Flammulated Owl (*Otus flammeolus*) Population and Habitat Inventory at its Northern Range Limit in the Southern Interior of British Columbia

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Abstract.—Flammulated Owl (*Otus flammeolus*) ecology at the northern limit of its range (southern interior of British Columbia) necessitates that inventory data include replicated sampling throughout and between breeding seasons for accurate population and habitat assessment. Auditory census and nest surveys must be linked to assess habitat suitability; census alone can only indicate habitat capability through documentation of presence or absence of Flammulated Owls. Standardization of comprehensive census and nest surveys can provide multi-year population data for landscape management plans. Trend data may serve as a measure of recruitment and help to identify source habitats for retention in management plans.

The Flammulated Owl (*Otus flammeolus*) is a neotropical migrant that nests in cavities in the montane Douglas-fir (*Psuedotsuga menziesii*) forests of western North America (McCallum 1994, Reynolds and Linkhart 1987a, Cannings 1982). Prior to 1989, little was known about the habitat requirements of the insectivorous owl in the southern interior of British Columbia, at the species' northern range. Incidental surveys had revealed the presence and absence of Flammulated Owls in the southern interior of the Province, and historical records indicated Wheeler Mountain, near Kamloops, B.C. (fig. 1), may have had a higher number of nesting pairs of owls than surrounding areas (Howie and Ritcey 1987).

Habitat research began on Wheeler Mountain in 1989, necessitated by a logging moratorium for the area. The objective was to investigate critical nesting and foraging habitat features to develop integrated management prescriptions. By the early 1990's, the decision was made by the B.C. Ministry of Environment, Lands and Parks and the B.C. Forest Service to defer logging on Wheeler Mountain. The area has since been officially set aside for preservation as part of a Protected Area by the Kamloops

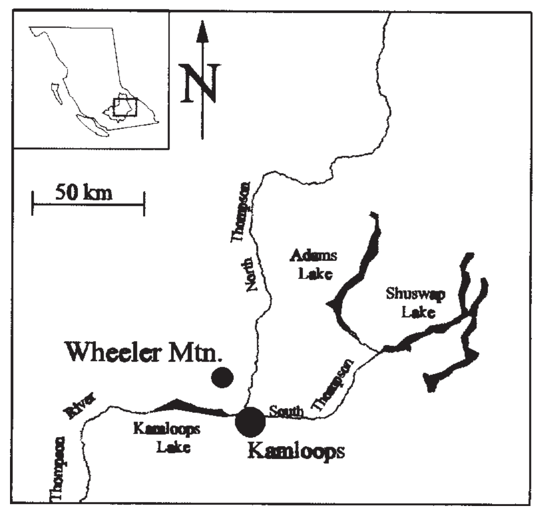

Figure 1.—Wheeler Mountain near Kamloops, British Columbia.

Land and Resource Management Planning (LRMP) Team (1995), proclaimed by British Columbia Provincial Government. Habitat research has expanded to include post-fledging studies and the development of a predictive model to assist managers with Flammulated Owl habitat inventory in the southern interior of B.C.

Multi-year data from Wheeler Mountain (1989-1991, 1994-1996) was used to assess the accuracy of auditory census and nest site

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survey techniques as management tools for habitat assessments. Results indicated that auditory census inventory techniques can only be used to determine presence or absence of owls in an area and should be replicated to confirm habitat capability. Nest surveys must be conducted to estimate habitat suitability and a standardized procedure that includes auditory census can be used to estimate relative nesting density. The long-term results clearly indicate the necessity for standardized, comprehensive inventory techniques and their appropriate selection to accurately meet informational requirements of integrated management.

STUDY SITES

Wheeler Mountain (fig. 1) was the principle study site and is a 1,600 ha area approximately 10 km north of the City of Kamloops, on the west side of Lac du Bois (50°46' N and 120°28' W). Elevation ranges from 850 to 1,200 m with slopes to 75 percent. Forest cover is classified as interior Douglas-fir biogeoclimatic zone, specifically IDFxh2—the Thompson very dry hot interior Douglas-fir variant (Lloyd et al. 1990). Wheeler Mountain is surrounded by grassland on the east and south aspects and continuous Douglas-fir and ponderosa pine (*Pinus ponderosa*) forest on the north and west aspects, respectively.

Forests on the mountain are mature to old-growth (80-200+ years). Forest cover at the top of the mountain is highly fragmented by cliffs and rock. Douglas-fir is the climax species dominating the study site with ponderosa pine occurring as a subdominant in sub-xeric to xeric sites. Ponderosa pine component has been reduced by fire suppression and previous selective timber harvests 25-35 years ago (D. Low, B.C. Ministry of Environment, Lands and Parks, pers. comm.). Fire suppression has resulted from British Columbia Forest Service policy (Watts 1983) as well as reduced understory fuel loading caused by cattle grazing (D. Low, Ministry of Environment, Lands and Parks, pers. comm.). The absence of fire has encouraged Douglas-fir regeneration in the form of dense thickets. The stem density of these thickets has led to stagnant stands with recurring outbreaks of western spruce budworm (*Choristoneura occidentalis*); budworm damage is extensive in mesic sites (van Woudenberg 1992).

