



Above photo, taken nine years after the 1994 Star Gulch Fire in Idaho, illustrates snags that were used as nesting habitat and as source of insect food by white-headed and Lewis's woodpeckers.

## Woodpecker Habitat After the Fire

### *Summary*

Public land managers are asked to minimize fuel levels after fires, including using techniques such as salvage logging. They are also responsible for maintaining suitable wildlife habitat, especially for species of concern to state and federal agencies. An area where these responsibilities could conflict is in the use of salvage logging in burned-over areas that also represent good habitat for certain wildlife such as woodpeckers.

Controversy over this conflict has led to litigation. Public land management agencies need consistent design criteria to maintain suitable habitats for these birds. Little information has existed on how to assess potential effects of post-fire logging on habitats and populations of wildlife. Recent research studies are developing tools to evaluate habitat suitability of postfire forests for several species of nesting woodpeckers in the inland Northwest. Data were collected on habitat characteristics at nest sites and on nesting survival at three sites (one each in Idaho, Oregon, and Washington) after wildfires.

## Key Findings

- Areas desirable for post-fire logging often overlap with highly suitable habitat for black-backed, Lewis's, and white-headed woodpeckers.
- Vegetation, burn severity, and topographic data derived from remote sensing, when used with a locally validated model, can forecast nesting habitat suitability for woodpeckers with good reliability. Using a model developed from one region to predict nesting habitat in another region will have lower reliability.
- Where salvage logging operations use a selective cut process and incorporate data from habitat suitability maps, remaining snags may continue to support persistent woodpecker populations.
- Woodpeckers favored burned areas where the pre-fire canopy was moderate (40–70 percent cover) to high (more than 70 percent).

## Fire and woodpeckers

Fire can create dense stands of standing dead trees that provide habitat for a variety of wildlife, notably black-backed, Lewis's, and white-headed woodpeckers in the inland Northwest. These and several other species of cavity-nesting woodpeckers are considered by state and federal agencies as at risk because their populations can be strongly influenced by fire and timber management activities.

The black-backed woodpecker is a medium-sized woodpecker that inhabits a broad range of forest habitat across Canada, Alaska and the northwestern U.S. It is a burned-forest specialist, feeding on outbreaks of wood-boring beetles that feed on recently burned trees. Black-backed woodpeckers are generally non-migratory but periodically make major population shifts, believed to be driven by changing habitat conditions.

Lewis's and white-headed woodpeckers are two other cavity-nesting species of concern that use burned forests for breeding habitat. Lewis's woodpecker is unique among woodpeckers in that it forages on flying insects rather than drilling for insects in the bark of trees. Large diameter dead and decayed trees are necessary for their nest cavities. Forest openings that allow for aerial foraging of flying insects are also required. Consequently, Lewis's woodpecker favors relatively open areas of burned forests in contrast to the high snag density patches preferred by black-backed woodpecker.

While black-backed and Lewis's woodpeckers are found nesting in moderate-to-high severity burned forests, white-headed woodpeckers use low-to-moderate severity burns adjacent to unburned forests. Nearby forests with live trees are particularly important for white-headed woodpeckers because they depend on seeds of pine cones for a portion of their diet during fall and winter months.

For all of these woodpecker species, nest excavation occurs mid-April to early June. Typically for black-backed and white-headed woodpeckers, each year a fresh nest is bored into the sapwood of dead trees or dead portions of live trees. Lewis's woodpeckers usually nest in old cavities or enlarge existing cavities for nesting. Abandoned nests of woodpeckers are often used by other cavity-nesting and

cavity-roosting species, including bluebirds, swallows, and bats.

In the U.S. and Canada, these species are not classified as endangered or threatened. However, in the Northwest there is concern that certain timber management practices can stress regional populations of these birds. Because of woodpecker dependence on standing dead trees (i.e., snags), some scientists and others have been concerned that the removal of snags in post-fire logging operations could dramatically deplete regional populations.

## Conflicting responsibilities

Within forests susceptible to wildfire, federal land managers need to balance dead tree removal for fuel reduction with habitat requirements for wildlife species associated with dead trees. In recently burned forests, salvage logging operations are used to lower fuel levels that can lead to wildfires. Areas identified for postfire salvage logging can overlap with suitable woodpecker habitat. To both meet policies of the National Fire Plan and comply with laws to maintain wildlife populations, accurate information on potential effects of salvage logging are needed. Until recently, such information was largely lacking.

