A Breeding Bird Survey of the West Mountain Wildlife Management Area and the Nulhegan Basin Division of the Silvio O. Conte National Fish and Wildlife Refuge 2000 Final Report

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ABSTRACT

In 1999, the U.S. Fish and Wildlife Service and the Vermont Agency of Natural Resources acquired two separate properties encompassing 48,000 acres of former timberland in Essex County, Vermont. The conserved lands contain regionally significant forests and wetlands that harbor vulnerable bird populations. To assist in the development of an avian conservation plan, I surveyed birds in 11 natural community types. This report describes the bird community associated with each type in terms of characteristic species, composition, richness, diversity, and proportionate representation of species identified as conservation priorities. I also present distributional and relative abundance data for nocturnal owls, which were surveyed in the same area with the use of audioplayback methods. Overall, results indicate that lowland spruce-fir forests are of primary conservation value to birds due to a high diversity index and a high proportion of priority species. When combined with black spruce bogs, black spruce swamps, and northern white cedar swamps, they form a lowland softwood complex inhabited by half of the area's breeding bird species. While the importance of this forest type appears to increase with extent and maturity, inclusions of younger stands may add to its bird conservation value.

In the uplands, red spruce-northern hardwood forests contain the greatest diversity of birds, supporting both softwood and hardwood associates. Non-forested wetlands also enrich the native avifauna. Alluvial shrub swamps rank high for diversity, while the dwarf shrub bog/poor fen/intermediate fen complex contains species found in no other natural community type. These findings suggest that successful bird conservation will require land stewards to protect the full complement of natural communities and allow natural processes, such as forest maturation and disturbance, to prevail. The resulting landscape will benefit native birds through the provision of habitat connectivity and heterogeneity. Further investigation will enable a better understanding of how and when to mediate natural processes to achieve bird conservation objectives.

BACKGROUND AND PURPOSE

In December, 1998 the Conservation Fund purchased 133,289 acres of land in Northeastern Vermont from Champion International Corporation. To conserve the most ecologically valuable areas of the property, the Fund conveyed 26,000 acres of the Nulhegan Basin to the U.S. Fish and Wildlife Service (USFWS) and approximately 22,000 acres of the adjacent West Mountain/Paul Stream area to the Vermont Agency of Natural Resources (VTANR). In 1999, the USFWS formed the Nulhegan Basin Division of the Silvio O. Conte National Fish and Wildlife Refuge, while the state established the West Mountain Wildlife Management Area (WMA). The surrounding lands, which received a measure of protection through a working forest easement, were sold to the Essex Timber Company. The area's rich assemblage of birds became a primary beneficiary of this series of transactions.

The Nulhegan Basin Division, the West Mountain WMA, and the linking Wenlock WMA contain outstanding examples of boreal habitat. The extensive wetland complexes and spruce-fir forests are considered to be of high regional value to bird populations (Laughlin and Kibbe 1985, Anderson et al. 1998). Several bird species that are uncommon in the Northeast occur here at the southern periphery of their breeding ranges. This group consists of year-round residents (Boreal Chickadee, Gray Jay, Spruce Grouse, Black-backed Woodpecker) and migratory species (e.g. Bay-breasted Warbler, Palm Warbler, Olive-sided Flycatcher, Rusty Blackbird, Philadelphia

Vireo). In addition, productive wetland and upland sites provide stopover habitat for transient birds and wintering habitat for irruptive finch, crossbill, and grosbeak populations. The bird conservation value of the Nulhegan-West Mountain area is further enhanced by its location near the heart of a physiographic region considered a breeding stronghold for neotropical migrants (Rosenberg and Hodgman 2000).

