Management Indicator Species Surveys on the Payette National Forest 2008: Field testing of methods

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Executive Summary

National Forests select Management Indicator Species (MIS) based on species habitat associations; species selected as MIS typically are representative of a particular forest type. Monitoring of MIS is used as an index to the extent, structure, and composition of associated forest types and thus, is a high management priority. In 2008, we tested field methods for monitoring the presence and absence of white-headed (*Picoides albolarvatus*) and pileated (*Dryocopus pileatus*) woodpeckers, MIS on the Payette National Forest. Our objectives were to compare point count and playback call methods, to estimate the proportion of forest stands occupied by MIS, and evaluate sources of heterogeneity, such as differences in detection rates among habitats or observers, in field sampling methods. We used established methods for estimating occupancy rates that consider the proportion of individuals present but undetected on a given survey (detection probability; MacKenzie et al. 2002, MacKenzie et al. 2003). Ultimately, our goal is to collect information that will allow us to recommend a long-term monitoring program for MIS on the Payette National Forest.

Our methods using point count and playback calls worked well for detecting pileated woodpeckers. Using data from both methods, naïve occupancy rates (unadjusted for detection probabilities) were 0.66% in 2008, compared with 18% and 17% from point count only surveys in 2004 and 2005, respectively. The number of detections by playback (44%) was greater than the number of detections by point count (37%), and we believe the use of playbacks improved our detections during the point count period. Therefore, we recommend the use of playback calls when surveying for this species.

We estimated the proportion of area occupied for pileated woodpeckers using unlimited distance counts as 1 and using 50-m fixed-radius counts as 0.67. This means pileated woodpeckers were expected to be within auditory range of all transects conducted, but were expected to be within 50-m of a point at 67% of the areas surveyed. The latter estimate is a better reflection of within-stand occupancy and is more meaningful for extracting occupancy estimates to other stands in the forest using GIS-based mapping. The forest type, as described by GIS classifications, influenced observers' ability to detect pileated woodpeckers. Therefore, we provided recommendations for future surveys that are stratified by habitat classification.

Unfortunately, we failed to detect white-headed woodpeckers on any transects in 2008, which was likely influenced by the delayed start of our surveys due to inclement weather. Field observations indicate white-headed woodpeckers are relatively rare on the Payette National Forest and thusly, require refined sampling methods for detection. Our recommendations for future surveys include sampling during the courtship period (March – mid-May), changing the broadcast calls to more closely replicate regional dialects, and refining the classification of potential white-headed woodpecker habitat.

Sampling of stand characteristics at each sampling point is ongoing. These data, when collected, will be used to refine estimates of occupancy associated with different forest types and to assess the accuracy of GIS-based stand maps.

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Introduction

Monitoring programs are becoming increasingly popular as a mechanism for assessing wildlife populations and the effects of management practices on those populations (e.g., Manley et al. 2005). On the Payette National Forest pileated (*Dryocopus pileatus*) and white-headed woodpeckers (*Picoides albolarvatus*) are classified as Management Indicator Species (MIS) because they are seemingly responsive to forest management practices; thus, monitoring MIS is a forest priority. In addition, public scrutiny and lawsuits on forest management has lead to a court order (Idaho Sporting Congress v. Madrid CV-99-217-S-BLW) to monitor pileated woodpeckers "to improve knowledge of species distribution, relative abundance, and trends across the Payette National Forest" and render an opinion on the viability of the species. Therefore, the PNF has contracted with researchers at the Rocky Mountain Research Station to field test methods for monitoring the presence/absence of these woodpecker species in forest types used for nesting habitat. Ultimately, these methods will be used to develop a long-term monitoring program for pileated and white-headed woodpeckers.

Point counts are a common method for detecting songbirds during the breeding season, as many individuals are singing to define their territories and attract mates during this time. Point counts involve recording all birds seen or heard within a given time frame at a given location (Ralph et al. 1993). Woodpeckers, however, do not sing but vocalize infrequently, defining territories with drumming and other cues. Thus, detection by point count can be difficult at times. Woodpeckers tend to be responsive to calling and drumming from conspecifics and playback calls are often used for standardized surveys of woodpecker species (e.g., British Columbia Resources Inventory Committee 1999). Response rate of woodpeckers to playbacks varies by species. For example, Nielson-Pincus (2005) found playback calls improved detection of black-backed woodpeckers (*Picoides arcticus*) by 61%, pileated woodpeckers by 48% and Williamson's sapsucker (*Sphyrapicus thyroideus*) by 33% in eastern Oregon. Responses to playbacks can also change over the breeding season, with individuals typically being more responsive during the courtship and early breeding stages (e.g., Barnes 2007).

Although playback calls may improve detection rates, using raw data from playback or point counts surveys to estimate occupancy rates assumes that all individuals of a given species that are present are detected. However, especially for rare or cryptic species, this is infrequently the case and failure to account for those individuals that are present but undetected can result in biased estimates of site occupancy or population status (Rosenstock et al. 2002). Both white-headed and pileated woodpeckers are relatively rare or widely dispersed (3-9% occupancy rates in eastern Cascades, and 12% occupancy rates in western Montana and Wyoming; Gaines et al. 2007 and Hutto 1995, respectively). Consequently, estimation of detection probabilities is especially important for these species. Detection probabilities can be influenced by several factors, including differences in observer ability and forest structure. For example, detection of a nonvocalizing individual may be more difficult in dense than more open forests. Models that account for these sources of variability are more likely to provide unbiased estimates of population status and change (Yoccoz et al. 2001, Thompson 2002).

Our objectives were to 1) evaluate the effectiveness of playback calls versus point counts for detecting woodpecker MIS species, 2) estimate the proportion of area occupied by each species in areas classified as potential white-headed or pileated woodpecker habitat from presence/absence data, and 3) assess the effect of covariates on occupancy or detection rates.

Methods

Sampling methods

The PNF previously used a stratified approach to identify potential nesting habitat for pileated and white-headed woodpeckers and to place transects across the forest (USDA Forest Service 2006). In general, pileated woodpeckers are found in mid-elevation, dense-canopied, mixed conifer forests (Bull and Jackson 1995), while white-headed woodpeckers nest in lower elevation, open-canopied forests dominated by ponderosa pine (Garrett et al. 1996). Twenty-five transects each with 10 point surveys located 300-m apart were selected in potential pileated and white-headed woodpecker habitat. For convenience, most of these transects were placed along roads or trails.

To increase our sample size and evaluate whether there is a bias associated with road surveys, we selected an additional 25 transects in each forest type using a stratified, random sampling procedure (Table 1). In a GIS, we used vegetation layers and species habitat models provided by the PNF to identify areas of potential nesting habitat for each species across the forest (Appendix 1). We eliminated from consideration areas that had moderate to high severity wildfire within the past 5-6 years because these two species are generally not associated with recently burned forests. Then, from among the potential habitat, we generated random points for survey locations. We used the random point as the starting point for each transect. When the random point was located such that a transect could not be completed within the forest type available, the starting point was adjusted to allow better coverage of the forest patch. Transects were separated by >1-km.