## Filling in the data gap

For this reason, a research project was undertaken using data from three previous wildfire sites in Idaho, Oregon and Washington. Principal investigators were Dr. Victoria Saab of the Forest Service Rocky Mountain Research Station in Bozeman, Montana, Dr. Jay J. Rotella of the Ecology Department at Montana State University, and Kim Mellen-Mclean of the Forest Service Pacific Northwest Region in Portland, Oregon. The research was funded in part by the Joint Fire Science Program.

Saab says, "We conduct research that helps with informing managers about minimizing impacts of various management activities on wildlife. Our habitat suitability models identify areas on the landscape that provide a range of suitability for nesting. Lower suitability areas with unlikely nesting habitat can be chosen for logging, whereas high suitability areas can be reserved for likely nesting."

The goal of this research project was fourfold:

1. To develop statistical models to assess the level of influence of post-fire logging operations on woodpecker nest survival and abundance in dry forest habitats in the Northwest.
2. To quantify the predictive accuracy of habitat suitability models developed from data collected in Idaho by applying that model using observations in Oregon.
3. To quantify the level of fuels reduction achieved after post-fire logging and its relationship to effects on wildlife habitat.
4. To develop guidelines for the use of remotely sensed pre-fire vegetation conditions and post-fire burn severity to predict habitat suitability of burned forests for woodpeckers.

## After the fire

According to Saab, black-backed woodpeckers are attracted to burned forests soon after the fire because of bark and wood-boring beetles in the charred trees, where the woodpeckers forage on beetles and build their nests. She explains that the trends for usage of the post-fire habitat vary with different woodpecker species. "Once the bark- and wood-boring beetles depart a burned forest around 4–5 years after a fire, the numbers of beetle-foraging woodpeckers such as the black-backed woodpecker diminish."

Woodpeckers that feed on flying arthropods, such as Lewis's woodpecker, will use a burned forest for more than a decade after the fire. She explains that nutrients are released after a fire, and these, along with increased sunlight, allow for shrub growth followed by associated arthropods. These are an important food source. "Because Lewis's woodpecker spends many years nesting in burned forests, snag longevity is essential for their nesting habitat."

She notes that snag longevity varies with location, tree species, and diameter and height. In general, thin-barked conifers like Englemann spruce, lodgepole pine and subalpine fir generally stand longer than thick-barked conifers such as Douglas-fir and ponderosa pine. "Larger diameter snags of all species stand longer than smaller diameter trees."

## Variability of habitat suitability

Saab points out, "Post-fire salvage logging operations vary considerably across the western U.S. Some are clear-cuts while others are selectively harvested. Consequently, there is no way of generalizing the extent of habitat degradation to black-backed, white-headed, or Lewis's woodpeckers by a typical operation."

She notes that there is also great variability in suitability of post-fire areas for woodpecker nesting and feeding. "We know that in recently burned dry coniferous forests, some areas are of higher habitat suitability for woodpeckers, whereas other areas are of lower suitability."

## Research sites determined

In this research, nest surveys and monitoring of black-backed woodpecker populations were conducted annually during the first four years after wildfire at three ponderosa pine forest sites. Fire sites used were the 1994 Star Gulch Fire in west-central Idaho, the 2002 Toolbox Fire in south-central Oregon, and the 2006 Tripod Fire in north-central Washington. Lewis's and white-headed woodpeckers were also monitored at the study sites where they occurred; Idaho and Oregon for Lewis's woodpecker, and Oregon only for white-headed woodpecker.



Two years after the Tripod Fire north-central Washington, the area is used for both nesting and as a source to feed on bark- and wood-boring beetles by black-backed woodpeckers.

At each site, areas surveyed averaged about 2,000 acres (800 hectares). Nest cavities were located by doing systematic searching along transects and using playback recordings of their calls to elicit responses by the birds. Nest searching and monitoring was conducted from mid-April through mid-August. The survey also included an evaluation of the habitat components for both nest locations and non-nest random locations on the three sites. In the Idaho and Washington sites, snags were dense and relatively uniformly distributed. In Oregon, snags were more patchily distributed. Proven methods of statistical analysis were used to characterize snag, tree and log characteristics at each site.

## Remote sensing an important tool

A key step in the data gathering process was the use of satellite image data to identify pre-fire forest characteristics and burn severity in post-fire images. Goals were to develop a method to correlate actual field information with Landsat 7 Thematic Mapper satellite images, and to predict woodpecker habitat suitability in post-fire locations. Vegetation cover in the satellite image was assigned as ponderosa pine, mixed conifer, and other types.