The stewardship priorities of the federal and state agencies demonstrate a commitment to protecting the area's extraordinary bird life. The Silvio O. Conte National Fish and Wildlife Refuge Act charged the USFWS with a mandate "to conserve, protect and enhance the natural diversity and abundance of plant, fish, and wildlife species and the ecosystems upon which these species depend in the refuge." Furthermore, the Final Environmental Assessment for the Nulhegan Basin Division places strong emphasis on the protection of rare species and migratory bird habitat. Actions to conserve migratory bird habitat fulfill the federal government's obligations under the multi-national Migratory Bird Treaty Act. In a similar vein, guidelines for management of the West Mountain WMA call for "the identification and protection of natural communities, wildlife habitats and other ecologically sensitive and/or important areas" (VTANR 1999). The departments responsible for administering this process are the Vermont Department of Fish and Wildlife and the Vermont Department of Forests, Parks and Recreation.

The common emphasis on conserving wildlife habitat facilitated the development of a cooperative relationship between the state and federal agencies. In a Conservation Partnership for the Nulhegan Basin and Paul Stream Area (USFWS 1999), "The ANR and USFWS agree[d] that by working together they can improve the value of the land for all wildlife. By considering their lands as a whole and cooperating on wildlife management, the ANR and USFWS may be able to better accomplish their individual goals." The first step in this joint stewardship initiative was a coordinated ecological inventory of the two new conservation lands. Between the late winter and fall of 2000, investigators representing a wide range of disciplines performed field studies that will guide the development of detailed management plans. The Vermont Nongame and Natural Heritage Program's natural communities classification system provided a common framework for these various investigations.

The Vermont Institute of Natural Science was contracted to document the occurrence, distribution and relative abundance of breeding owls, passerines, and woodpeckers. Although recorded when encountered, diurnal raptors, goatsuckers, gallinaceous birds, and water birds were not systematically sampled. Our specific objectives were to:

1. create a list of birds occurring in the study area during the breeding season;
2. identify species and habitats of management interest;
3. associate species with specific natural community types;
4. produce an index of relative abundance for each species;
5. establish a baseline for monitoring changes in local populations; and
6. document the distribution of rare species.

Results are intended to help land managers in and around the study area develop stewardship priorities and predict effects of management activity. Continued bird study will enable the USFWS and the VTANR to evaluate changes in the area's avian community resulting from their conservation efforts.

Study Area

The Nulhegan Basin Division is located north of route 105 in Essex County, Vermont. Its 26,000 acres include parts of four towns: Lewis, Bloomfield, Ferdinand, and Brunswick. The basin, itself, is a low-lying, circular area surrounded by prominent hills. It is drained by four tributaries of the Nulhegan River: the North Branch, the Logger Branch, the Yellow Branch, and the Black Branch. National Wetland Inventory maps show close to 7,000 acres of wetland within the Division's boundaries. These include boreal bogs, black spruce swamps, shrub swamps, and sedge meadows. Conifer and mixed forest predominate in the lowlands, while northern hardwoods ring the basin on upland slopes. Intensive logging in the 1970's, hastened by spruce budworm outbreaks (USFWS 1999), have resulted in an extensive matrix of young, regenerating cut-blocks. Mature forest remnants were identified for inclusion in this study.

The West Mountain WMA lies south of Route 105 in the towns of Ferdinand, Brunswick, and Maidstone. It contains proportionately more upland than the Nulhegan Basin Division, and a correspondingly higher percentage of hardwood forest cover. Nonetheless, the area contains two outstanding wetland complexes (Ferdinand Bog and Dennis Pond wetlands), plus several remote ponds. Conifer forest is concentrated atop West, North Notch, and Notch Pond Mountains, and along the margins of Paul Stream, which flows for 11 miles through the property. As in the Nulhegan Basin, the composition and structure of communities in this area reflect its history as an actively managed timberland. The best natural community representations occur on hillsides or within large wetland zones.