The predominant understory species include saskatoon (*Amelanchier alnifolia*), birch-leaved spirea (*Spirea betulifolia*), common snowberry (*Symphoricarpos albus*), soopolallie (*Shepherdia canadensis*), kinnickinnick (*Arctostaphylos uva-ursi*), pinegrass (*Calamagrostis rubescens*), bluebunch wheatgrass (*Agropyron spicatum*), and rough fescue (*Festuca scabrella*). Mesic sites tend to be dominated by pine grass and rough fescue with variable amounts of shrubs. Bluebunch wheatgrass dominates xeric and south aspect sites, also with a variable shrub layer; common juniper (*Juniperus communis*) occupies the shrub layer at low elevations. The bryophyte layer is sparse in both mesic and xeric sites.

The mean annual precipitation for the area is 37.5 cm with maximum precipitation occurring in spring (May and June) and winter (December and January) (Mitchell and Green 1981). Mean annual temperature is -5°C, mean July temperature is 16°C and a frost free period of 90 days.

The additional study sites surveyed in 1996 that immediately surround Wheeler Mountain include the Tranquille Valley and Red Plateau. The Tranquille River Valley runs north-south between Red Plateau on its west flank and Wheeler Mountain on its east. Skull Mountain is approximately 70 km north of the City of Kamloops, near the town of Barriere and is located on the west side of the North Thompson River. Habitats sampled in the additional study sites in 1996 were of the same elevational range, forest cover type and structure and biogeoclimatic variant as Wheeler Mountain.

METHODS

A standardized, auditory census methodology was first developed in 1989 and improved with multi-year results. Based on census techniques initially used by Howie and Ritcey (1987), census stations were established at 500 m intervals. Established roads or reconnaissance lines through a stand served as transects. On Wheeler Mountain, the entire main road (18 km) was sampled in 1989-1991, and 1994-1996. The road traversed Flammulated Owl habitat across the entire area at mid-slope, providing an optimal cross-section of the site's habitat. The same people surveyed Wheeler Mountain for several years, suggesting that bias in the numbers of birds detected from year to year was reasonably controlled.

Auditory census began at dusk and often continued until dawn. Ten minutes were spent at each census station along a transect to record any birds calling spontaneously. If no birds were detected, the territorial or advertisement call was mimicked by the observer for an additional 5 minutes to induce a response. Mimicking calls was found to be more effective to induce a response than playback tapes; sampling was conducted by observers who were capable of reproducing a call that could induce a response from a Flammulated Owl. The bearing of the call and estimated distance to the owl based on the strength of the call were recorded. The variability associated with the bearing of an owl call was quantified using discrete confidence intervals of plus or minus 0, 15, 30, or 60 degrees. Distances were estimated based on the strength of the call which was determined by the number of notes detected in each vocalization of a calling series. For example, at large distances (> 200 m), the typical two-noted hoot was commonly detected as one quiet note; at very close proximity—within a few meters—two notes with an intervening rasp (sometimes referred to as the three-note call) was detected. Interference from background noise, such as wind or running water, and influence of terrain and forest cover were considered in distance estimates. Visual detections of calling birds by census takers provided experience with estimating distances.

Census results were applied to a standardized method for nest site searches to estimate the relative nesting density of owls. For 1995-1996 data, the locations of all census stations along a transect were recorded using a hand-held GPS (Global Positioning System) and compass bearings to calling owls were mapped using a GIS (Geographic Information System). Triangulation of the bearings assisted nest site surveys by identifying areas used by calling owls (e.g., potential home range locations) and therefore the vicinity of nest sites. Nest site surveys were conducted along parallel transects 50 m apart that traversed areas where owls were detected during census efforts. Auditory censes were conducted between mid-May and early June and nest site searches were conducted during the months of June and early July, beginning with xeric sites. Surveys conducted on Wheeler Mountain were expanded to include the Tranquille Valley, Red Plateau, and Skull Mountain in 1996.

Aerial photographs were used in support of nest site surveys. Flammulated Owl nesting and foraging habitat areas investigated on Wheeler Mountain typically had a distinct forest cover texture that could be recognized on aerial photographs. Areas displaying the characteristic texture were delineated on 1:15,840 air photos and overlaid with nest site survey transects. Auditory census results did not always include owl detections in all areas of the habitat forest cover texture. Periodically, areas of "non-Flammulated Owl habitat" forest cover texture were surveyed to ensure that nest sites were not being missed and the methodology was accurate. Nest surveys were conducted during the coolest part the of day—early in the morning. Nest sites were confirmed by locating a female Flammulated Owl at the cavity entrance upon disturbance at the bole of the tree or snag. During the first 3 years of the project, limited resources and research objectives necessitated the same individuals to work both late evenings and full days. Consequently, nest site searching was conducted during the daytime while census work was completed at night.

