark beetles occur naturally at low levels. Bark beetles attack slow-growing, decaying, or diseased trees, and those weakened by competition in overcrowded forests, lightning, fire, or other injuries. The tree mortality caused by bark beetles is a normal part of the ecological process, and over time produces a range of snag conditions as the forest matures and replaces itself.

Climate conditions heavily influence bark beetles including the number of eggs laid, their ability to disperse, and over-winter survival. Warmer and drier than normal conditions can increase bark beetle activity, while cooler, moister conditions will inhibit bark beetle activity.

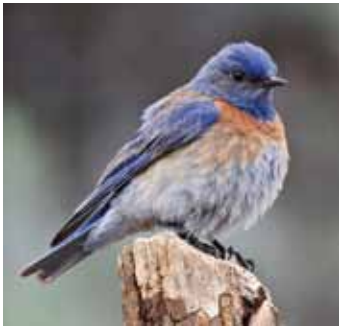
Bark beetles attack trees by chewing through the outer bark and feeding on the nutritious, soft, inner bark. Healthy ponderosa pine trees ordinarily produce abundant amounts of resin, which pitches out or ejects attacking beetles or inhibits their larval development. However, when deprived of moisture, stressed trees cannot produce sufficient resin to thwart beetle attacks. After attack, female beetles emit a chemical scent (pheromone) that attracts other beetles. The beetles then mate and lay eggs in galleries or chambers they construct between the bark and the wood. A "blue stain" fungus carried by the beetles contributes to the death of the tree by clogging its water-conducting tissues. Larvae feed and overwinter before emerging as adults in mid-summer to attack new trees.

Mountain pine beetle: Ron Long, Simon Fraser University, Bugwood.org

Galleries of western pine beetle, showing characteristic serpentine pattern. Photo: Ladd Livingston, Idaho Department of Lands, Bugwood.org

Snags provide essential habitat for approximately one-quarter of all breeding birds in western coniferous forests.

Pygmy Nuthatch. Photo: James Ownby



Western Bluebird. Photo: Alan D. Wilson

Ponderosa Pine Snags and Wildlife

Ponderosa pine trees generally produce excellent snags for wildlife, due in part to their high proportion of sapwood (the outer tree layer). Sapwood decays fast in dead pine trees, and this thick layer provides a deep area of material for cavity excavation. The hollow cores that often develop in older trees are not as common in ponderosa pine as other conifers, but are occasionally caused by heart rot fungi or fires.

Snags are classified for wildlife in a number of ways. One key characteristic is the soundness of the wood, and is described as either "hard" or "soft." The wood in "hard snags" is essentially solid, while soft snags are in an advanced state of decay. Some birds only excavate in soft snags. Others, including most woodpeckers, typically require harder snags because of the stability they provide for nest cavities. Patterns of decay vary based on many factors including fungi in the wood, how the tree died, and the age of the tree.

Other characteristics of snags important to wildlife include the size (diameter and height) and their location and arrangement within the forest. In ponderosa pine stands and throughout western conifer forests, large snags are valuable habitat elements because they stand longer and provide higher quality foraging and nesting opportunities.

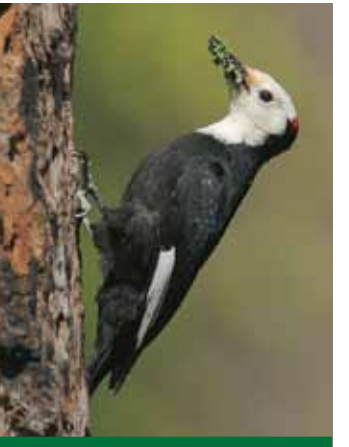
Cavity-Nesting Birds

Snags provide essential habitat for approximately one quarter of all breeding birds in western coniferous forests. Dead trees are used by birds for foraging, cavity nesting, perching, food storage and drumming (pecking against the tree to communicate). Some birds, such as sapsuckers and woodpeckers, excavate their own nests in snags (primary cavity nesters). Other birds occupy abandoned or natural cavities (secondary cavity nesters). Primary cavity nesters are considered "keystone species" because of the role they play in providing habitat for many other species, and their declines could have cascading effects in the ecosystem.