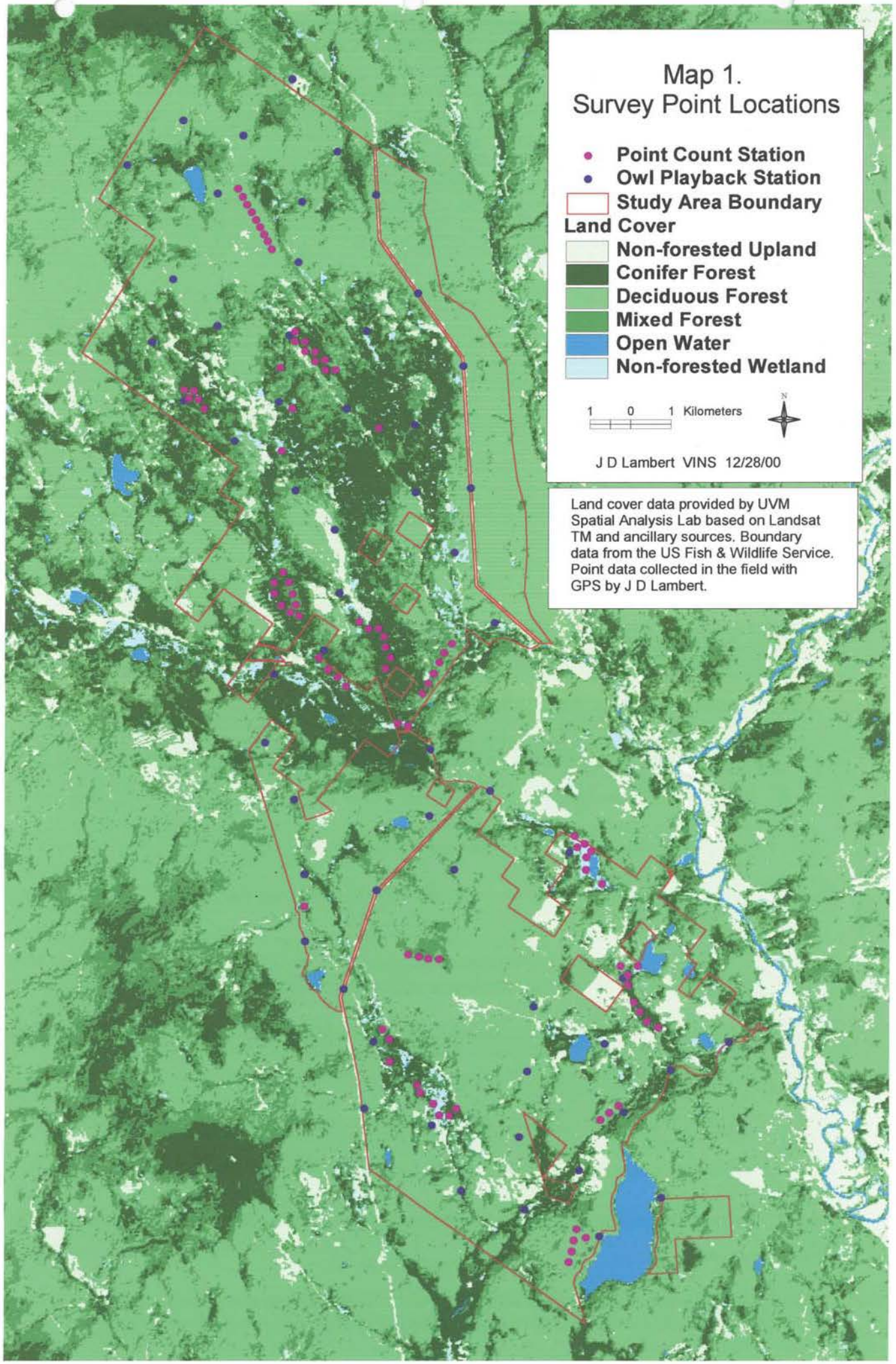
The 1,993-acre Wenlock Wildlife Management Area, which straddles route 105, links the Nulhegan Basin Division and the West Mountain WMA. Maidstone State Park, a 469-acre property, abuts the West Mountain unit to the south. About 10 km to the southwest of Maidstone, lies close to 23,000 additional acres of state land in the Victory area. The entire network of conservation lands lies within the Mahoosuc-Rangely Lakes subsection of the Northern Appalachian/Boreal Forest Ecoregion (Anderson et al. 1998). Physiographic maps drawn by Partners In Flight (PIF), an international coalition of over 150 bird conservation groups, place the network of conservation lands in Region 28, the Eastern Spruce-Hardwood Forest. Rosenberg and Hodgman (2000) state that "from a global perspective, this region ranks among the highest priorities for long-term bird conservation in eastern North America."