RESULTS

Auditory Census

During the 1989 nesting season, owls were censused on Wheeler Mountain from 15 May until 20 June. Figure 2 indicates the proportion of the total calls detected at each station. The third week of May was the peak calling period. Overall, calling began to decline by late May; fewer spontaneous calls were detected than induced calls. The fewest numbers of birds were detected 23 May 1989 (on this night temperatures were so low that rain turned to snow between 2300 and 2400 hrs).

Census data results for 23 May in 1995 and 1996 are shown in table 1. The data for 1996 shows the highest numbers of birds recorded.

Nest Site Surveys

Table 2 shows the numbers of nests found on Wheeler Mountain in each year of study since 1989. The numbers of nests found in the first few years of research were consistently lower than the latest years of surveys. The highest number of nests were found in 1995 (14 nests). The fewest nest sites found recently were surveyed in 1996; at least three of the nine nest sites found failed.

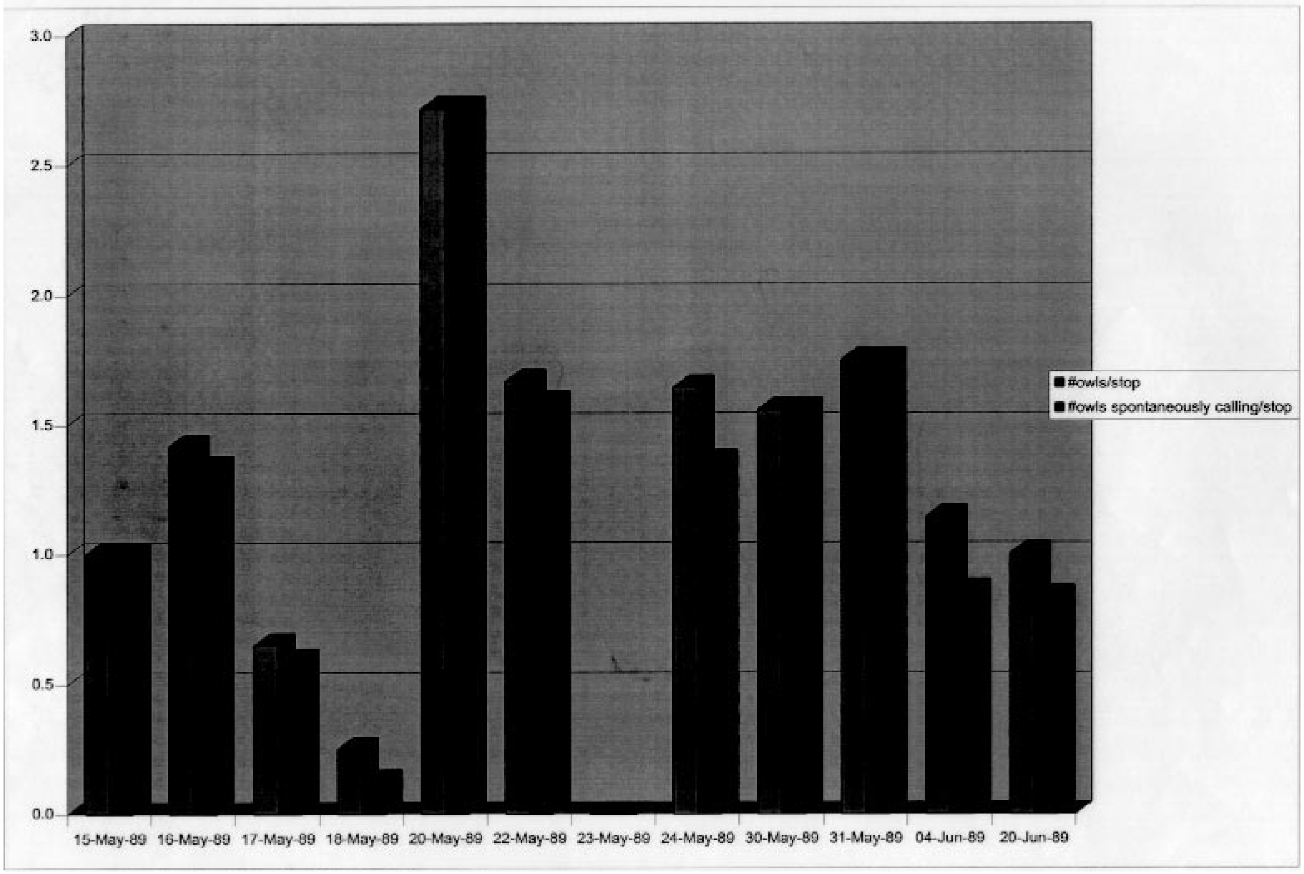

Figure 2.—Proportion of Flammulated Owls (Otus flammeolus) detected per census stop on Wheeler Mountain near Kamloops, British Columbia in 1989.