The Idaho Fish and Game Department (IFGD) conducted playback surveys for white-headed woodpeckers in 1991 on 25 transects in potential nesting habitat on the forest. We made an exception to our random approach described above to include some of these transects in our sample, because of the benefits of repeating these surveys. IFGD transects that were closer than 1-km spacing or were not in the correct forest type as defined above were excluded from consideration. Thus, 12 IFGD transects were included and an additional 13 transects were randomly selected to survey for white-headed woodpeckers. Transects were reviewed by PNF staff for accessibility. An observer marked newly identified transects prior to surveys and recorded precise GPS locations for each survey point (see Appendix 2 for protocol description).

Table 1. Survey transects for pileated and white-headed woodpecker by district on the Payette National Forest. See Appendix 1 for description of potential nesting habitat.

Year established	District	Potential nesting habitat	IDFG repeat surveys	Number of survey routes
2005	Krassel	Pileated	0	3
	McCall	Pileated	0	5
	New Meadows	Pileated	0	7
		White-headed	0	6
	Council\Weiser	Pileated	0	9
		White-headed	0	19
2008	Krassel	Pileated	0	10
	McCall	Pileated	0	3
	New Meadows	White-headed	0	2
	Council\Weiser	Pileated	0	12
		White-headed	12	23

Comparison of methods

To identify the best methods for detecting pileated and white-headed woodpeckers, we conducted point counts and playback calls on each transect. We conducted 10-minute point counts as done previously on the PNF following techniques described in Ralph et al. (1993). We recorded the distance of an individual from the point as 0-50 and >50-m. Immediately after completing a point count and before leaving a survey point, we conducted playback surveys modified from the British Columbia Resources Inventory Committee (1999) protocol (see Appendix 3 for protocol description). We broadcast calls for 20 seconds then listened for 30 seconds in 3 directions; we followed the complete set of calls by an additional 2 minutes of observation. We played broadcast calls for both species at all points regardless of potential habitat designation. This approach allowed us to compare methods directly. We summarized the number of woodpeckers detected by species using both methods, playbacks only, and point counts only to calculate naïve occupancy rates (unadjusted for detection probability) and compared these with point count only naïve occupancy rates provided by the PNF.

Estimating the proportion of area occupied and detection probabilities

The proportion of area occupied is an adjusted estimate of occupancy rates that incorporates the number of individuals estimated to be present but undetected (MacKenzie et al. 2002). To estimate the number of woodpeckers present on transects but undetected, we conducted repeat sampling on a subset of transects (Royle and Nichols 2003). This allowed us to estimate the probability of detecting an individual without marking individual birds. This method also allowed us to include covariates, such as habitat or observers, into the modeling framework (MacKenzie et al. 2002). In general, ≥ 5 repeat visits are needed for relatively unbiased estimates when detection rates are low (MacKenzie et al. 2002). If detection rates are higher (>0.50), two repeat visits are usually adequate to provide reasonable results. Because our objective for this field season was to evaluate methods and we did not know the detection probabilities for either species, we conducted 5 repeat visits at 10 transects (5 per habitat type). Transects for repeat sampling were randomly selected from the subset of transects that tend to be accessible throughout the survey period (Fig. 1 and Table 2). Transects excluded from consideration were those typically inaccessible until later in the season because of snow or road maintenance.

We used program PRESENCE to estimate the proportion of area occupied (Ψ) and detection probabilities (P; Hines 2006). We generated a set of models that evaluated undefined variation in occupancy (Ψ group membership), survey-specific P, and defined site (habitat) and survey (date, observer) specific covariates that may influence occupancy (Ψ) or detection rates (P). Group membership evaluates whether there are two or more groups in the data not identified by covariates that have different occupancy rates. For example, if occupancy rates of pileated woodpeckers were significantly different on the east versus the west side of the forest, but we did not control for that with a covariate for survey location, the best model for the data would identify two groups for estimating Ψ. Survey-specific P evaluate if detection varies among individual surveys. For example, weather conditions might affect detection on individual surveys. We assessed whether occupancy and detection rates varied by habitat type (site-specific covariate). We assessed the influence of survey-specific covariates (date, observer) on detection rates only. From our set of candidate models for predicting proportion of area occupied, we used AIC to identify the best model(s). We considered those models with ΔAIC of <2.0 as the most parsimonious (Burnham and Anderson 2002). We also calculated AIC weights (w_i), which indicate the amount of support for the model relative to the other models in the set.

We estimated the proportion of area occupied using the best supported model for all pileated woodpecker detections regardless of distance from point. However, field observations suggested pileated woodpeckers were sometimes responding to broadcast calls from considerable distances and were not always in the same habitat type as the survey transect. To refine our estimates of area occupied and provide information for extracting occupancy estimates to GIS mapped stands, we also estimated pileated woodpecker occupancy using only those individuals detected within 50-m of the point (Nichols et al. 2000) using program PRESENCE as described above. We used these results to simulate the effect of changing the number of repeat visits on occupancy estimates in program PRESENCE for future recommendations.

Table 2. Selected transects for repeat sampling on the Payette National Forest.

District	**Potential nesting habitat**	**Transect name**	**# of Visits in 2008**	**# of PIWO detections**	**# of WHWO detections**
Krassel	Pileated	Teapot	5	2	0
	woodpecker	Warren	5	1	0
New Meadows	Pileated woodpecker	Hazard teepee	5	5	0
Council/Weiser	Pileated	Cow creek	5	3	0
	woodpecker	Jungle creek	3	2	0
	White-headed	Mill creek	4	3	0
	woodpecker	Crooked river	6	2	0
		Shingle flat	6	1	0
		Cuprum (IDFG)	6	4	0
		Hitt creek (IDFG)	4	0	