Methods

Nocturnal Owl Survey

Working with a field assistant, I established 57 owl survey stations throughout the study area's network of snowmobile trails (Map 1). The minimum distance between points was 1.6 km. Twenty-nine points were located in the Nulhegan Basin Division, and another 28 were placed in the West Mountain WMA. We surveyed each station twice, once between 9 and 19 March and a second time between 16 and 27 April.

Each survey began 30 minutes after sunset and continued until completion. Average time of completion was 5 h 4 min. After arriving at each survey station, we listened silently for three minutes. When this time elapsed, we used a portable cassette player (Sony CFS-B15) to broadcast a seven-minute tape-recording of owl vocalizations. The playback consisted of 45-s periods of recorded owl calls alternating with one-minute silent listening periods, in the


Map 1.
Survey Point Locations
Point Count Station
Owl Playback Station
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field with GPS by J D Lambert.

following sequence: Boreal Owl, silence, Northern Saw-whet Owl, silence, Barred Owl, silence, Great Horned Owl, silence.

For each owl observed, we recorded the species, time of response, compass bearing, and estimated distance of the first detected location. I used this information to map the approximate position of detected owls. Some of these positions fell outside the boundaries of the study area. Observations of owls made in June were later added to this map. For each species, I calculated the frequency of occurrence (number of points at which a species was detected divided by the total number of points surveyed) within three time periods (March, April, and March/April) and three geographic units (the Nulhegan Basin Division, the West Mountain WMA, and both areas combined). Using results from the whole study area and treating each species separately, I used Fisher's exact test to evaluate differences between March and April frequency of occurrence data. To measure the relative abundance of each species, I calculated the average number of individuals detected per point in each month. I chose not to make interspecific comparisons of frequency of occurrence or relative abundance because responsiveness to audioplayback is likely to vary among owl species.

Survey of Natural Communities and Rare Species Mapping

We located 1-14 point count stations, separated by at least 200 m, in each of 11 natural community types (Table 1, Map 1). Stations were classified as primary or secondary depending on the extent and ecological integrity of the surrounding habitat. Primary point count stations were situated in continuous, uncompromised examples of the designated community type. Secondary point count stations included those located near inherent structural or compositional edges or where management impacts were apparent. The Nulhegan Basin Division contained 49 survey points, plus 6 just outside the boundary in the Wenlock WMA. The West Mountain WMA contained 39 survey points, for a combined total of 94.

Table 1. Number of primary and secondary point count stations in each of 11 natural community types.

Natural Community Type	Primary	Secondary	Total
Alluvial shrub swamp	6	6	12
Beaver meadow/sedge meadow/marsh	4	1	5
Black spruce bog	6	1	7
Black spruce swamp	8	3	11
Dwarf shrub bog/poor fen/intermediate fen complex	10	2	12
Lowland spruce-fir forest	9	2	11
Montane paper birch-fir forest	4	0	4
Northern hardwoods	13	1	14
Northern white cedar swamp	3	0	3
Red spruce-northern hardwood forest	7	7	14
Sweet gale shoreline swamp	1	0	1
Total	71	23	94

I surveyed each station once between 1 and 20 June. Survey periods began within 15 minutes of sunrise and ended within four hours. During a 10-minute silent listening period, I counted all individuals seen and heard in two distance classes, within and beyond 50 m. Each

bird was assigned to one of five location categories: (1) within focal community, (2) at edge of focal community, (3) in adjacent, unclassified community, (4) flying overhead, or (5) at unknown position.

Using birds in category one only, I calculated frequency of occurrence and relative abundance measures for each natural community type and each distance class. I defined frequency of occurrence as the number of points at which species occurred divided by the total number of points surveyed. Relative abundance was measured as the total number of individuals divided by the total number of points surveyed. Recognizing that species differ in their detectability, I determined that comparisons among species should be made with caution and only using values in the 50-m distance class.