Table 1.—Results of Flammulated Owl (Otus flammeolus) 23 May census at Wheeler Mountain near Kamloops, British Columbia for 1995 and 1996.

	1995	1996
Owl detections/linear km surveyed	3.3	6.2
Mean number birds detected/stop	1.6	3.0
Total number of detections	52	100
Conservative estimate of birds present	26	40

Table 2.—Flammulated Owl (Otus flammeolus) nest sites found on Wheeler Mountain near Kamloops, British Columbia in each year of survey from 1989-1996.

Year	Number of nest sites detected
1989	3
1990	4
1991	4
1994	12
1995	14
1996	9

Figures 3 and 4 show the overlay of census bearings and nest site locations for 1995 and 1996, respectively. Nest sites were located near or at bearing lines of owl calls recorded during census and also away from bearings, near areas where calling birds were detected. Census transects shown are roads that traversed suitable Flammulated Owl habitat.

Along the main road in the Tranquille Valley, 28 detections were made at 30 census stations sampled between 20 and 21 May 1996; no nest sites were found. In the Tranquille community area, approximately 20 ha near the head of the Tranquille Valley, 29 detections were made at 22 census stations 25 and 28 May. This site was traversed on foot along a B.C. Forest

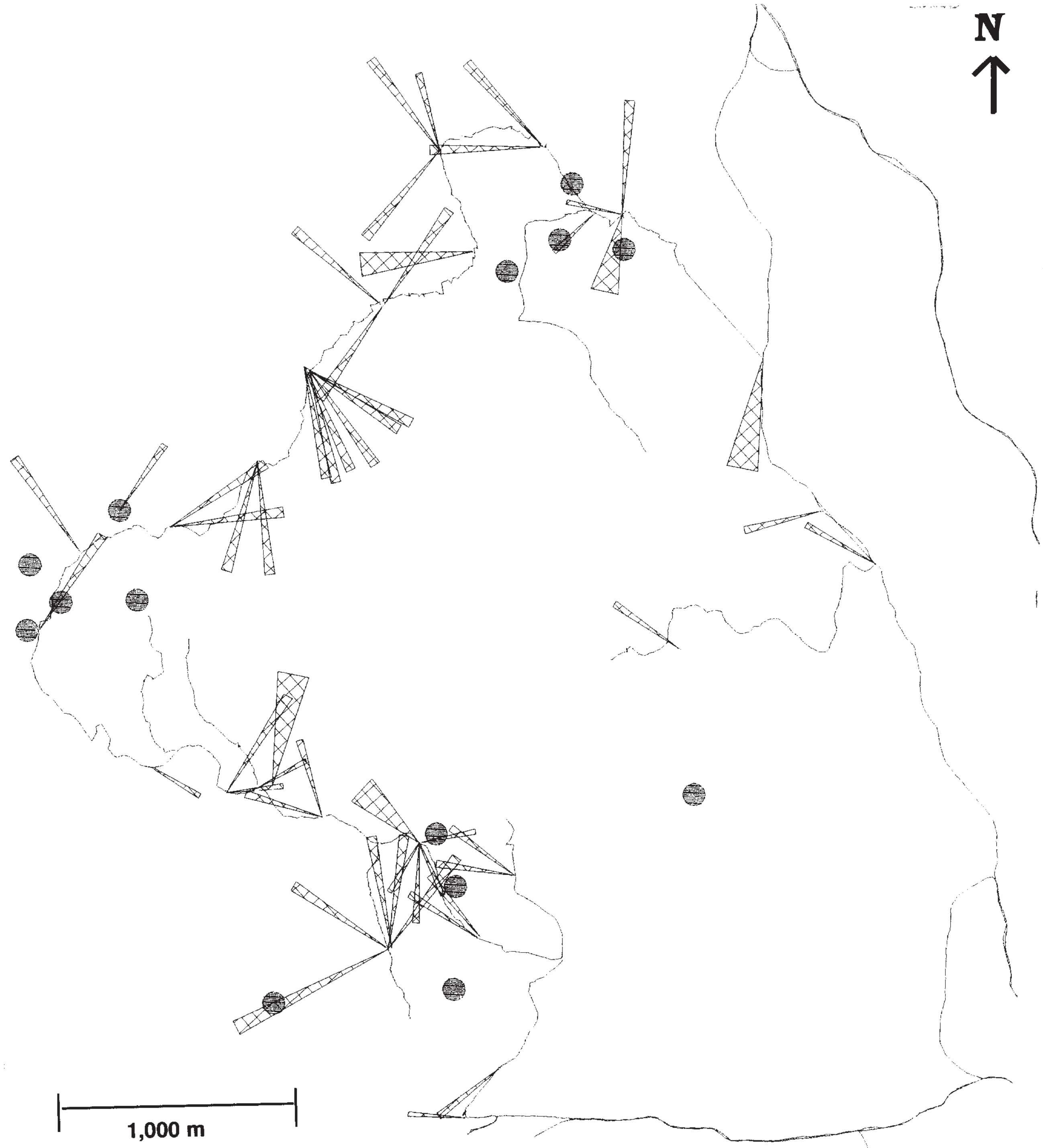

Figure 3.—Bearings (wedges) of Flammulated Owl (Otus flammeolus) calls recorded on 23 May 1995 and nest sites (circles) located in 1995, near Kamloops, British Columbia.

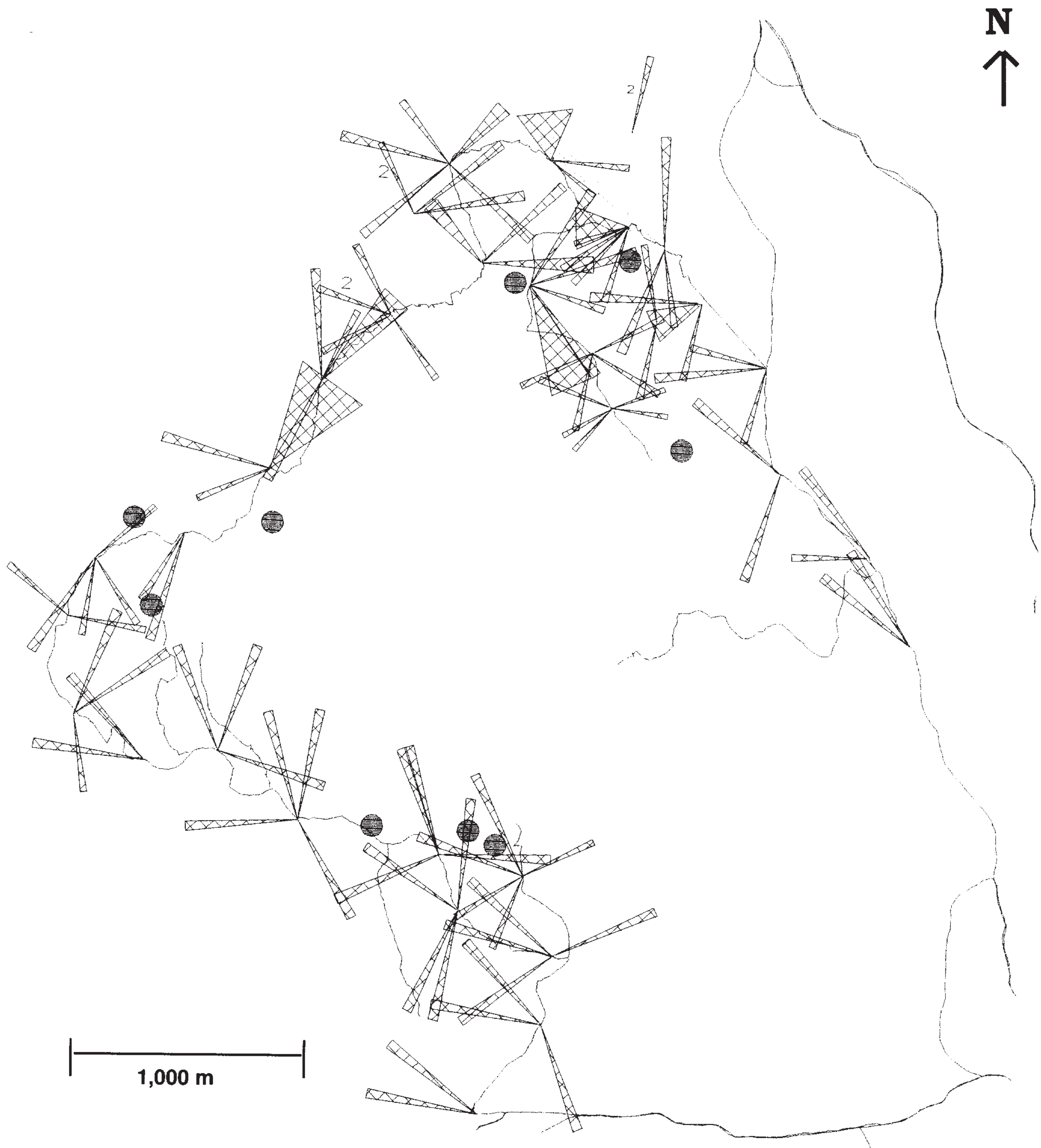

Figure 4.—Bearings (wedges) of Flammulated Owl (Otus flammeolus) calls recorded on 23 May 1996 and nest sites (circles) located in 1996, near Kamloops, British Columbia.