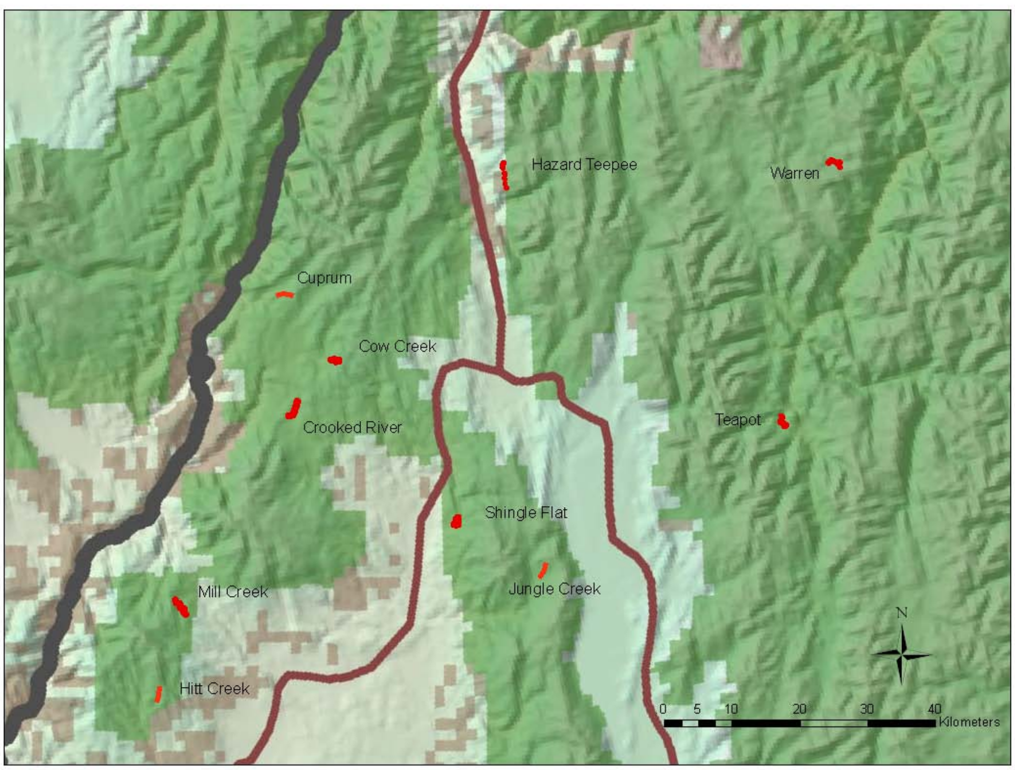


Figure 1. Transects for repeat sampling in 2008 on the Payette National Forest.

Stand characteristics sampling

To assess stand characteristics associated with woodpecker presence and to evaluate the accuracy of the GIS layers for identifying potential woodpecker habitat, we collected data on stand characteristics at each of the 10 sampling points on transects. We established a 100-m sampling transect beginning on the point and directed toward the following point; therefore for each survey transect, we measured 1000-m. We collected data on dbh and height by species for live trees and snags, logs, and stumps (Appendix 4).

Preliminary Results

We surveyed for pileated and white-headed woodpeckers on 71 transects across the forest from May 8 – July 11, 2008 (Table 3). We were unable to complete the full set of 100 transects because of late-season snow, poor access, and changes in prioritization of personnel time. Of transects surveyed, 32 were in potential pileated woodpecker habitat and 39 were in potential white-headed woodpecker habitat, although observers broadcast and recorded observations of both species on all transects. Five in each potential habitat type were sampled 3 – 6 times (Table 2), the remainders were sampled once. We detected pileated woodpeckers at least once using either method on 47 of 71 transects. Unfortunately, no white-headed woodpeckers were detected on any transect.

Comparison of Methods

We used data from all surveys regardless of whether or not transects were repeated to compare point count and playback methods for pileated woodpeckers. Of detections, 46% were by both methods, 21% were by point count only, and 33% were by playback only. Using only transects where pileated woodpeckers were detected using playbacks, our naïve occupancy rate was 44%. If we used only those transects where woodpeckers were detected using point counts, our naïve occupancy rate was 37%. In 2004 and 2005, without the use of playbacks naïve occupancy rates for pileated woodpeckers on the Payette National Forest were 18% and 17%, respectively.

Proportion of Area Occupied – Unlimited distance counts

We calculated a naïve occupancy rate forest wide of 0.66 for pileated woodpeckers across forest types using all detections regardless of distance from point and method (Table 3). The best models for estimating pileated woodpecker occupancy included the one group Ψ, constant P and one group Ψ, covariate-specific P (date, habitat; Table 4). This means there was no unknown grouping that partitioned the estimate of occupancy, the detection probability was considered consistent, and the addition of covariates explained some of the variation in detection probabilities but did not change the fit of the model. The covariate coefficients indicated that detection probability was higher in areas designated as potential pileated woodpecker habitat and higher as the season progressed.

Using the simplest model (one group Ψ, constant P), we calculated a probability of detection of 0.55 ± 0.04 (SE), which means we detected only 55% of pileated woodpeckers present. Overall, when adjusted for the proportion of woodpeckers present but undetected, the probability of site occupancy in either potential habitat type was 1.

This means pileated woodpeckers were expected to be within auditory range of all transects sampled.

Proportion of Area Occupied – Fixed-radius Counts

Naïve occupancy rates across forest types and methods within 50-m of the transect point were 0.32. The best model for estimating occupancy rates was the one group Ψ, covariate-specific P (habitat), indicating that occupancy rates were consistent across the study area, but detection probabilities varied among habitat types. Using this model, the probability of detecting a pileated woodpecker varied from 0.21 ± 0.07 (SE) in habitat designated as white-headed woodpecker habitat to 0.68 ± 0.12 (SE) in habitat designated as pileated woodpecker habitat. Overall, the probability of site occupancy in either potential habitat type was 0.67 ± 0.13 (SE). This means we estimated that pileated woodpeckers were present within 50-m of a point at 67% of all transects surveyed but our ability to detect them was greater in potential pileated woodpecker habitat.

Simulations suggest that the number of repeat visits conducted in potential pileated woodpecker habitat could be reduced to 2 without unduly increasing the estimated variance. However, at least 5 repeat visits are needed in potential white-headed habitat to keep variance within acceptable levels.

Stand Characteristic Sampling

Data collection of stand characteristics is ongoing. As of September 30, 2008 we had sampled all 10 points on approximately 19 transects. Without these data, we were unable to undertake a more detailed analysis of the influence of habitat covariates on occupancy or detection probabilities.

Table 3. Summary of unlimited distance transects conducted and detections of pileated woodpeckers on the Payette National Forest in 2008.

Potential nesting habitat	Total transects surveyed	Single visit surveys	Transects with repeated surveys	PIWO detections	Naïve occupancy rates[a]
PIWO	32	27	5	26	0.81
WHWO	39	24	5	21	0.54
Total	71	51	10	47	0.66

[a]Estimates unadjusted for individuals present but not detected.

Table 4. Candidate models for estimating the probability of detecting an individual if present for pileated woodpecker surveys using unlimited distance counts on the Payette National Forest, ID in 2008. Models in bold are most supported by the data.

Model	*K*	-2*LogL	AIC	ΔAIC	w_i
1 group Ψ[a], Covariate-specific P[b] (habitat, date)	**4**	**146.83**	**154.83**	**0.00**	**0.37**
1 group Ψ, Constant P	**2**	**151.18**	**155.18**	**0.35**	**0.31**
1 group Ψ, Covariate-specific P (habitat, date, observer)	5	146.83	156.83	2.00	0.14
2 groups Ψ, (habitat), Constant P	3	151.12	157.12	2.29	0.12
2 groups Ψ, Constant P	4	151.72	159.72	4.89	0.03
2 groups Ψ (habitat), Covariate-specific P (date, observer)	4	151.72	160.56	5.73	0.02
1 group Ψ, Survey-specific P	7	147.16	161.16	6.33	0.02
2 groups Ψ, Survey-specific P	14	138.80	166.80	11.97	0.00

[a]Group membership evaluates the number of undefined groups in the data with different occupancy probabilities (Ψ)
[b]P refers to detection probability which can be constant among surveys, vary among surveys, or vary by defined covariates.

Table 5. Summary of 50-m fixed-radius counts conducted and detections of pileated woodpeckers on the Payette National Forest in 2008.