In addition to nesting habitat, snags provide food for many of these same species by way of insects beneath the bark. Most cavity-nesting birds consume large quantities of insects each year. Woodpeckers remove the outer bark from infested trees to feed on the larvae and can play a significant role in reducing the number of bark beetles within a tree. Additionally, beetle larvae that are not eaten are left with only a thin layer of protective bark, increasing their susceptibility to desiccation and parasitism. This "biological control" by woodpeckers can help stabilize conditions at low beetle population levels, but their action alone cannot control outbreaks.

Several ponderosa pine cavity-nesting bird species are considered high priorities for conservation because they are experiencing local and/or regional population declines. In the Pacific Northwest, these species include the Flammulated Owl, Lewis's Woodpecker, White-headed Woodpecker, and Williamson's Sapsucker. Some other cavity-nesting birds include Pygmy Nuthatch, White-breasted Nuthatch, Mountain Bluebird, and Western Bluebird.

Most cavity-nesting birds consume large quantities of insects each year.

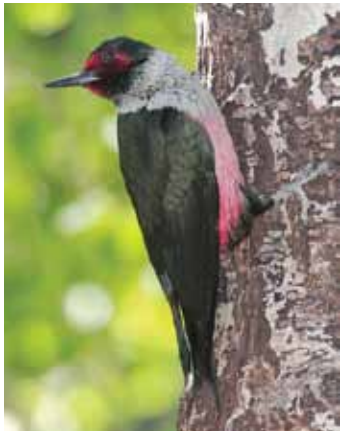


White-headed Woodpecker. Photo: Tom Grey

General Habitat Requirements of Priority Cavity-Nesting Birds in Ponderosa Pine Forests

	Snag Size	Snag Densities	Canopy Cover	Shrub Cover	Key Factors
Lewis's Woodpecker	>21 in.	1-3/acre	10-40%	>40%	Very open forest, shrub cover for insect production
White-headed Woodpecker	>21 in.	1-3/acre	20-50%	<50%	Large territories, >350 acres per pair
Flammulated Owl	>12 in.	1-3/acre	20-50%	<20%	Patches of young dense trees, small grassland openings
Williamson's Sapsucker	>18 in.	1-10/acre	25-70%	<50%	Open to closed canopy; mixed ponderosa pine forest

Snag densities assume the tree is suitable for use (decay state, location, etc.)



Lewis's Woodpecker. Photo: James Ownby

Lewis's Woodpecker: The Lewis's Woodpecker is a large bird that will excavate its own cavity in soft wood, but also will use existing cavities and even nest boxes. It is dependent on open ponderosa pine habitat, preferring sites with very large snags and moderate shrub cover. Unlike other woodpeckers, it forages for insects by specialized aerial fly-catching behavior. It also feeds on ripe fruits and acorns in the fall.

Flammulated Owl: The tiny Flammulated Owl nests in cavities created by woodpeckers in moderate to large pine snags in forest stands that combine open forest with occasional clumps of dense, small trees for roosting and calling. Adjacent grassland openings are essential habitat for foraging. Flammulated Owls are neotropical migratory birds that feed almost entirely on insects, especially moths and beetles.

Flammulated Owl. Photo: Michael Woodruff

White-headed Woodpecker: The White-headed Woodpecker prefers large tracts of open, mature ponderosa pine forest with snags for nesting and large, live trees for foraging on pine seeds. It excavates nesting cavities in snags often less than ten feet from the ground.