I summarized results for each natural community type in two tables: one for primary points only and one for primary and secondary points, combined. From the former, I generated a list of "characteristic species" for each natural community type by identifying those that occurred within 50 m of 20% or more of the survey points. From the list of birds occurring in either distance class, I measured the proportionate representation of species appearing on state and/or PIF priority lists.

I then calculated Shannon's diversity index (H) for all natural community types. This index accounts for species richness, abundance and evenness. In the formula below, s represents richness and p is the proportionate representation of species *i* among the total number of individuals.

$$H = -\sum_{i=1}^{s} p_i \ln p_i$$

Because Shannon's diversity index assumes that species do not differ in their detectability, I used the distance class that best supports this assumption (<50 m) in the calculations. To standardize the sampled area across habitats, I randomly selected four point count stations to represent each natural community. Natural communities sampled with fewer than four point count stations were excluded from this analysis.

Next, I ranked each natural community according to its proportionate representation of listed species and Shannon's diversity index. Results of this analysis justified the combination of lowland conifer forest types into a single natural community complex. After pooling data from black spruce bogs, black spruce swamps, northern white cedar swamps, and lowland spruce-fir forests, I repeated the above measures for the lowland conifer forest complex.

To maximize the utility of survey data, I recorded new species encountered between point counts. I took particular care to record rare species. Survey results formed the basis of priority species distribution maps. To these maps, I added observations made during transect layout and during occasional area searches. I also added records submitted by skilled, volunteer observers. The resulting maps do not represent the full distribution of rare species, since sampling effort was uneven across the 48,000 acres. Nonetheless, they provide useful information to guide future decision-making and bird study.

The combination of survey and mapping methods described above ultimately enabled development of a preliminary species list for both properties, with records organized by natural community type.

Results

Of the four owl species surveyed, we detected three, all by ear. They were Barred Owl, Northern Saw-whet Owl, and Great Horned Owl. Table 2 shows frequency of occurrence results, organized by management unit and survey period. Map 2 depicts the estimated locations at which birds first vocalized.

Table 2. Frequency of owl occurrence at 29 Nulhegan Basin (NB) and 28 West Mountain (WM) survey stations in 2000; n = 57 survey stations for both areas, combined.

	March			April			March and April		
Species	NB	WM	Both	NB	WM	Both	NB	WM	Both
BDOW	0.00	0.07	0.04	0.00	0.18	0.09	0.00	0.21	0.11
NSWO	0.00	0.11	0.05	0.07	0.07	0.07	0.07	0.14	0.11
GHOW	0.24	0.00	0.12	0.07	0.07	0.07	0.28	0.07	0.14

Barred Owls occurred at 11% of the survey stations, but were not detected in the Nulhegan Basin Division in March or April. Two June observations, made at the extreme northern and southern ends of this property, were the only records of the species north of route 105. South of 105, in the West Mountain WMA, Barred Owls occurred at 7% of survey points in March and 18% of the points in April. Overall, Barred Owls averaged 0.05 per point in March and 0.12 per point in April. Detections were of individual owls in all cases but two. A pair of Barred Owls responded on separate nights between Wenlock Station and North Notch Mountain. A Fisher's exact test found no temporal difference in the frequency of Barred Owl occurrence ($p = 0.44$).

Like Barred Owls, Northern Saw-whet Owls occurred at 11% of the survey points. Lone individuals were observed at four stations in the Nulhegan Basin Division and at two stations in the West Mountain WMA An additional observation on the state property was added in June. The average number of Saw-whet Owls per station was 0.05 and 0.07 in March and April, respectively. Frequency of occurrence for this species did not differ between the two months ($p = 1.00$).

Great Horned Owls occurred at 18% of the survey stations, primarily in the Nulhegan Basin Division. Six of the survey's 11 occurrences were recorded on a single, clear, calm evening under a full moon, when owl vocal activity is at its height (Takats and Holroyd 1998). All but one of the full-moon observations were of two or three individuals. Surprisingly, no other owls were heard on this night. On the strength of this one evening's results, Great Horned Owl numbers averaged 0.25 per point in March. In April, this figure dropped to 0.07 per point.