Potential nesting habitat	Total transects surveyed	Single visit surveys	Transects with repeated surveys	PIWO detections	Naïve occupancy rates[a]
PIWO	32	27	5	16	0.50
WHWO	39	24	5	8	0.21
Total	71	51	10	24	0.32

[a]Estimates unadjusted for individuals present but not detected.

Table 6. Candidate models for estimating the probability of detecting an individual if present for pileated woodpecker surveys using 50-m fixed-radius counts on the Payette National Forest, ID in 2008. Models in bold are most supported by the data.

Model	*K*	-2*LogL	AIC	ΔAIC	w_i
1 group Ψ[a], Covariate-specific P[b] (habitat)	**3**	**111.39**	**117.39**	**0.00**	**0.86**
1 group Ψ, Covariate-specific P (habitat, date, observer)	5	111.32	121.32	3.93	0.12
2 groups Ψ (habitat), Constant P	3	120.87	126.87	9.48	0.01
2 groups Ψ, Constant P	4	119.69	127.69	10.30	0.01
1 group Ψ, Constant P	2	124.77	128.77	11.38	0.00
2 groups Ψ (habitat), Covariate-specific P (date, observer)	5	120.86	130.86	13.47	0.00
1 group Ψ, Covariate-specific P (date, observer)	4	124.58	132.58	15.19	0.00
1 group Ψ, Survey-specific P	7	124.21	138.21	20.82	0.00
2 groups Ψ, Survey-specific P	14	115.08	143.08	25.69	0.00

[a]Group membership evaluates the number of undefined groups in the data with different occupancy probabilities (Ψ)
[b]P refers to detection probability which can be constant among surveys, vary among surveys, or vary by defined covariates.

Implications and Future Directions

Our results indicate the methods used in 2008 worked well for assessing the presence of pileated but not white-headed woodpeckers. Playback calls increased the number of pileated woodpeckers detected within the 2008 season compared with point counts, and the combination of point count and playback calls yielded considerably higher detections than in previous, point count only surveys. It is important to consider that we did not conduct any point count surveys in 2008 that were not followed by playback calls. It is likely that the use of playbacks increased detections during the point count period as well as the playback period because pileated woodpeckers may move closer to a vocalization to investigate before vocalizing themselves; thus, there may be a delayed response to playback calls. Our results indicate that the use of playback calls can improve surveyors' ability to detect pileated woodpeckers on the Payette National Forest.

Our estimates of occupancy at the 50-m scale are probably more appropriate for extrapolating pileated woodpecker occupancy estimates forest-wide using GIS-based stand data. Using GIS, forest managers can map potential pileated and white-headed woodpecker (but see below) habitat, as defined in Appendix 1, and estimate that at least one pileated woodpecker is present in approximately 67% of those forest stands. Clearly some habitat will be more suitable than others and density may be higher in some forests. However, identifying areas with higher densities of woodpeckers or higher quality woodpecker habitat is outside the scope of this monitoring program. Because pileated woodpeckers occupy large home ranges and can be heard vocalizing at great distances (Bull and Jackson 1995; authors' observations), our unlimited distance counts likely overestimate site occupancy.

The covariate coefficients in our models indicated that detection probability of pileated woodpeckers was higher in areas designated as potential pileated than white-headed woodpecker habitat, but occupancy rates were consistent. This is contrary to our hypothesis that occupancy rates of pileated woodpeckers would be higher in potential pileated habitat. One of the assumptions of the models we used is that occupancy rates remain constant over the survey period (MacKenzie et al. 2002). However, species with large home ranges, like pileated woodpeckers, may have core-use areas (mixed-conifer) and more ancillary (ponderosa pine) areas within their home ranges. They occupy all habitats, but occupy core-use areas more frequently. Therefore, we suspect differences in detection rates among habitat types are actually representative of pileated woodpeckers occupying potential white-headed habitat less frequently. This is an important point because it suggests that applying our proportion of area occupied estimate of 0.67 to potential white-headed woodpecker habitat may over-estimate pileated woodpecker presence. Because our estimates are driven, in part, by the number of repeat samples, one solution might be to increase the number of surveys that receive repeat visits.

The effect of date on detection probabilities may be a result of survey effort or breeding season behavior. More surveys were conducted later in the season and thus, the increased effort may have resulted in more detections. It is also possible that pileated woodpeckers were less likely to respond during the incubation period (mid-May to early June) and increased their vocalizations during the nestling or post-fledging period (mid-June to mid-July; Bull and Jackson 1995). In addition, we sampled more of the potential pileated woodpecker areas later in the season because these areas typically were snow-free later than the white-headed habitat. Thus, the effect of habitat on detection probabilities may be correlated with the effect of date. Although we found no effect of observer bias in our data set, the benefits of multiple observers have been well documented in other research (Sauer et al. 1994, Rosenstock et al. 2002) and we continue to recommend rotation of survey effort among multiple observers.

Our failure to detect white-headed woodpeckers in 2008 may be related to a late-season start because of high-snow pack and limited access. White-headed woodpeckers may be less likely to respond to playback calls than pileated woodpeckers and the best time to detect them may be by point count during the courtship period (March – early May; Garrett et al. 1996) when they are actively vocalizing (R. Dixon, pers. comm.). Counts from previous survey years and field observations suggest white-headed woodpeckers are relatively rare on the Payette National Forest; thus, it is important to refine the areas searched to best target potential areas of white-headed woodpecker occupancy. The GIS categories used to classify potential white-headed habitat may have been too broad and we recommend refining this classification and resampling transects from within the refined areas for future surveys. In particular, the inclusion of forests with canopy closure of 40-70% is largely outside the range of characteristics important for white-headed nesting sites (Garrett et al. 1996, Wightman et al. *In Prep*.) and we recommend eliminating this category from consideration.

Data from stand characteristic sampling, when completed, will provide additional insight into covariates affecting occupancy and detection rates. It will also allow us to evaluate the accuracy of our GIS classifications of potential habitat. We plan to conduct this analysis when data are available. Until these data are analyzed, we cannot provide recommendations on the number of surveys required for a long-term monitoring program.

Recommendations for 2009

1. Use playback calls to survey for pileated woodpeckers during May and June.
2. Conduct 2 repeat visits on 7 transects in potential pileated woodpecker habitat and 5 repeat visits on 7 transects in potential white-headed woodpecker habitat.
3. Use counts from 50-m fixed radius surveys for estimating pileated woodpecker presence and extrapolating results to GIS-stand maps; however continue to collect data at both the 50-m and unlimited radius scales.
4. Use caution when applying our estimate of pileated woodpecker occupancy rates to potential white-headed woodpecker habitat across the forest, as we believe our calculated rates in this forest type may overestimate pileated woodpecker presence.
5. The distance between sampling points on each transect can be increased from 300m to 600m for pileated woodpeckers but not for white-headed woodpeckers.
6. Continue to include date and habitat type in estimates of proportion of area occupied.
7. Continue to rotate surveys among multiple observers within a season to reduce bias associated with few observers, especially if observers may change among years.
8. Refine the potential white-headed woodpecker habitat classification and resample transects from within this refined GIS layer for a total of 50 transects.
9. Conduct surveys for white-headed woodpeckers, using point counts and playback calls, in potential white-headed habitat from April 1 – May 15.
10. Update the white-headed woodpecker broadcast calls to a more similar regional dialect.