Service main reconnaissance line with perpendicular secondary lines. At each 100 m interval, bearings of continuous owl calls were recorded, providing detailed information for triangulation which was used to estimate the minimum number of owls present in the area to be seven; one abandoned nest was found (table 3). A transect section of 7.5 km in the Red Plateau area had four nest sites; two nest sites were found in the remaining 15 km of linear transect (table 3).

Table 3.—Flammulated Owl (Otus flammeolus) nest sites per linear km of census transect surveyed in 1996, British Columbia.

Location	Nest sites/km	Transect length (Linear km sampled)
Wheeler Mountain	0.5	18
Tranquille Valley	0.1	14
(includes Tranquille community area)		
Red Plateau	0.3	13
Skull Mountain	0.2	14

DISCUSSION

The census results for Wheeler Mountain indicate the range of fluctuation in detections of owls within one season and between years (fig. 2, table 1). Depending on the time of the census, new migrant arrivals may be detected among those that are in the process of or have already set up territories and acquired mates. The third week of May is the peak calling period (fig. 2), when migrants have likely saturated the area and territory boundaries are being established and defended. Mimicking a calling owl in mid-May on Wheeler Mountain has often resulted in the individual retreating before responding. At the end of May and early June, Flammulated Owls will respond by moving closer to the observer, presumably to defend their territory by advertising the boundary location.

At the beginning of May, early migrant arrivals will either reclaim territories used in the past (Reynolds and Linkhart 1987b) or begin establishing a new home range, the latter being the owl that may retreat from a mimicked call made by an observer. At the peak calling period, most birds have arrived and are competing for mates and territories. The early migrants that have established territories may or may not be contributing to the calls detected. Males that have a territory but as yet are unmated may be calling to attract females from the latest arrivals. If pairs have formed on territories established early in May, territorial or advertisement calling will be unnecessary except to warn intraspecific intruders. For example, two birds were heard calling on 8 May 1995 from an area where owls have consistently been found on Wheeler Mountain; on 10 May 1995 only one of these birds was heard calling. Further, on 23 May 1995, when the highest number of calls were recorded elsewhere on the mountain (fig. 3), only one bird was heard at this location. Nest surveys located five nests in the area, three of which were directly along the bearings of the calls. The observations suggest that early arrivals may have had established territories and potentially begun nesting activity by the time most migrants were passing through searching for territories and mates. Habitat at sites where nesting begins earliest is likely preferred and may be optimal; if limited to those census results recorded only during peak calling periods, the area with five nests would not have documented, and nest searches relying on these same census results would have failed to detect all the nest sites.

Figures 3 and 4 exemplify the need to replicate surveys of census transects from the time migrants first arrive until nesting is underway so that most calling males can be detected and nest sites are less likely to be missed during nest surveys. The mapped bearings of calls for one evening only in 1995 and 1996, (figs. 3 and 4, respectively) at the peak calling period, illustrate that not all nest sites are located in the vicinity of census bearings or where birds were detected calling. The multi-year results for Wheeler Mountain showed that nests occurred in clusters, relative to total available area, and tended to be located in areas where birds were heard calling. These data suggest productive nesting habitat may have a patchy distribution. Nesting productivity may also be unevenly distributed through time. Xeric, south and east aspect sites that receive more sunlight earlier in the spring than mesic, north and west aspect sites and have warmer temperatures for longer periods throughout the day will likely provide earlier nesting opportunities to Flammulated Owls. South aspect nest sites tended to fledge before north aspect sites, suggesting that south aspect, xeric sites will have territorial males calling sooner and potentially for less time through May than birds in mesic sites. Therefore, triangulation of bearings recorded at multiple auditory surveys beginning in early May, when migrants first arrive, will delineate potential home range sites and indicate patches of productive habitat for nest surveys.

The owl calls plotted for the peak calling periods (figs. 3 and 4) likely represent mate advertisement by new arrivals and territorial boundary displays (Reynolds and Linkhart 1987a). The few calls that have been detected in early May, the bearings of which have often led directly to nest sites, may have resulted from males reclaiming territories used in previous years and advertising for past or new mates from potential nest trees (Reynolds and Linkhart 1987b). By the third week of May, a greater proportion of the calls was likely a result of territory defense and competition, and therefore less indicative of potential nest site locations.