Discussion

Our failure to detect Boreal Owl is not surprising, given that the southern extent of its continuous breeding range lies approximately 200 km north of the study area. Although the secretive bird likely breeds in northernmost Maine, it appears to be absent from elsewhere in the Northeast except during winter irruptions, when it is difficult to detect (Hayward and Hayward 1993). We included this species in the sampling protocol because no other study had attempted to locate a disjunct population in northern Vermont.

The presence of the three other owl species (Barred, Northern Saw-whet, Great Horned) supports records from *The Atlas of Breeding Birds in Vermont* (Laughlin and Kibbe 1985). Between 1976 and 1981, atlas workers surveyed six 25-km^2 blocks in and adjacent to the study area and detected these same three species. The Great Horned Owl occurred in only one of the blocks and was considered a possible breeder. The Northern Saw-whet Owl also appeared in a single block, where it was assigned probable breeding status. Barred Owl records were more widespread. This species occurred in three blocks as a probable breeder and in one as a possible breeder.

Differences in survey methodology, time scale, and geographic scope preclude direct comparison of our findings with atlas results. Furthermore, comparing 2000 frequency and relative abundance data among the three species is not possible due to interspecific differences in responsiveness to audioplaybacks. Despite these limitations, our data improve understanding of owl distribution and abundance in three important ways. First, they permit spatial analysis at a finer scale than that afforded by the atlas. Second, they enable preliminary, inter-regional comparisons of owl abundance. And third, they form a local basis for interpreting the effect of season on owl detectability.

Distribution

The distribution of owl observations, shown on Map 2, reveals an intriguing pattern. While Saw-whet Owl locations occurred in close proximity to both Barred and Great Horned Owl records, there appeared to be spatial separation between the two larger owls. Although the pattern may have occurred by chance, it could also reflect the uneasy ecological relationship between the two species. Since both species prey upon small mammals and birds, they may compete for resources (Bosakowski and Smith 1992) and space themselves accordingly. Overlap in Great Horned and Barred Owl home ranges does occur (Fuller 1979 as cited by Mazur and James 2000). However, the Barred Owl is known to avoid its larger cousin, which is its most common avian predator (Bent 1938, Johnson 1993).

The observed pattern may also emerge if Barred Owls, owing to their vulnerability, are less vocal in areas of high Great Horned Owl activity, and therefore more difficult to detect. Under the call-suppression hypothesis, the apparent separation between Barred and Great Horned Owls may not be real. The findings of McGarigal and Fraser (1985), who found no effect of Great Horned Owl playbacks on Barred Owl calling, raise doubts about this possibility. In our own study, 5 out of 6 Barred Owls vocalizing at the start of Great Horned Owl playbacks, continued to call during and/or after the larger owl's vocalizations were broadcast.

Finally, the possible separation may arise from differences in habitat or nest site availability between the Nulhegan Basin Division and the West Mountain WMA. However, these variables were beyond the scope of this investigation. The uncertain relationship between Great Horned and Barred Owl distributions in the study area invites further investigation, particularly when placed in context of the Northern Saw-whet Owl's widespread occurrence.

Because of its smaller size and relatively limited prey-handling capacity, there is less overlap between the Saw-whet Owl diet and the diets of the larger owls than there is between the diets of the larger owls, themselves. Furthermore, there is little evidence of predation on Saw-whet owls by Barred or Great Horned Owls (Cannings 1993). Saw-whet Owls and Great Horned Owls responded to playbacks at three of the same survey stations, on different nights. At two of these

stations, the smaller owl continued to vocalize throughout and beyond the broadcast of Barred *and* Great Horned Owl calls.

Relative Abundance

The average number of individuals of each species per survey station varied between 0.05 and 0.25 in March and 0.7 and 0.12 in April. Table 3 compares our findings to 1999 results from more extensive surveys, performed with similar sampling methods, in central and northern Ontario. Volunteers conducted the Ontario surveys along plowed, predominantly forested roads (Francis and Whittam 2000).

Table 3. Average number of individuals per point for three owl species in three North American regions. Northern Vermont (N. VT) data were gathered in 2000. Data from central Ontario (C. ON) and northern Ontario (N. ON) are from 1999.