On the Toolbox Fire in Oregon, researchers also measured levels of biomass in trees, snags and logs surrounding nest trees and non-nest random trees, both before and after salvage logging operations. Results in

metric tons/hectare were tabulated to determine specific wood loads in these areas. Wood volumes were determined both in proximity to nest trees and in non-nest areas. A total of 210 black-backed and 45 white-headed woodpecker nests were located and monitored after the Silver/Toolbox Fires from 2003 to 2006 to evaluate nest survival. Snags of lodgepole pine and ponderosa pine made up 90 percent of the nest tree species.

Statistical modeling was used to develop relationships between nest survival and habitat. Use of sophisticated statistical methods allowed evaluation of the influence of numerous variables on nest survival, including habitat, time since fire, observer and weather conditions. The goal was to be able to discriminate between potential nest and non-nest locations based on field and remotely-sensed habitat characteristics and to determine if the same factors affected nest survival.

## Research findings

Black-backed woodpecker nest numbers in the area of the Silver/Toolbox Fire in Oregon were evaluated both before and after salvage logging operations, and these were compared with control areas in the same fire area that were not logged. Salvage logging slightly decreased snag density and average snag diameter, whereas coarse woody debris increased after logging.



Individual nests were monitored with an electronic cavity viewer.

Nesting densities were reduced in logged areas, however, nest survival appeared unaffected by salvage logging. In Idaho, nest survival increased with distance to unburned forest. At all three sites, the best predictors of nest occurrence for the black-backed woodpecker were high snag densities of relatively small diameters, as measured in the field, and burn severity and pre-fire canopy cover, as measured remotely.

Nest studies also demonstrated that in post-fire areas with both standing lodgepole pine and ponderosa pine, the black-backed woodpecker during the first several years following the fire has a nesting preference for the lodgepole pine. After approximately the third year, the preference of lodgepole pine diminishes and nests in ponderosa pine become dominant.

In contrast to black-backed woodpecker, Lewis's woodpecker selected more open areas with moderate snag densities of larger diameters. This woodpecker had higher nest densities in partially logged units compared to

unlogged units. Consistent with black-backed woodpeckers, salvage logging had no apparent effects on nest survival of Lewis's woodpecker. Their nest survival was associated with weather conditions and with time since fire. Habitat selection by Lewis's and black-backed woodpeckers represent a range of conditions after wildfires that incorporate habitats used by other cavity-nesting birds. Partially logged areas with moderate snag densities of larger diameters are characteristic of nesting habitat for Lewis's woodpecker, whereas black-backed woodpeckers are typically found nesting in unlogged areas of high snag densities with smaller diameters.

White-headed woodpecker displayed similar patterns in nest site selection as Lewis's woodpecker. The landscape surrounding white-headed woodpecker nests was open-canopied before and, consequently, after wildfire. The habitat at nest trees of white-headed woodpecker had fewer live trees per hectare and more decayed and larger diameter snags than at non-nest sites. They also used a mosaic of burn severities after wildfire.



Black-backed woodpecker climbing a ponderosa pine four years after the Toolbox Fire in Oregon.

Consistent with Lewis's woodpecker, habitat variables were not associated with nest survival for white-headed woodpecker. High daily survival rates and little variation within habitat features among nest locations suggest white-headed woodpeckers were

consistently selecting high suitability habitats. Management activities that open the forest canopy and create conditions conducive to a mosaic burn pattern will probably provide suitable white-headed woodpecker nesting habitat after wildfire.

## Maps have predictive value

Researchers used multiple variables to develop models for nesting habitat suitability. It was found that remotely-sensed pre-fire canopy cover, burn severity, slope and aspect can be used to develop well-performing habitat suitability models. The models for black-backed woodpecker performed well when applied to forests with similar tree composition, topography, and burn severity.

## Applying the models

This research indicates that habitat suitability models and associated maps developed from remotely-sensed data allow managers to rapidly select areas for both post-fire timber harvest and for retention of wildlife habitat in recently burned forest areas. Models performed well when developed and tested in the same general location, but results were mixed when applied to ponderosa pine-dominated forests in other areas. Habitat suitability models