Literature Cited

Barnes, K.P. 2007. Ecology, habitat use, and probability of detection of flammulated owls in the Boise National Forest. M.S. Thesis. Boise State University, Boise, ID.

British Columbia Resources Inventory Committee. 1999. Inventory methods for woodpeckers: standards for components of British Columbia's biodiversity No. 19. Resources Inventory Committee, British Columbia, Canada. Available online at: http://www.for.gov.bc.ca/ric. Accessed 1/18/08.

Bull, E. L. and J. A. Jackson. 1995. Pileated Woodpecker (Dryocopus pileatus), The Birds of North America Online (A. Poole, Ed.), Cornell Lab of Ornithology, Ithica, NY. http://bna.birds.cornell.edu/bna/species/148. Accessed 4/14/08.

Burnham, K.P. and D.R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach, second edition, Springer-Verlag, New York, New York.

Gaines, W.L., M. Haggard, J.F. Lehmkuhl, A.L. Lyons, and R.J. Harrod. 2007. Short-term response of land birds to ponderosa pine restoration. Restoration Ecology 15:670-678.

Garrett, K.L., M.G. Raphael, and R.D. Dixon. 1996. White-headed woodpecker (Picoides albolarvatus), The Birds of North America Online (A. Poole, Ed.), Cornell Lab of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/bna/species/252. Accessed 01/24/08.

Hines, J.E. 2006. PRESENCE2 – Software to estimate patch occupancy and related parameters. USGS Patuxent Wildlife Research Center, Laurel, MD http://www.mbr-pwrc.usgs.gov/software/presence.html (Accessed February 2008)

Hutto, R.L. 1995. Composition of bird communities following stand-replacement fires in northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1040-1058.

MacKenzie, K.L., J.D. Nichols, G.B. Lachman, S. Droege, J.A. Royle, and C.A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83:2248-2255.

MacKenzie, D.I., J.D. Nichols, J.E. Hines, M.G. Knutson, and A.B. Franklin. 2003. Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology 84:2200-2207.

Manley, P.N., M.D. Schlesinger, J.K. Roth, and B. Van Horne. 2005. A field-based evaluation of a presence-absence protocol for monitoring ecoregional-scale biodiversity. Journal of Wildlife Management 69:950-966.

Nichols, J.D., J.E. Hines, J.R. Sauer, F.W. Fallon, J.E. Fallon, and P.J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from point counts. Auk 117:393-408.

Nielsen-Pincus, N. 2005. Nest site selection, nest success, and density of selected cavity-nesting birds in northeastern Oregon with a method for improving the accuracy of density estimates. M.S. Thesis. University of Idaho, Moscow.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. USDA Forest Service General Technical Report, PSW-GTR-144, Albany, CA.

Rosenstock, S.S., D.R. Anderson, K.M. Giesen, T. Leukering, and M.F. Carter. 2002. Landbird counting techniques: current practices and an alternative. Auk 119:46-53.

Royle, J.A. and J.D. Nichols. 2003. Estimating abundance from repeated presence-absence data or point counts. Ecology 84:777-790.

Sauer, J.R., B.G. Peterjohn, and W.A. Link. 1994. Observer differences in the North America breeding bird survey. Auk 111:50-62.

Thompson, W.L. 2002. Towards reliable bird surveys: accounting for individuals present but not detected. Auk 119:18-25.

USDA Forest Service. 2006. Payette National Forest MIS Monitoring Program. Internal document revised on 9/27/06.

Wightman, C.S., V.A. Saab, C. Forristal, K. Mellon-McLean, and A. Markus. *In Prep*. White-headed woodpecker nesting ecology after wildfire. For submission to Journal of Wildlife Management.

Yoccoz, N.G., J.D. Nichols, and T. Boulinier. 2001. Monitoring of biological diversity in space and time. Trends in Ecology and Evolution 16:446-453.

APPENDIX 1: Payette National Forest Wildlife Habitat Standardized GIS Queries

Common Name	Scientific Name	PVG	WG	Strata	Habitat Description	Comments
Management Indicator Species						
Pileated Woodpecker	*Dryocopus pileatus*	3-Cool, moist DF 6-Cool, moist GF 8-Warm, moist SAF 9-Hydric SAF moderate and high canopy closure 2 and 5 when outside their historic range of variability	1-MC high 2-MC mod 3-MC low 4-SAF/LPP 5-ES 6-LPP 7-PP high	23-Mature/overmature (>70% CC) 24-Mature/overmature (35-70% CC) 26-Partial cuts (like strata 22 age >100yr)	Late successional forests or younger forests with large dead trees (4 snags/acre with 400 lineal feet of ≥ 12" downed logs) Nest trees > 20" dbh. Nest stands 50-100 contiguous acres, generally <5000' elevation, w/ basal areas of 100-125 ft^2/acre and a relatively closed canopy.	Use: Mature and Old Growth Acres on the Payette National Forest March 17, 1999
White-Headed Woodpecker	*Picoides albolarvatus*	1-Dry PP xeric DF 2-Warm, dry DF moist PP 3-Cool, moist DF 5-Dry GF 6-Cool, moist GF low canopy closure	1-MC high 2-MC mod 3-MC low 7-PP high 8-PP mod 9-PP low	21-Partial cuts (10-15% CC, 80-120yr) 24-Mature/overmature (35-70% CC) 25-Mature/overmature (10-35% CC) 26-Partial cuts (like strata 22 age >100yr) 41-Unsuitable (10-35% CC) 42-Unsuitable (35-70% CC) Note; 24 & 42 may have too high CC	Mature and old growth PP (eats the seeds), especially in winter.	

PVG = Potential Vegetation Group, WG = Working Group

APPENDIX 2: Transect establishment protocol for MIS survey transects on the PNF

1. General transect locations were selected randomly from within specific strata and working group combinations identified by the Payette and Boise National Forests targeting white-headed and pileated woodpecker habitat.

Species	**Working group**	**Strata**
Pileated woodpecker	Mixed conifer (low to high productivity) Sub-alpine fir/lodgepole pine Engleman spruce Lodgepole pine Ponderosa pine (high productivity only)	Mature/overmature and partial cuts (>35% CC)
White-headed woodpecker	Mixed conifer (low to high productivity) Ponderosa pine (low to high productivity)	Mature/overmature and partial cuts (10-70% CC)

2. Use GPS coordinates and maps provided in the office to navigate to the first point. For white-headed woodpecker transects, establish the first point, as described below, if grand fir, Douglas fir, or ponderosa pine are present. If none of these species are present, do not establish the transect and report the misclassification immediately. Recognize that some areas might not seem like white-headed woodpecker habitat; however, you should establish the transect anyway if the correct conifer species are present.
3. For pileated woodpecker transects, establish the transect in forested patches as described below. Do not establish the transect only if the patch is >50% deciduous trees, shrublands, grasslands or agriculture.
4. If the first point is in a non-target forest type (e.g., a meadow), relocate the point to the closest stand of the target forest type. If there is no target forest type in the vicinity (~500m), do not establish the transect. Report this immediately to project coordinators so a substitute transect can be identified, if appropriate.
5. When establishing a point, select the largest tree within a 10m radius of the GPS coordinates as the point center. Mark the tree with pink flagging and record GPS coordinates at the base of the point center tree. Make sure the accuracy of the GPS coordinates is ±10 m or better before recording.
6. Following transect instructions, travel to next point. Record the bearing from point 1 to point 2. Repeat the steps above for locating the point center.
7. Except under unusual situations, points along a given transect should be linear. Occasional turns on a route are allowed; however, zig-zagging should be avoided.