Williamson's Sapsucker: The Williamson's Sapsucker uses open- to closed-canopy ponderosa pine and mixed conifer forest where there are large snags and an open understory with low shrub cover. These birds feed on the sap and phloem from small holes they drill in trees. Ants are a large part of their diet, though they also consume damaging insects such as the spruce budworm that periodically defoliate Douglas-fir and true firs.

Several ponderosa pine cavity-nesting bird species are considered high priorities for conservation because they are experiencing local and/or regional population declines.

Williamson's Sapsucker. Photo: Peter LaTourrette, 2010, http//birdphotography.com

Snags in Managed Forests

The first steps toward ensuring snag resources in a forest are adequate to meet the needs of cavity-nesting birds involves setting management goals and conducting an inventory of dead or dying trees. Once targets are set and snag conditions assessed, actions can be directed to enhance these habitat features by retaining existing snags and creating new snags as necessary to meet the habitat requirements of priority cavity-nesting birds.

White-headed Woodpecker leaving nest hole. Photo: Larry Selman

Retaining and Recruiting Snags

Retaining snags is the primary approach to maintaining cavity-nesting bird habitat. A range of soft to hard snags should be left. Typically, all soft snags should be retained, as they have little if any commercial value, and are hazardous to cut. Hard, sound snags should be retained wherever possible when snag resources are lacking.

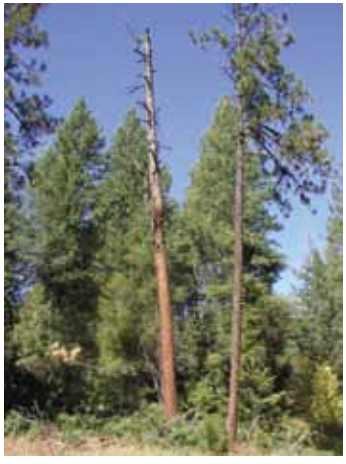
If all snags cannot be retained, land managers should try to leave dead or dying trees that have the following characteristics:

- ✔ large diameters
- ✔ existing woodpecker holes or cavities
- ✔ conks of heart rot fungi; wounds or scars from fire, lightning, or mechanical damage
- ✔ dead areas on living trees
- ✔ both sound and decayed wood
- ✔ occur in areas of both low and high tree density and across a range of topography (ridges, slopes, and bottomland)
- ✔ arranged as solitary dead trees or in small clumps (up to ten)

Nest hole in created pine snag. Photo: Dan Casey, 2008

When conducting forest management such as thinning, it is also important to retain some trees that are likely to be good snags in the future. These "snag recruitment" trees should be as large as possible, and may have sections of dead

Washington landowner Matt Welles and forester Darin Stringer with large snag used by White-headed Woodpeckers. Photo: Dan Casey, 2008



Snags can be created to help establish healthy forest conditions. Photo: Dan Casey, 2008

wood, scars, and features that predispose them to dying, such as sparse, declining crowns or broken tops. Thinning the forest in variable patterns including relatively open conditions to dense patches of trees is a good way to encourage a steady recruitment of natural snag formation, while reducing the risk of wildfires and excessive beetle mortality.

Creating Snags

In areas where dead trees are deficient, snag creation will enhance habitat for cavity-nesting birds. Snag creation may require balancing the needs of cavity-nesting birds with other objectives. Developing a snag management plan will help landowners and managers choose areas to enhance with snags, select individual trees, and identify the best methods to use. In areas where tree density is too high, snag creation should be done after activities such as thinning and slash removal are completed. Additional considerations include:

- Most created snags should be well-distributed because of the territorial requirements of cavity-nesting birds. However, clumps of snags can also be beneficial for some species. Consider the position of a snag in the landscape and in relation to other trees, openings, and foraging areas.
- Snag-dependent birds and other wildlife have different preferences for location of snags. Many priority species prefer snags in more open areas.
- Avoid creating snags near structures or roads and other areas where falling trees pose a safety risk.
- Avoid creating snags in areas of high tree densities that may result in elevated bark beetle mortality.

