Title: Revisiting the CFIRP - Assessing long-term ecological value and characteristics of snags created for wildlife

Investigators:
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Project duration:
Our group initiated a two-year (2015-2016) study to assess snag characteristics, as well as foraging and breeding use of snags that were created as part of the College of Forestry Integrated Research Project (CFIRP).

Objectives:
1. Quantify contemporary foraging and nesting use of 25-year old snags by birds.
2. Assess whether silvicultural treatments undertaken at the time of snag creation have caused differences in contemporary snag persistence and characteristics.
3. Measure contemporary avian community response to created snags.

Summary of accomplishments over past year:
During the 2015 breeding season we surveyed a large sample of created snags (n=136) to quantify nesting and foraging use by birds. In 2016, we resurveyed the snags that were monitored in 2015 and increased our sample by 50% for a total of 204 created snags. In both years, we found 36 active bird nests belonging to 4 forest species in our focal snags (Table 1), with the majority of nests belonging to the Chestnut-backed Chickadee (see Tables 1 and 2 for scientific names), an obligate cavity-nesting species. Other species included the Red-breasted Nuthatch, Red-breasted Sapsucker, and Northern Flicker. Through the course of regular field work we also located an additional 17 nests in non-focal created snags of the Chestnut-backed Chickadee (n=12 nests), Northern Flicker (n=2 nest), Red-breasted Sapsucker (n=1 nest), Red-breasted Nuthatch (n=1 nest) and Northern Pygmy Owl (*Glaucidium gnoma*, n=1 nest); we note these additional nest data were not included in summary estimates because non-focal snags were not included within our original sampling frame. The great majority of nests we monitored (97.2%) appeared successful and produced offspring based on behavioral observations made in the vicinity of nest sites, with the exception of a single Chestnut-backed chickadee nest in 2016.

We found that approximately 10% of focal snags harbored active nests during the 2015 and 2016 breeding seasons (Table 1). Nests we located were found in all three silvicultural treatments, with more nests in the group selection (n=15) than either the clearcut (n=13) or the two-story treatments (n=8). Chickadee nests were found in all three treatments whereas the flicker and nuthatch nest were both in group selection stands; the single sapsucker nest was found in a clearcut treatment stand. Relative to our current-day data, nest searching efforts conducted on created snags during the 2001 breeding season located active nests in 20.2% of the created snags monitored by Walter and Maguire (2005, Journal of Wildlife Management 69:1578-1591). The relative composition of active nests used by Chestnut-backed Chickadee, a species classified as a weak cavity excavator, shifted from 33% in 2001 to 89% in 2015-2016. Moreover, we detected a notable decline in strong excavators that nested in created snags during 2001 (i.e., Red-breasted Sapsucker, Northern Flicker, and Hairy Woodpecker), yet these species were detected regularly within the vicinity of created snags during the course of our field work. Taken together, this suggests that the suitability of created snags as a nesting resource at the current time has decreased markedly over the last 15 years.

Table 1. Number of active nests located in 836 created snags surveyed during the 2001 breeding season (Walter and Maguire, 2005) contrasted with those located during the 2015-2016 breeding season.

	2001		2015-2016	
Species	**# nests**	**% total nests***	**# nests**	**% total nests***
Chestnut-backed Chickadee (*Poecile rufescens*)	56	33%	32	89%
House Wren (*Troglodytes aedon*)	31	18%	0	0%
European Starling (*Sturnus vulgaris*)	28	16%	0	0%
Red-breasted Sapsucker (*Sphyrapicus ruber*)	21	12%	1	3%
Red-breasted Nuthatch (*Sitta canadensis*)	15	9%	2	6%
Violet-green Swallow (*Tachycineta thalassina*)	10	6%	0	0%
Northern Flicker (*Colaptes auratus*)	7	4%	1	3%
Hairy Woodpecker (*Leuconotopicus villosus*)	1	1%	0	0%
All species combined	**169**	---	**36**	---

* Total does not sum to 100% because of rounding error.