APPENDIX 3: Pileated and White-headed Woodpecker Survey Protocol

Before conducting a survey:

1. Practice estimating distances and pacing using a rangefinder and measuring tapes.
2. Practice distinguishing between woodpecker species. Listen for calls or drumming, make your best educated guess, and then go find the bird to make a positive visual identification. Continue practicing until you repeatedly identify birds by sound correctly.
3. If possible, locate the starting point for an established transect the day before. Use provided GPS coordinates, topographic maps, and compass to navigate to the point and look for markers on all PNF survey routes (except those in the wilderness area which are not marked).
4. For new routes established in 2008, walk the survey route the day before and mark each survey point with flagging. Record GPS locations on the route description data sheets provided and mark in your GPS unit. Make sure your GPS is recording the location with relatively high accuracy (± 10m) before marking and recording the point.

To conduct a point count survey:

1. Note any woodpecker species observed when you approach a survey point. Record these birds on your point count data sheet as observed prior to the starting the survey.
2. Fill out the header information.
3. Start the point count survey. Be sure to record 1 under the Methods column to indicate a point count survey. Record weather, wind, and temperature using the categories listed on the data sheet.
4. Using a watch, break your observations in 2 time periods: 0:00-5:00 minutes (period 1) and 5:01-10:00 minutes (period 2).
5. Rotate your direction throughout the count to spend equal time observing in all directions for each time period.
6. If woodpeckers are detected, record each pileated or white-headed woodpecker seen or heard with the species code (e.g., PIWO or WHWO). If no woodpeckers are detected, write “none” under species code. Do NOT leave blank.
7. Record sex as M (male), F (female), or U (unknown). If a pair of woodpeckers is detected, record P for pair.
8. Record your detection method as A=auditor or V=visual. If you both hear and see a woodpecker, record the method that first allowed you to detect the bird.
9. Record bird behavior using categories provided on the data sheet. Record the dominant behavior, e.g., if a bird is foraging it might fly from tree to tree. You would record F for foraging, not FL for flying. Reserve flying and perched categories when none of the other behaviors are appropriate.
10. Place an X in the appropriate column to record the bird’s location from the point (0-50m or >50m).
11. Record flyovers as above but mark the Fly? category in the distance columns.
12. Record other woodpecker species as time permits.

13. **Be sure to fill in all columns for each row of data** (unless you have recorded "none" under species).
14. Record individuals once. This will require keeping track of recorded birds to make sure you do not record individuals twice.
15. Stop recording after 10 minutes.
16. Record notes, observations or birds detected outside the sampling period under "notes and incidentals" on page 2 of your data sheet.

To conduct a playback survey:

1. Remain at the point. Record 2 under Methods for playback calls.
2. Record weather, wind, temperature, and time period as above. Time period 1 will coincide with your first set of calls and waiting period for one species and time period 2 will be the second set of calls and waiting time.
3. Consider the playback surveys a new survey and record all woodpeckers seen or heard during the playback survey regardless of whether or not they were recorded on the point count survey.
4. Broadcast a call for one species at a time at 60° from the transect line, turning left or right and continuing in the same direction during subsequent turns. Listen and watch for 30 seconds. Turn 120° and repeat the procedure. Then turn another 120° and repeat the procedure.
5. Playbacks will consist of 20 seconds of calling/drumming for one species followed by a 30 second break. This is repeated 3 times in the 3 directions for a total of 2.5 minutes. Then pause and observe for 2 minutes.
6. Discontinue the playback series if a woodpecker responds to the calls (same species), but do continue with second species playback calls.
7. Record data on species, sex, detection method, behavior, and distance from point as described above for point count surveys.
8. Follow the same 20/30s, 20/30s, 20/30s procedure in 3 directions (60, +120, +120) for the second set of playback calls. Pause and observe for another 2 minutes.
9. Discontinue the series if a woodpecker responds to the calls (same species).
10. Again, **be sure to fill in all columns for each row of data** unless you have recorded "none" under the species code column.
11. End the survey, approximately 10 minutes after starting the broadcast surveys.
12. Move to the next point on the transect and start over (point counts followed by broadcast surveys).

Immediately after completing a transect:

1. Review data sheets and make sure that all data is recorded accurately and clearly. Fill in any blank columns.
2. File data sheets in travel storage folder (provided) or office at the end of the day.
3. Make copies of all data sheets as soon as possible. For remotely-stationed field crews, this may mean copying the week's worth of data sheets in the office on Friday afternoon before the weekend.

APPENDIX 4: Stand sampling protocol for MIS surveys

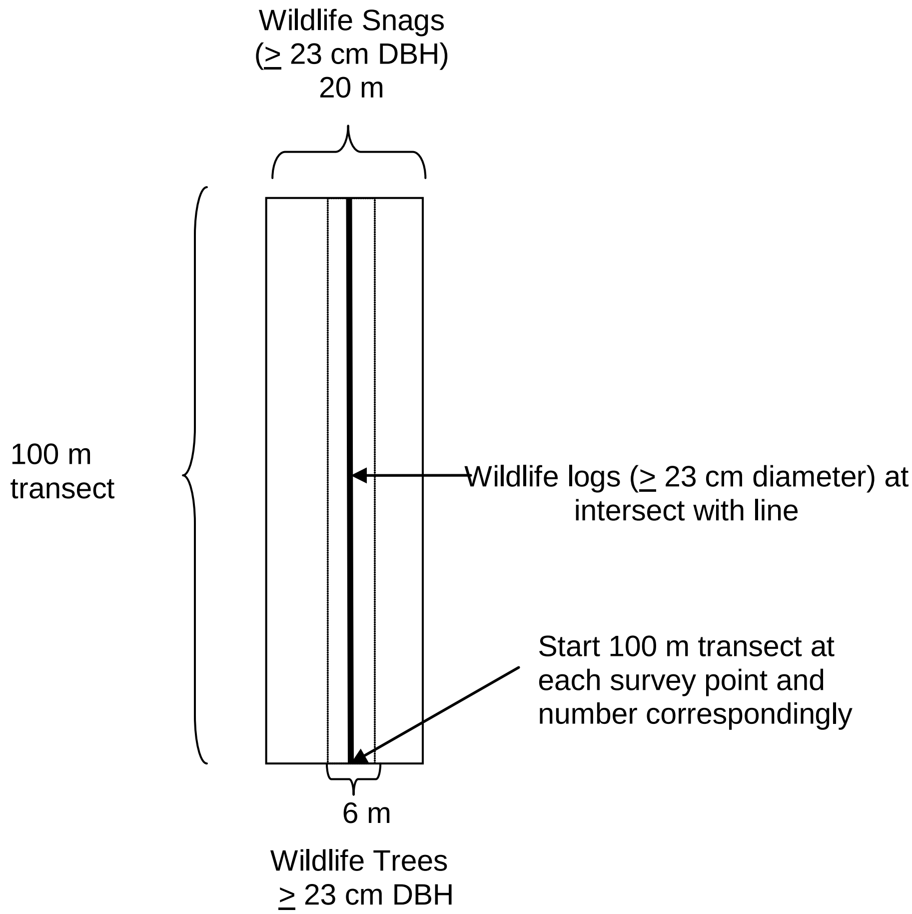


Figure 1. Sample layout for measurements

<u>HEADER INFORMATION</u>

Route name: Record the woodpecker survey route name

Forest type: Record the forest type assigned to this route: **1** = ponderosa pine, and **2** = mixed-conifer.