There are three primary methods for creating ponderosa pine snags:

Girdling uses a chainsaw to sever the bark and cambium. Two cuts are made about 8-10 inches apart and the bark between the two cuts removed. This can be done low enough to kill the entire tree, or higher, to create a dead top.

Topping involves climbing a tree or using mechanized logging equipment to remove the top at a desired height, followed by disposing of live limbs below the topped section.

Pheromone Attractants is a recently tested method that shows promise as an effective snag creation technique that uses pheromones of naturally occurring bark beetles to target mortality to specific trees.

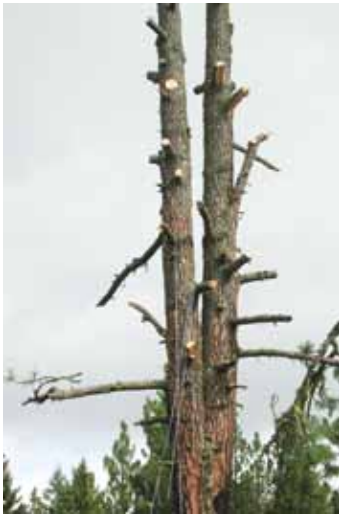
Choosing a Snag Creation Method

The different snag creation methods have trade-offs. Topping is the most expensive because of the time and skills required. Additionally, topping trees can be hazardous, and girdling is also not without safety concerns.

Recent experimental trials using bark beetle pheromone packets in California and Oregon have yielded varying degrees of success. The pheromone packets resulted in mortality to nearly all the targeted trees with minimal to no spillover mortality to adjacent trees when placed in appropriate situations. This work also indicated that ponderosa pine snags created by bark beetles provided better and quicker foraging and nesting conditions for woodpeckers compared to girdling or topping. Using beetle pheromone packets is considerably less expensive and hazardous than manually topping trees to create snags. Girdling and/or topping may be substitutes for landowners who are not comfortable using beetle pheromones.

For those interested in the use of pheromones, a few key factors should be carefully considered before implementing:

- ✔ Treated areas should contain mostly vigorous, healthy trees to reduce risk of mortality of non-targeted trees, and contain trees large enough to be good snags for wildlife. A recently thinned stand where slash has been treated is a good candidate area.
- ✔ Pheromone packets should not be placed along property boundaries, especially if adjacent forests are overstocked or showing signs of stress.



A combination of topping, limbing, and/or girdling can be used to create snags. Photo: Dan Casey, 2008

Packet containing western pine beetle pheromones. Photo: Darin Stringer, 2008

Typical ponderosa pine restoration prescriptions address the need to reduce fire and beetle risk, but may degrade wildlife habitat if snags are removed.

Consulting forester Darin Stringer with a snag created on a property in central Oregon. Photo: Dan Casey, 2008

- ✔ Isolating pheromone-treated trees at least 50 feet from other trees should reduce or eliminate non-target tree mortality.
- ✔ Pheromone packets should be applied during summer months when adult beetles take flight.
- ✔ Pheromone packets should be targeted with mountain pine beetle for younger pine and western pine beetle for older pine.
- ✔ Pheromone packets should only be used in consultation with a professional experienced with this technique.

Integrating Snag Management with Forest Stewardship

Snags are just one component of a functional and resilient ponderosa pine forest. Their management should be incorporated into a broader plan that assesses and seeks to achieve the ecologically appropriate conditions for each site. The determination of "desired future conditions' is a key step to successful management of this resource.

Restoration prescriptions typically focus on removing trees such as Douglas fir, grand fir, lodgepole pine, and juniper that have encroached on ponderosa pine in the absence of fire, thinning dense ponderosa pine, retaining the largest trees, treating fuel build-ups in the understory to reduce intense fire behavior, and re-introducing fire to reinvigorate bunchgrasses and desirable shrubs while reducing fuels. These common "restoration" prescriptions address the need to reduce fire and beetle risk, but may degrade wildlife habitat if snags are removed, and do not address the full spectrum of ecological restoration when snag resources are not a part of the prescription. For this reason, American Bird Conservancy has developed a program for conservation of cavity-nesting birds in ponderosa pine forest that emphasizes education and habitat management to ensure that snags are adequately represented in the forest landscape to support populations of the priority bird species that depend on them.