In addition to nesting activity, we also quantified use of created snags by birds within the context of foraging activities during the breeding season. We amassed >750 hours of observations on focal snags over both seasons, documenting foraging events by 13 bird species on 61 separate occasions (Table 2). The greatest number of foraging observations was made in the group selection treatment, followed by the clearcut, and the two-story treatments (Table 2). The Pileated Woodpecker was the most commonly observed species foraging on created snags (n=21 observations), followed by the Chestnut-backed Chickadee (n=15 observations) and the Brown Creeper (n=8 observations); 10 additional species were observed foraging on created snags 3 times or less.

Table 2. Distribution of bird foraging observations collected during focal watches on created snags from May-July 2015-2016 relative to initial silvicultural treatment.

	# of foraging observations		
Species	**Clearcut**	**Group selection**	**Two-story**
Pileated Woodpecker (*Hylatomus pileatus*)	12	6	3
Brown Creeper (*Certhia americana*)	0	7	1
Chestnut-backed Chickadee	7	6	2
Red-breasted Nuthatch	0	2	0
Pacific Wren (*Troglodytes pacificus*)	0	2	0
Northern Flicker	0	1	0
Red-breasted Sapsucker	0	1	1
Gray Jay (*Perisoreus canadensis*)	0	1	2
Barred Owl (*Strix varia*)	0	0	1
Swainson's Thrush (*Catharus ustulatus*)	1	0	0
Black-throated Gray Warbler (*Setophaga nigrescens*)	1	0	0
Dark-eyed Junco (*Junco hyemalis)*	0	1	0
Hairy woodpecker (*Leuconotopicus villosus)*	0	3	0
All species combined	**21**	**30**	**10**

From mid-January to mid-April 2016, we collected data on persistence (i.e., proportion of snags standing) for all snags created as part of the CFIRP program (n=731 snags). On a random subset of created snags that were still

standing (n= 238), we also collected data on cavity cover, bark cover, and bark integrity; these measures provide information about historic use of snags, habitat components of snags that are available for birds, and level of snag decomposition. We found that 91% of all created snags were still standing after 25 years. Additionally, we found that 35% of all created snags had broken somewhere along the bole. Snag persistence did differ among at least one of the silvicultural treatments (X^2 = 7.12, P = 0.03) and the odds of a created snag being broken also differed among at least one of the silvicultural treatments (X^2 = 6.46, P = 0.04). Group selection stands had that highest proportion of snags still standing and also the lowest proportion of snags broken 25 years after creation (Table 3).

Table 3. Persistence and proportion of snags broken among treatments in CFIRP stands in 2016.

Silvicultural Treatment	# snags	Proportion standing	Proportion broken
Clearcut	171	87%	46%
Group Selection	386	93%	33%
Two-story	174	89%	49%

Cavity cover across all treatments averaged 11%, with bark cover averaging 82%; both measures differed by treatment (both P < 0.01). Slightly over half of created snags (54%) had bark that was loosely attached or peeling away from the bole of the snag. The proportion of snags that had bark loosely attached also differed by treatment (X^2 = 38.3, P < 0.01). Group proportions for snag characteristics are displayed in Table 4.

Table 4. Snag characteristic measurements for focal snags (n = 238) among treatments in CFIRP stands in 2016.

Silvicultural Treatment	# snags	Mean % cavity cover	Mean % bark cover	Proportion of snags with bark loosely attached
Clearcut	96	12%	75%	71%
Group Selection	73	9%	94%	22%
Two-story	69	13%	80%	66%

Avian point count and call-playback surveys were conducted from May-June in 2016 only (2016) to increase detection rates and to estimate occupancy for 4 woodpecker species present on our study sites: Red-breasted Sapsucker, Northern Flicker, Hairy Woodpecker, and Pileated Woodpecker). Each point was visited 4-5× over the survey season. During call-playback surveys, we detected woodpecker species using all three treatment types, and naïve occupancy varied among focal woodpecker species from 27-58%. That these primary cavity-nesting species were detected on stands with created snags but where not observed using them (with the Pileated Woodpecker being the lone exception for its foraging use of created snags) suggests created snags are not suitable habitat features for woodpeckers 25 y after creation.