Transect #: Record the transect number (1-10) where the number corresponds with the survey point number for that route

Azimuth: Record the direction (°) of the sampling transect line

Date: Record the date stand data was collected

Recorder(s): Record the names of all recorders as first initial and last name (e.g., C. Wightman)

GPS start: Record the northing and easting GPS coordinates (UTM zone 11, NAD83) for the start of the transect

GPS start: Record the northing and easting GPS coordinates (UTM zone 11, NAD83) for the end of the transect

DATA FORM – LIVE TREES, SNAGS, LOGS/DOWN WOOD and STUMPS

SUBSEG (m): Assign a unique numeric identifier (1-8) to indicate which 12.5-m (or 50 ft) long subsegment is being surveyed. MOST IMPORTANTLY, the first subsegment of each transect should start with the "1". This will allow SnagPRO to join consecutive subsegments.

1. Live Wildlife Trees > 23 cm dbh: All live trees within 3m of transect line
For the purposes of this study a WILDLIFE TREE is defined as a standing live tree ≥ 23 cm DBH. If a tree has any green needles or leaves retained on it, regardless if it is upright or fallen over, treat it as a tree. If the central axis of a wildlife tree is < 3 m from the center transect line, it should be measured. Use the CENTRAL AXIS of each tree to determine whether a tree qualifies to be counted within the plot. For trees whose distances are marginal (can't visually tell how far away they are), use a tape to measure the PERPENDICULAR distance from the transect line to the side of the tree where the central axis is located.

SPECIES (Spp): Enter the corresponding four- or five-letter code of the tree species.

Grand fir (*Abies grandis*)	**ABGR**
Subalpine fir (*A. lasiocarpa*)	**ABLA**
Western larch (*Larix occidentalis*)	**LAOC**
Engelmann spruce (*Picea engelmannii*)	**PIEN**
Lodgepole pine (*Pinus contorta*)	**PICO**
Ponderosa pine (*P. ponderosa*)	**PIPO**
Douglas-fir (*Pseudotsuga menziesii)*	**PSME**
Western hemlock (*Tsuga heterophylla*)	**TSHE**
Quaking aspen (*Populus tremuloides*)	**POTR**
Black cottonwood (*P. trichocarpa*)	**POTRI**

CLASS (Cl): Enter the numeric value for the appropriate structural class of the tree.

1 = Sound
2 = Some decay evidence (broken top/branch, fungi, fire scars, insect evidence, woodpecker foraging)
3 = Broomed-trees

4 = Hollow

DBH: Enter the diameter at breast height (1.37 m) of the tree using calipers, a DBH stick, or diameter tape to the nearest cm.

HEIGHT (Ht): Enter the height of the tree using a clinometer, to the nearest m.

CAVITY (Cav): Enter the four letter code of the woodpecker species occupying the tree. If no woodpeckers are observed occupying a cavity, record "0".

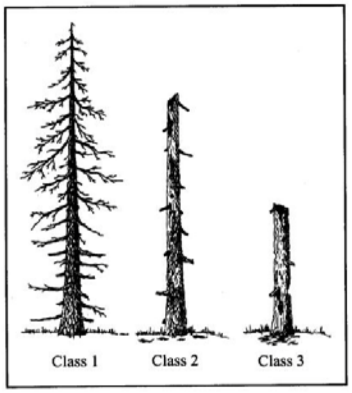
2. Snags > 23 cm dbh: All snags within 10 m of transect line

SNAGS: For the purposes of this study a snag is defined as a standing dead tree. If any green needles or leaves persist anywhere along the bole, treat it as a live tree instead of as a snag. Wildlife snags are ≥ 23 cm DBH and ≥ 1.4 m in height. For leaning dead trees, if the angle between the dead tree and the ground is > 45 degrees it is a snag; otherwise it is a log. Measure the DBH of the snag on the uphill side of the snag in steep terrain. For snags with irregular growth (i.e. one side is flattened), take the mean of the DBH from two sides. If the central axis of a wildlife snag is < 10 m from the center transect line, it should be measured. **For wildlife snags directly on the line, measure the first, disregard the second, and so on.** Use the central axis (rather than the edge) of each snag to determine whether a snag qualifies to be counted within the plot. For snags whose distances are marginal (can't visually tell how far away they are), use a tape to measure the PERPENDICULAR distance from the transect line to the side of the snag where the central axis is located.

SPECIES (Spp): Enter the corresponding four- or five-letter code of the snag species.

Grand fir (*Abies grandis*)	**ABGR**
Subalpine fir (*A. lasiocarpa*)	**ABLA**
Western larch (*Larix occidentalis*)	**LAOC**
Engelmann spruce (*Picea engelmannii*)	**PIEN**
Lodgepole pine (*Pinus contorta*)	**PICO**
Ponderosa pine (*P. ponderosa*)	**PIPO**
Douglas-fir (*Pseudotsuga menziesii)*	**PSME**
Western hemlock (*Tsuga heterophylla*)	**TSHE**
Quaking aspen (*Populus tremuloides*)	**POTR**
Black cottonwood (*P. trichocarpa*)	**POTRI**
Unknown species	**UNKN**

DECAY: Enter the numeric value for the appropriate decay class of the snag (Bull et al. 1997):



1 = Snags that have recently died, typically have little decay, and retain their bark, branches, and top.

2 = Snags that show some evidence of decay and have lost some bark and branches, and often a portion of the top.

3 = Snags that have extensive decay, are missing the bark and most of the branches, and have a broken top.

4 = Burnt snag; almost entire outer shell is case-hardened by fire; looks like charcoal (not shown above).

DBH: Enter the diameter at breast height (1.37 m) of the tree using calipers, a DBH stick, or diameter tape to the nearest cm.

HEIGHT (Ht): Enter the height of the tree using a clinometer, to the nearest m.

CAVITY (Cav): Enter the four letter code of the woodpecker species occupying the tree. If no woodpeckers are observed occupying a cavity, record "0".

