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ScienceDirect
Forest Ecology and Management 255 (2008) 2085–2093
Forest Ecology and Management
www.elsevier.com/locate/foreco

Snag density varies with intensity of timber harvest and human access

Michael J. Wisdom [a,*], Lisa J. Bate [b]

[a] USDA Forest Service, Pacific Northwest Research Station, 1401 Gekeler Lane, La Grande, OR 97850, United States
[b] 389 LaBrant Road, Kalispell, MT 59901, United States

Received 20 July 2007; received in revised form 3 December 2007; accepted 5 December 2007

Abstract

Many species of vertebrates depend on snags (standing dead trees) for persistence, and limited research suggests that snag density is lower in areas of intensive timber harvest and increased human access. While intensive timber harvest is one source of potential snag loss, ease of human access to forest stands may also facilitate loss via firewood cutting of snags. Accordingly, we hypothesized that density of snags (number of snags/ha) would decline in forest stands with increasing intensity of timber harvest and increasing ease of human access. We tested our hypothesis by sampling stands under varying levels of timber harvest and access on National Forest land in the northwestern United States. Stands with no history of timber harvest had 3 times the density of snags as stands selectively harvested, and 19 times the density as stands having undergone complete harvest. Stands not adjacent to roads had almost 3 times the density of snags as stands adjacent to roads. Unharvested stands adjacent to non-federal lands and closer to towns had lower snag density, as did stands with flat terrain in relation to nearest road. Our findings demonstrate that timber harvest and human access can have substantial effects on snag density. Meeting snag objectives for wildlife will require careful planning and effective mitigations as part of management of timber harvest and human access.

Keywords: Access; Forest management; Roads; Snags; Snag density; Timber harvest; Wildlife

1. Introduction

Snags (standing dead trees) provide essential habitat for many terrestrial vertebrates in western North America (Thomas, 1979), including many species at high risk of extirpation (Raphael et al., 2001). Intensive timber harvest and increased human access, however, can substantially reduce snag density (number of snags/ha) (Bate et al., 2007). Timber harvest may result in snag loss because some snags are felled for their commercial value, while others are felled to mitigate safety hazards or to reduce perceived fire or disease risk (Hann et al., 1997; Wilhere, 2001; DeLong et al., 2004). Road construction, often associated with timber harvest, further reduces snag density as part of the conversion of forest to roadway (Trombulak and Frissell, 2000; DeLong et al., 2004). In turn, increased access provided by roads may facilitate firewood cutting of snags, further reducing density (Hann et al., 1997; Bate et al., 2007).

Throughout western North American, ponderosa pine (*Pinus ponderosa*) and western larch (*Larix occidentalis*) have been intensively harvested because of their high value as wood products and firewood (Hann et al., 1997). These tree species also are two of the most widespread and valuable species for a suite of vertebrates of conservation concern (Wisdom et al., 1999; Wisdom et al., 2000). Many species of cavity-using wildlife rely on ponderosa pine and western larch (hereafter referred to as pine and larch) snags because they provide some of the most suitable nest and roost sites, owing to characteristics of the wood and its decay patterns (Bull et al., 1997). Consequently, understanding how timber harvest and human access affect pine and larch snags is critical to effective management of snag-dependent wildlife across large areas of western North American (Wisdom et al., 1999).

Further complicating the management of snags is their use for firewood. Cutting of snags for firewood was limited in the past by the distance that wood (log rounds) could be physically carried to a truck. Now, however, many firewood cutters use cable systems to harvest and transport snags, similar to systems used for yarding logs during commercial timber harvest. Snags can now be cut and moved at substantially longer distances from roads because of this improved technology. This begs the

* Corresponding author. Tel.: +1 541 962 6532; fax: +1 541 962 6504.
E-mail address: mwisdom@fs.fed.us (M.J. Wisdom).

0378-1127/$ – see front matter © 2008 Published by Elsevier B.V.
doi:10.1016/j.foreco.2007.12.027

question: how does human access affect snag density? Distance from a road is a factor, but other factors of human access, such as distance to nearest town and adjacent land ownership, also could influence snag density. In northeast Oregon, Bate et al. (2007) found that snag density was lowest in pine and larch stands adjacent to roads, adjacent to private or other non-federal lands, and closest to towns. Whether these patterns are common to pine and larch forests across a broader area of western North American, however, has not been investigated.