Problems, barriers, proposed changes to objectives:

We did not experience any significant problems or barriers to field work during 2015 or 2016. One minor issue that did arise is that the video cameras that were used to peer into nest cavities to quantify nest survival and record nesting data (e.g., clutch size) were too large and could not be used as planned. However, we were still able to quantify nest success using a more traditional manner by recording behaviors around the nest site that are indicative of successful nests (e.g., parents entering the cavity with food, begging calls of fledglings near the nest).

Planned work:

Our planned work remains as outlined in the initial project proposal. At the current time, graduate student Amy Barry is collating historical data from multiple sources, undertaking statistical analysis, and writing up results. We anticipate analysis and write-up will continue through spring 2017, at which time manuscripts should be finalized for submission to peer-review journals.

List of names and brief overview of graduate and/or undergraduate engagement in project:
Amy Barry in the Department Forest Ecosystems and Society, Oregon State University is involved with the project as a graduate student and is collecting data toward her M.S. thesis by investigating use of created snags by wildlife, with a focus on understanding contemporary use of snags as foraging and nesting substrates by birds. During 20152-2016 she hired and worked closely with four young professionals to collect data on the project, three of which were recent graduates of Oregon State University.

In addition, our group has provided outreach activities to high school students as part of the College of Forestry STEM Academy program during 2015-2016, as well as the 2016 "Explore Your Forests" program. In all programs, students were taught about the importance of snags and cavity-nesting species in forested ecosystems and were introduced to research methodologies used to study forest birds. We also worked with videographers creating an outreach video for the College Forests and the College of Forestry, and informally presented research to Sarah Beldin with USGS (FRESC) for general use at USGS. Finally, we have also provided an interview to Hannah O'Leary for an article for the Oregon Stater magazine focused on the history of the College Forest.

Finally, we are organizing a symposium on cavity-nesting bird ecology at the joint 2017 meeting of the American Ornithological Society and Canadian Society of Ornithologists. This symposium will bring together researchers from across North America to share results from studies focused on cavity-nesting bird species, and we are targeting students and other young professionals (e.g., postdoctoral researchers) for inclusion in the symposium.

List of presentations, posters:

Barry, A. M., J. C. Hagar, and J. W. Rivers. 2016. Created snag dynamics and impacts on cavity-nesting bird communities over 25 years in western Oregon. Invited oral presentation at the West Coast Regional Meeting of The National Council for Air and Stream Improvement, Inc., Vancouver, WA.

Comstock. A. M. 2015. An investigation of long-term use of created snag by cavity-nesting birds in timber stands in the Pacific Northwest. Poster presentation at the annual Western Forestry Graduate Research Symposium (WFGRS), Oregon State University, Corvallis, Oregon. ***Won award for best overall poster.***

Comstock, A. M., J. C. Hagar, and J. W. Rivers. 2015. Re-evaluation of the effectiveness of created snags as bird habitat after 25 years. Oral presentation at the Willamette Valley Bird Symposium, Oregon State University, Corvallis, Oregon.

Comstock, A. M. 2014. An investigation of long-term avian use of created snags in managed forests. Oral presentation to the AVES seminar group, Oregon State University, Corvallis, Oregon.

List of publications, thesis citations:

Barry, A. M. An assessment of the long-term ecological value and characteristics of snags intentionally created to provide habitat for wildlife. M.S. thesis, Department of Forest Ecosystems and Society, Oregon State University. Anticipated March 2017.

Barry, A. M., J. C. Hagar, and J. W. Rivers. Created snags provide long-term ecological value for birds breeding in managed Douglas-fir forests. For *Ecological Applications*. Anticipated May 2017.

Barry, A. M., J. C. Hagar, and J. W. Rivers. Long-term changes in physical characteristics of Douglas-fir snags intentionally created as wildlife habitat. For *Forest Ecology and Management*. Anticipated May 2017.