3. Logs/Down Wood

WILDLIFE LOGS: For the purposes of this study, a WILDLIFE LOG is any log ≥ 23 cm large-end diameter (LED) and ≥ 1 m in length that are INTERSECTED by the transect line. To qualify, the axis of the log or stem must lie above the ground (above duff and mineral soil layer). Dead stems attached to a live tree are not counted. For leaning dead trees, if the angle between the dead tree and the ground is < 45 degrees it is a log; if greater, it is a snag. If the central axis of a suspended log is < 1.8 m above the ground where the transect passes, tally the log on the transect; otherwise, disregard it. For logs broken into two pieces, treat it as one log if the pieces are touching. Otherwise, treat them as separate logs.

SPECIES: Enter the corresponding four- or five-letter code of the log species.

Grand fir (*Abies grandis*)	**ABGR**
Subalpine fir (*A. lasiocarpa*)	**ABLA**
Western larch (*Larix occidentalis*)	**LAOC**
Engelmann spruce (*Picea engelmannii*)	**PIEN**
Lodgepole pine (*Pinus contorta*)	**PICO**

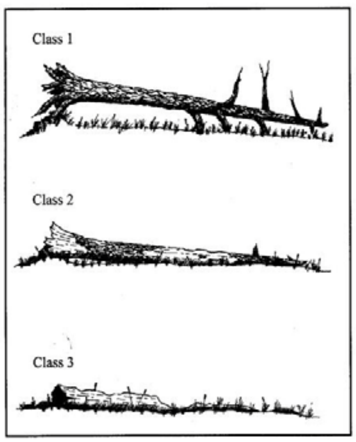
Ponderosa pine (*P. ponderosa*)	**PIPO**
Douglas-fir (*Pseudotsuga menziesii)*	**PSME**
Western hemlock (*Tsuga heterophylla*)	**TSHE**
Quaking aspen (*Populus tremuloides*)	**POTR**
Black cottonwood (*P. trichocarpa*)	**POTRI**
Unknown species	**UNKN**

INT_DIA: Measure the diameter at line intercept to the nearest cm. If no wildlife logs are encountered along the transect, enter the code 9999 in the INT_DIA column

LED: Measure the large-end diameter to the nearest cm of the wildlife log. See Figure 2 to determine where the LED is on logs with different characteristics.

LGTH: Enter the total length of the log in meters.

DECAY: Enter the numeric value for the appropriate decay class of the log (Bull et al. 1997):



1 = Logs that have recently died, typically have little decay, and retain their bark, branches, and top.

2 = Logs that show some evidence of decay and have lost some bark and branches, and often a portion of the top.

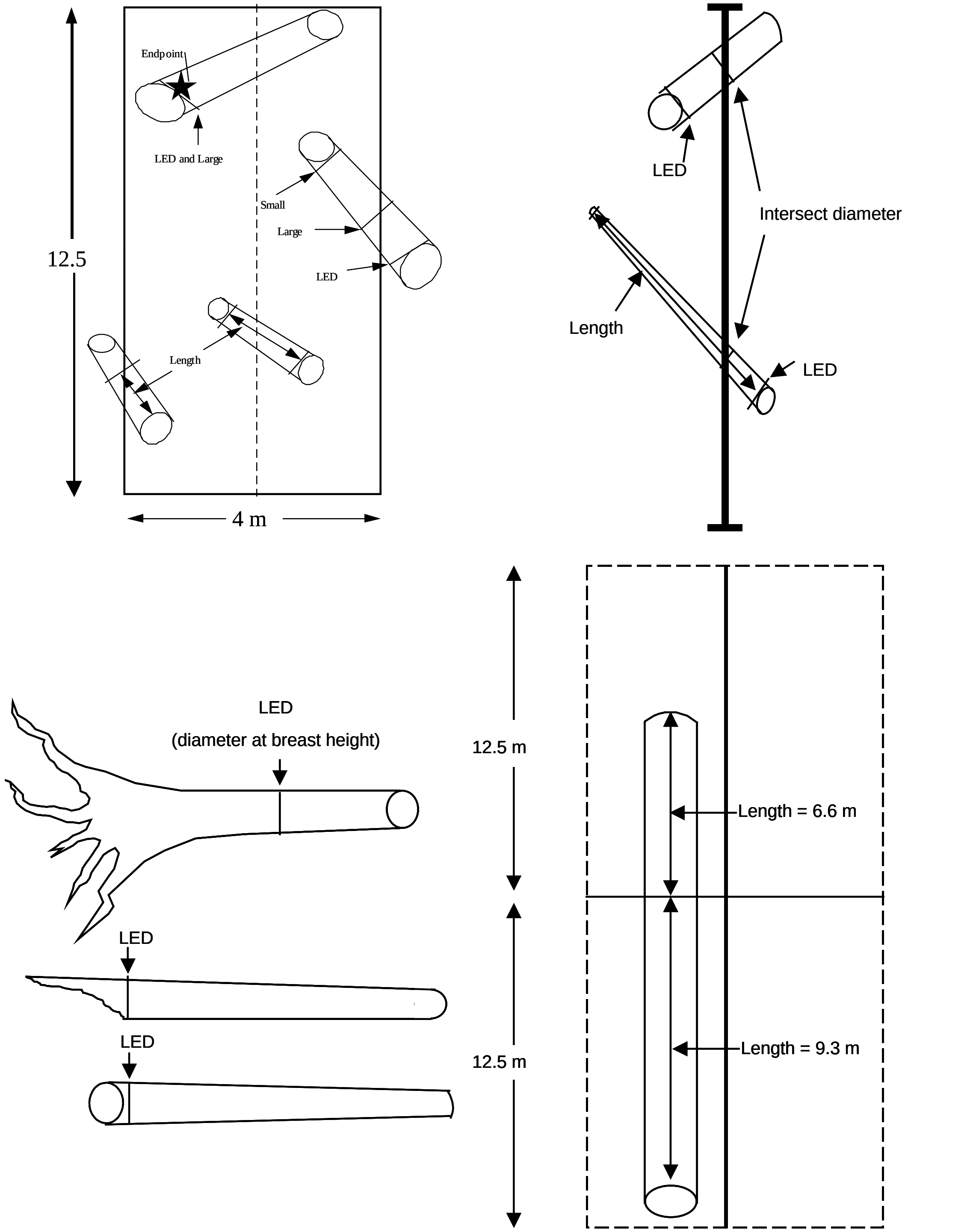
3 = Logs that have extensive decay, are missing the bark and most of the branches, and have a broken top.

4 = Burnt log; almost entire outer shell is case-hardened by fire; looks like charcoal (not shown above).

4. Stumps: All stumps within 1-m of the transect line

Natural stumps: Total the number of natural stumps (n) within 1 m of the center line. For the purposes of this study a natural stump is defined as any stump < 1.4 m in height and ≥ 15 cm at the **TOP of its bole** created by breakage due to natural conditions (i.e. wind, rot). Enter "0" if there are none.

Cut stumps: Total the number of cut stumps (n) within 1 m of the center line. For the purposes of this study a cut stump is defined as any stump < 1.4 m in height and ≥ 15 cm



at the **TOP of its bole** that was created by a chainsaw or other mechanical means. Enter "0" if there are none.

Figure 3. Sampling illustrations for down wood.