Consequently, we evaluated snag density in relation to intensity of timber harvest and human access in pine and larch forests in northwestern Montana, USA. Our objective was to document if similar relations between snag density, timber harvest, and factors of human access, as observed by Bate et al. (2007) in Oregon, also occurred in a distinctly different geographic area, thus expanding the inference space of results across a broad area of western North America.

2. Study area

Our study took place on the Flathead National Forest, MT, USA (Fig. 1). The Forest covers 9300 km^2 in the northern Rocky Mountains, with elevations of 1400–2600 m. Mixed-conifer forests are common, with pine and larch forests dominating the warmer environments at lower to middle elevations.

Timber harvest and firewood cutting are common activities in the lower to middle elevation forests, and these activities are served by a large network of roads. At the time of our field work in 2001, the Forest contained 5730 km of mapped roads. Of these, 1944 km were open year-round, 663 km open seasonally, and the remainder closed. Extensive road closures were initiated during the late 1980s and early 1990s to meet security objectives for grizzly bear (*Ursus arctos*), but most of these roads were open during earlier decades. Thus, closed roads also were important to include in our analysis of human access, considering that under past management, many of these roads were open to motorized access and originally built as haul routes for timber harvest.

Because timber harvest and firewood cutting are common activities that could reduce snag density, the Flathead National Forest originally adopted snag retention standards in the 1980s. Current snag retention standards, adopted in the late 1990s, specify that 7–20 snags/ha >30 cm dbh will be maintained in forest types like those we studied. The specific retention standard varies with land use allocation and vegetation community.

Meeting such snag objectives has become increasingly important in recent years, as rural cities near the Flathead National Forest are growing rapidly, and with this growth has come a substantial increase in use of roads for consumptive activities such as firewood cutting. Population growth in Flathead County, which encompasses much of the Flathead National Forest, has increased 15% during the short period from 2000 to 2006. Characteristics of the Forest, its human uses, and its snag objectives are typical of many National Forests, making it a suitable area to study relations of timber harvest and human access with snag density.

3. Methods

3.1. Stand selection

We used a stratified random method to select stands for sampling. We selected these stands from the Timber Stand Management Record System of the Flathead National Forest. Stands with a dominant overstory of pine or larch were first identified from this database. For smaller-diameter stands with a mean tree diameter-at-breast height (dbh) of ≤12.7 cm, the dominant overstory was identified as the tree species of highest density. For larger stands with a mean tree dbh >12.7 cm, dominance was based on the tree species of highest basal area.

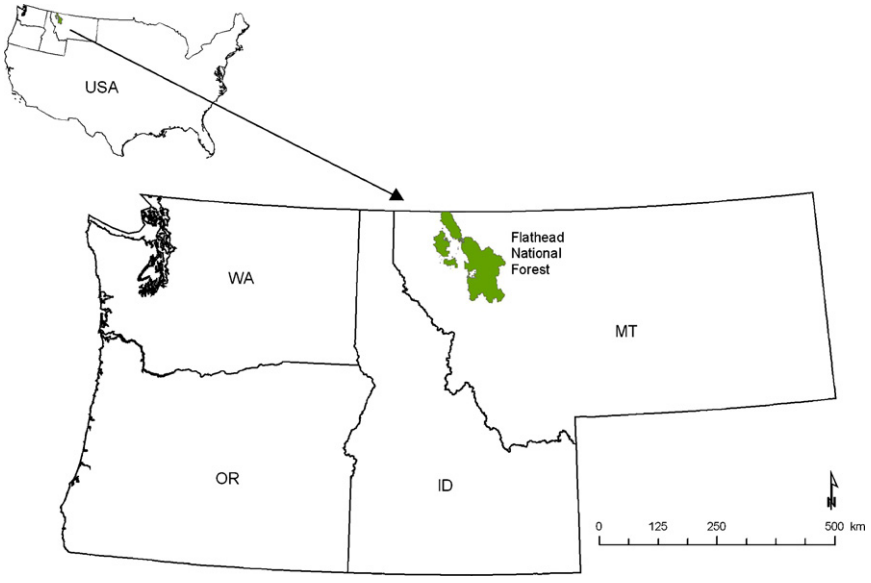

Fig. 1. Location of study area, Flathead National Forest, northwestern Montana, USA.