FAQs

Q. Why do we need to create snags when there are millions of dead and dying trees in the West due to wildfires and beetle infestations?

A. Not all snags are created equal. Most of the recent, large-scale bark beetle attacks throughout the West are occurring in lodgepole pine forests, which has a very different relationship with insects and fire. These forests naturally grow very dense, are often killed by large bark beetle outbreaks, and burn under very intense conditions, setting the stage for a new cycle of dense tree regeneration. While the snags and habitats created by these conditions are important to some wildlife, the priority cavity-nesting birds associated with ponderosa pine forests require very different forest conditions, including larger snags arranged in small clumps and single trees within landscape mosaics of living tree structure and openings.

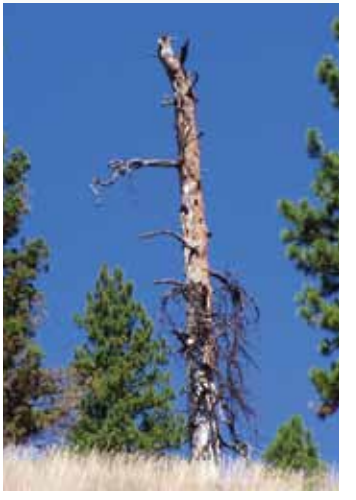
Q: I am doing ponderosa pine restoration trying to recreate healthy conditions…shouldn't that help the birds associated with those forests also?

A: Yes, these actions will help some non-cavity-nesting ponderosa pine birds, but most restoration prescriptions for ponderosa pine forests are being done to reduce fuels and risk of high-intensity fires, and do not consider snag resources. Thinning of low-vigor and defective trees is often a part of this prescription, which also removes future snags. Prescriptions might consider leaving some larger, weakened trees for future recruitment as snags, as well as some clumps of younger trees as roost sites.

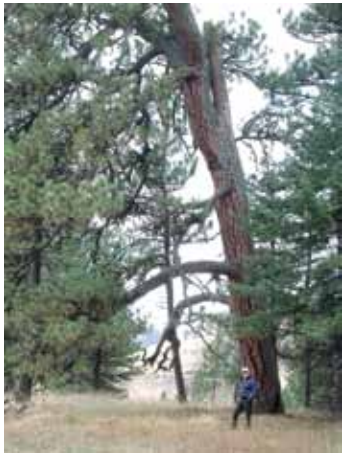
Q: I want to provide habitat for cavity-nesting birds, but I also need to manage my forest for the economic value of the trees. Can I do both?

A: Yes. Trees desired by cavity-nesting birds typically have low economic value due to defect and decay. Dead trees do not occupy growing space resources for other trees. The bird communities that occupy snags contribute to the health of the forest, and these healthy forest conditions are ultimately the foundations for

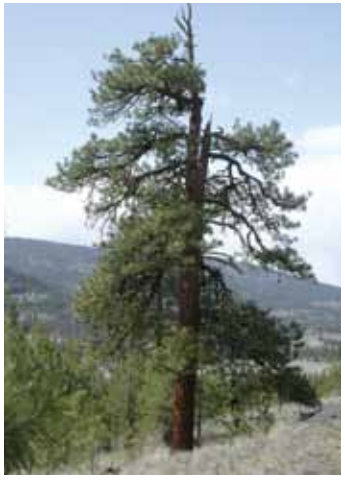
Not all snags are created equal.