The net result of the peak calling period is likely an abundance of non-nesting individuals passing through the area. In Colorado, Linkhart has found that the majority of calling individuals are territorial (B. Linkhart, pers. comm.). Reynolds and Linkhart (1987b) have also delineated most territories on their study site and report that they tend to all be occupied in most years. The variable number of birds detected calling on Wheeler Mountain from year to year and the differences between numbers of calling birds and nest sites found in the same year suggest one of two possible occurrences: either

1. there is a surplus of non-breeding birds that pass through the area during migration, or
2. the total number of nest sites have never been found and many potential territories remaining unoccupied during most years.

If each calling owl represents one territory, the fluctuations between the numbers of birds detected in census surveys between years would suggest that habitat on Wheeler Mountain is rarely saturated. Furthermore, the disparity between the numbers of nest sites found (tables 2 and 3) and numbers of birds conservatively estimated to be present from census data (table 1), suggests that many territories are occupied by non-nesting birds (in 1996, 31 territories would remain non-nesting). If this were the case, far more birds should be detected calling in June and potentially into July (fig. 2) (see Reynolds and Linkhart 1987a). It would be expected that if all calling birds were territorial, detections might persist for at least a few more nights (fig. 2). Therefore, the fluctuations in numbers of birds heard between years and the extremely short peak in spontaneous calling (fig. 2) suggest that a surplus of non-territorial birds must occur on Wheeler Mountain. It is possible that not all nest sites are detected each year and the survey methodology developed as of late (results shown in table 1) may be improved by expanding nest surveys to include night searches. However, migratory species, particularly passerines, are often recorded in atypical habitats and at large densities en route during migration (R. Howie and D. Low, B.C. Ministry of Environment, Lands and Parks, pers. comm.). Wheeler Mountain may provide preferred habitat for migrants. The combination of security cover and food supply may be optimal for migrants but is likely inadequate to support 1.8 territorial birds/ha (extrapolating linear data from table 1 to the area, 895 ha).

The highest density of Flammulated Owls on Wheeler Mountain was recorded in the coldest and wettest year of research; this strongly suggests that the site is preferred habitat but the numbers of calling birds is not indicative of the numbers of territories present. The only census station where an owl was not detected on Wheeler Mountain (on 23 May 1996) was in an area of some of the poorest habitat on the mountain. The nesting results shown in table 3 suggest a disproportionate selection for habitat on Wheeler Mountain. Although Wheeler Mountain had fewer nests than the previous year, it retained the highest nesting density compared with surrounding areas. Replicated census and nest site surveys in the surrounding areas in subsequent years are necessary to quantify habitat preference.

Fewer calls were detected later in the breeding season, near the end of June (fig. 2) when nesting activity had begun. In particular, spontaneous calling dropped off. Mate advertisement and intraspecific territory defense were no longer necessary. If similar numbers of birds are calling in an area as late as July, critical nesting habitat features are likely absent and the habitat is unsuitable, or marginal at best, for nesting owls. Reynolds and

Linkhart (1987a) found that few birds called on their study site spontaneously in July and those that did were confirmed to be unmated males. Conversely, in stands of productive owl habitat, territorial male owls may call only a few nights or couple of weeks after they arrive at the site. Particularly if a warm spring produces an abundance of insects, experienced pairs of owls familiar with a breeding home range may begin nesting activity shortly after they return. The male will stop, or markedly reduce calling once he has attracted his mate. van Horne (1983) suggests that non-breeding adults that comprise the surplus of a population may occupy marginal habitats at higher densities than breeding adults in high quality habitats.

The multi-year results suggest that behavioral characteristics in combination with environmental factors, such as climate, can reduce the accuracy of census results, necessitating that auditory census be replicated within a season. Census data may be useful to indicate habitat capability, but cannot be used to assess habitat suitability. The successive years of census data for the evening of 23 May (fig. 2, table 1) clearly show that censes must be replicated between as well as within seasons to determine habitat capability. No owls were detected 23 May 1989 due to adverse weather conditions. At the same site in 1995 and 1996, an average 1.6 and 3 owls, respectively, were detected 23 May.

The inherent error in the census technique compounds the limitations of the methodology. Flammulated Owls have a ventriloquial call and many of their habitats in British Columbia have variable topography that can contribute to errors in identifying call locations. New arrivals move around a great deal, which the census techniques can encourage so that the same individual may be recorded calling spontaneously at more than one census station. Background noise can be significant, reducing an observer's ability to detect calling owls and accurately identify the species.