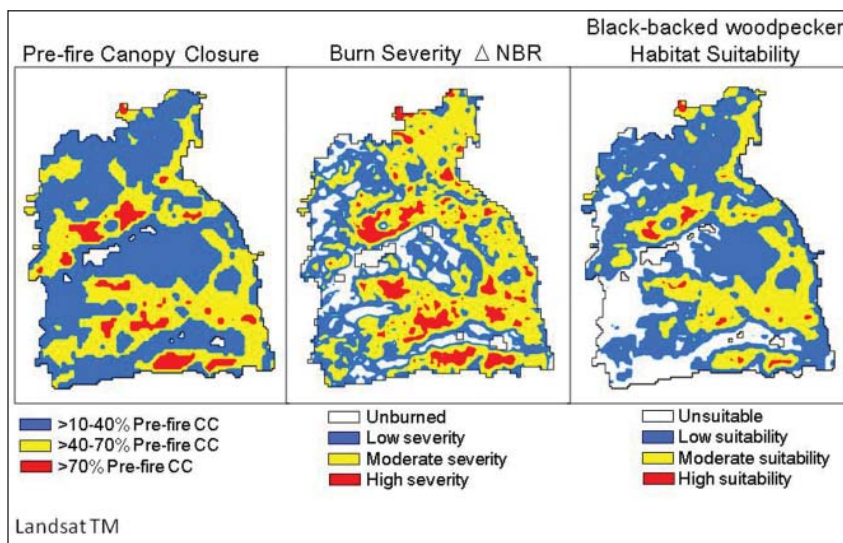
may not be transferable to other areas where topography and tree species composition differ.

Saab indicates, "Land managers could apply our research results to regions within dry mixed-conifer forests of the inland Northwest to identify habitat suitability, but predictive ability is expected to be lower in areas outside the model origin. Model validation and refinement using other locations both from our and other study areas are necessary to improve the utility of our models. Models should be developed for specific localities until models are refined after field testing across different sites."

She notes that land managers on National Forests in Oregon, Washington, Idaho and Montana have used the research results for identifying high and low habitat suitability areas. "This is to help inform them of locations for salvage logging that will likely minimize impacts primarily to black-backed woodpeckers."

In Oregon on the Fremont-Winema National Forest, the models were used to identify reserve areas of high-to-moderate habitat suitability, and those areas were used to survey and monitor nests of woodpeckers. Saab explains, "Monitoring data were used for litigation purposes to demonstrate that black-backed woodpeckers nested successfully in these reserve areas."

Saab notes, "Land managers can download or request remotely-sensed imagery (Landsat) and classification of burn severity (Burned Area Reflectance Classifications, or BARC) by accessing the Remote Sensing Applications Center (RSAC) website. To apply the habitat suitability model to an area of interest, the remotely-sensed variable values that occur at each pixel of the Landsat imagery are used to create a habitat suitability map. Our next step is developing a training course for managers on how to evaluate and create habitat suitability maps that would be used to guide forest restoration activities."



Nesting Habitat Suitability

## Management Implications

- Using remote sensing tools and locally-based models, habitat suitability maps will give useful guidance on which areas will support preferred nesting habitat for black-backed, Lewis's, and white-headed woodpeckers, and which areas can support salvage logging with minimal impact on woodpecker populations.
- Models for woodpecker habitat suitability in one area will not always be applicable to other areas. Applicability of models across sites depends on similarities in coniferous tree species, elevation, burn severity, and topography. Models should be developed for specific localities until they are field tested across different sites and refined for broader applicability.
- Nest survival for black-backed woodpecker and some other cavity-nesting birds could be improved if unlogged reserves are located centrally in postfire forests distant from unburned habitats that potentially serve as sources of nest predators.

## Further Information: Publications and Web Resources

Birds and Burns Network: <http://www.rmrs.nau.edu/wildlife/birdsandburns/>

Climate-Fire Dynamics Group:  
<http://www.firelab.org/firebgc-wildlifeshi>

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- Saab, V.A., R. Russell, J. Rotella, and J. Dudley. 2011. Modeling nest survival of cavity-nesting birds in relation to postfire salvage logging. *Journal of Wildlife Management*. 75: in press.
- Wightman, C., V.A. Saab, C. Forristal, K. Mellen-Mclean, and A. Markus. 2010. White-headed woodpecker nesting ecology after wildfire. *Journal of Wildlife Management*. 74(5):1098-1106.

## Scientist Profiles

**Victoria Saab** has been a Research Biologist with the U.S. Forest Service Rocky Mountain Research Station since 1989. She is currently working with the Station's program, Ecology and Conservation of Terrestrial Wildlife and Habitats in the Interior West. Over the past 25 years she has conducted research on songbirds, woodpeckers, grouse, and raptors of the Interior West and has also studied birds in relation to land use activities in Mexico. Since 1994, she has been leading long-term studies of fire effects on habitats and populations of wildlife in dry coniferous forests of the Interior West.



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*Results presented in JFSP Final Reports may not have been peer-reviewed and should be interpreted as tentative until published in a peer-reviewed source.*

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