Natural snag in an open ponderosa pine stand in central Oregon. Photo: Dan Casey, 2008



A very large ponderosa pine in northern Idaho with broken sections suitable for cavity nesters. Photo: Dan Casey, 2008



This dead-topped pine on a property in Washington is a good candidate for conversion (or natural recruitment) into a snag. Photo: Dan Casey, 2008

protecting your future financial investments in the forest. Ideally, encouraging snag conditions for optimal wildlife populations is recommended. However, even a few snags can help bolster habitat quality on your property. By maintaining the proper density of trees, you can ensure bark beetles and fire don't cause undesirable economic losses. Leaving scattered patches of higher density forest as well as scattered large-diameter and weakened trees is a good approach.

Q: Don't snags cause fires and lead to beetle spread?

A: Snags have always been part of ponderosa pine forests, and these forests historically were very resilient to fire and beetles. Because burning snags can spread fire from the embers they emit during certain conditions, it is important that the forest is managed so fire (when it occurs) can behave as servant rather than master. Bark beetles only attack living trees. Once the cambium of the tree dies out (within a year of tree death), a snag will not contribute to the spread of bark beetles. In stands that are thinned to proper densities and have fuels removed, the risk posed by leaving some snags is minor compared to the ecosystem benefits from these structures.

Q: I want to provide habitat for cavity-nesting birds and I am considering the use of bark beetle pheromones, but I am concerned about killing more trees than are targeted. Aren't bark beetles too destructive to have on my property?

A: Bark beetles can play a positive role in properly managed ponderosa pine forests by thinning trees, creating snags, and providing food for birds. Research is showing that the use of pheromone packets to attract bark beetles (which are already present in the landscape) can be managed and controlled so the likelihood of impacts to other trees is very low. However, landowners should not implement this technique on their own, but consult a professional resource manager with experience in snag creation using this technique.

Q: How many snags do I need to create, and do I need to be concerned about placement of the snags?

A: The number of snags you retain and/or create on your property is based on your management objectives. It would be optimum to have 1-2 large snags (>20 inches diameter at breast height) or more per acre across the landscape, based on our understanding of historic conditions and species needs in ponderosa pine forests. Snag levels can and likely will fluctuate across your ownership based on current conditions, such as availability of good candidate trees for recruitment as dead trees. Snag placement is important to each cavity-nesting species; even a single, well-placed snag can be valuable. Maintaining snags in both open and denser forest will provide a range of conditions for wildlife. Remember, cavity-nesters need snags in a variety of decay stages, but moderately decayed are most desired by the greatest range of species.

Q: How long and often do I have to manage for snags?

A: Snag management should be included as part of periodic forestry operations. Ideally, snags are created naturally over time by the agents described above so a range of decay classes, positions and sizes occur on your property. Snags decay and fall, and so need to be replaced. Monitoring snag conditions every 5-10 years will guide whether additional snag creation is warranted based on the targets you have set for your forest.

American Bird Conservancy has developed a program for conservation of cavity-nesting birds in ponderosa pine forest that emphasizes education and habitat management.

Pygmy Nuthatch. Photo: Dan Casey, 2006

Photo: Darin Stringer, 2009

ABOVE AND BELOW: Snags in combination with a healthy understory can easily provide for the needs of declining birds.

Photo: Dan Casey, 2008

Photo: Dan Casey, 2008

American Bird Conservancy (ABC) is a non-profit organization whose mission is to conserve native birds and their habitats throughout the Americas. ABC acts across the full spectrum of conservation issues to safeguard the rarest bird species, restore habitats, and reduce threats, while unifying and strengthening the bird conservation movement. ABC advances bird conservation through direct action and by finding and engaging the people and groups needed to succeed. **www.abcbirds.org**

Forest Restoration Partnership is a non-profit organization founded to promote the conservation and restoration of declining forest habitats on private lands in the western United States. We promote this mission through collaborative projects that emphasize the design and implementation of cutting-edge habitat restoration practices and holistic forest management, and education and outreach to promote innovative forest restoration systems. **www.forestpartners.org**