The extreme cold temperatures and wet conditions throughout the spring and summer months of 1996 were likely responsible for the nesting failures detected on Wheeler Mountain and the fewer number of nest sites found than in 1995 and 1994, despite the record number of owls detected in 1996. Low food supply was strongly suspected to contribute significantly to lower nesting numbers than previous years and high rates of nesting failure. Multi-year foraging data for Wheeler Mountain suggests that Flammulated Owls are highly opportunistic and will prey on locally abundant insects, including late larval instar stages of the western spruce budworm during its cyclical outbreak (van Woudenberg 1992). Adult nesting Flammulated Owls were observed gleaning budworm from young Douglas-fir crowns throughout the nesting period in 1990. Photography data indicate that Flammulated Owls may have been using orthopteran species disproportionately in low years of the budworm cycle, 1994-1996 (the western spruce budworm follows a 7-year cycle, Koot et al. 1990). The preliminary results suggest that climate may have reduced the availability of supplemental insect prey, reducing overall nesting success. At its northern range limit, the Flammulated Owl may be an opportunistic predator tracking insect cycles by preying on the locally abundant, large-bodied insects. This life strategy could predispose Flammulated Owls to fluctuate in nesting numbers from year to year at their northern range; this characteristic necessitates successive year standardized population inventories.

Poor productivity for Flammulated Owls in 1996 may have been confounded by higher numbers of predators. In the southern interior of B.C., Barred Owls (Strix varia) appear to present the greatest predatory risk to Flammulated Owls and this risk is likely greatest at the time of fledging (van Woudenberg 1992). Our observational data for several years (1989-1991, 1994-1996; one survey 1991) suggest that in 1996, Barred Owls may have been more abundant than in previous years. Barred Owls have been observed harassing Flammulated Owls at their nests on several occasions; the results have been Flammulated Owl nest abandonment and strong evidence for fledgling predation. In the Kamloops area, adult Flammulated Owls have always been observed to remain within thickets of young Douglas-fir, where the closely spaced stems inhibit maneuverability of larger birds. These observations suggest adult Flammulated Owls are much less at risk from predation than fledglings.

INVENTORY RECOMMENDATIONS

Relative densities for owls present in an area must be estimated using a standardized census replicated within and between seasons. Census points should be recorded using a handheld GPS and call bearings should be entered into a GIS for accuracy of bearing triangulation. Triangulated bearings of calls can be used in estimating the numbers of birds in an area. Bearings of owl calls recorded at intervening points between the 500 m census stops may contribute to the precision of using bearing triangulation for bird locations. Density estimates of owls present in an area cannot be used to estimate territorial occupancy due to census bias resulting from (1) the high risk of error associated with estimating distances of calling birds, particularly by inexperienced surveyors; (2) the inability to rule out detecting the same calling male at more than one census stop; and (3) the potential for surplus birds to be recorded en route during migration.

Census surveys must be linked to nesting surveys for standardization. Mapped census data will increase both the efficiency of nest site surveys and accuracy of estimated relative nesting density. Censes must be replicated throughout the time migrants are arriving to help identify potential nest site locations. Areas where few birds are detected only during early arrival time may be highly productive areas. Nest sites should be searched along systematic transects that traverse both the surrounding area of a triangulated bearing location and areas of potential habitat identified from aerial photographs. Nest searches must be conducted at times other than the heat of the day, when adult female owls may roost in nearby trees if the temperature within the nest cavity increases.

The inventory procedure must be selected to meet the information requirements of the management objective for an area. Census data alone should not be extended beyond habitat capability assessment. Nest site surveys in combination with replicated censes are necessary for habitat suitability assessment and to develop management prescriptions. If several owls are detected during censes in an area, but no nests are found, critical features such as cavities in larger trees or snags (> 35 cm d.b.h.), food supply, or security cover may be limiting; the area would be assessed as capable but not suitable nesting habitat.

Recruitment into the population is the most revealing measure of habitat suitability and will identify sink and source habitats. Banding and radio-telemetry of fledglings will provide the greatest accuracy of population trends over multiple years; although less accurate, successive year nesting densities are less costly and may provide trend data to help identify sink and source habitats. Population information can be integrated into landscape management plans; suitable mosaic patterns can be developed to contribute to the sustainability of Flammulated Owl populations at the northern edge of their range.

CONCLUSIONS

There is an increasing trend among resource managers toward standardization of wildlife monitoring. The sustainable management of Flammulated Owls is dependent on the accuracy of the inventory data. Landscape management prescriptions developed for sustainability of breeding Flammulated Owl populations will be effective if sites of habitat capability and suitability are identified.

Accurate habitat inventory is particularly important at the species' northern range where populations may fluctuate from year to year. Changes in predator numbers can contribute to fluctuations in Flammulated Owl populations by reducing recruitment. Differences in annual population numbers necessitate multi-year, comprehensive, standardized census and nest site surveys conducted in combination. Recruitment information will indicate long-term population trends that can be used to identify areas of high productivity (source habitats) for retention in management plans at the northern limits of the species' range.

For those interested in determining the presence or absence of owls, we recommend that a minimum 4-5 visits be conducted to each of the census points. For those engaged in demographic studies of the owls, more visits are needed to detect a greater percentage of the birds; we recommend a minimum of 5-7 visits. Census efforts should be conducted between mid-May to mid-June.

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