	March			**April**		
Species	N. VT	C. ON	N. ON	N. VT	C. ON	N. ON
N. Saw-whet	0.05	0.10	0.07	0.07	0.20	0.18
Barred	0.05	0.19	0.14	0.12	0.22	0.11
Great Horned	0.25	0.09	0.14	0.07	0.09	0.10

In four out of six possible comparisons, Vermont's 2000 relative abundance values fall below those recorded in both central and northern Ontario in 1999. Exceptions arise in comparisons of April Barred Owl and March Great Horned Owl data. Comparison of April Barred Owl figures show Vermont's value (0.12) to be only negligibly higher than that recorded for Northern Ontario (0.12) and about half that recorded for Central Ontario (0.22). March Great Horned Owl results, in which northern Vermont figures far exceed those for the other two regions, can be explained by the extraordinary level of Great Horned Owl activity on a single, full-moon survey (see above).

The Ontario data place results from the Nulhegan and West Mountain areas in perspective. However, comparing results from two separate years is of limited use since annual variations in owl numbers may be pronounced (Francis and Bradstreet 1998). Years of data would be required to determine how the study area truly compares to other regions in terms of owl abundance. Efficient and thorough performance of future surveys will depend, in part, on an understanding of whether and how owl vocal behavior varies between months.

Effects of Sampling Period of Detection Frequency

Among owls, investment in mate attraction, pairbonding, and territorial defense varies with seasonal changes in breeding status. Vocalization rates may vary, in turn. The use of audioplayback to elicit responses from non-vocalizing birds serves to moderate the influence of season on survey results (Falls 1981). Frequency of occurrence data, gathered for territorial birds along the same routes during the same breeding season, should reveal temporal differences in detectability, were they to exist in a given species. In this study, there was no difference between March and April frequency of occurrence for any of the detected owl species.

These preliminary results suggest that a single, two-week survey period may suffice for long-term monitoring of owl populations in northeastern Vermont. Local phenological data that might favor one month over the other are lacking for the three species in question. Such data would be

useful in refining the survey design. Continued investigation could also reveal whether climatic and moon-phase variables might have masked temporal differences in owl detectability during the pilot year. Meaningful evaluation of these factors would require a multivariate analysis of data gathered over several years.

Natural Community Survey

Results and Discussion

We observed 103 species in the study area during the breeding season, including 13 listed by the state of Vermont as rare or uncommon, of special concern, or endangered (Table 5). Twenty-one of the detected species appear on the Partners in Flight priority list for the Eastern Spruce-Hardwood Forest (Rosenberg and Hodgman 2000). In all, 30 of the 103 observed species (29%) are considered conservation priorities by the state and/or Partners in Flight. An additional state- and PIF-listed species, Bicknell's Thrush (*Catharus bicknelli*), was observed on Seneca and Gore Mountains, within 3 km of the study area.

Table 5. An alphabetical list of bird species observed during the 2000 breeding season in the Nulhegan Basin Division and the West Mountain Wildlife Management Area, organized by natural community occurrence.

Common Name	Scientific Name	NTMB	NBD	WMWMA	ASS	BMSMM	BSB	BSS	DSBPFIF	LSFF	MPBFF	NH	NWCS	RSNHF	SGSS	LCFC
Alder Flycatcher	*Empidonax alnorum*	x	x	x	x	x	x	r	x						x	
American Bittern RU	*Botaurus lentiginosus*			x					x							
American Black Duck	*Anas rubripes*			x					x						x	
American Crow	*Corvus brachyrhynchos*		x	x												
American Goldfinch	*Carduelis tristis*		x	x	x	x			x					x		
American Redstart	*Setophaga ruticilla*	x	x	x	x						x	x		x		
American Robin	*Turdus migratorius*		x		x				e	x		x	x	x		x
American Woodcock P	*Scolopax minor*		x	x												
Barn Swallow	*Hirundo rustica*	x		x												
Barred Owl	*Strix varia*		x	x												
Bay-breasted Warbler RU, P	*Dendroica castanea*	x	x	x						x						x
Belted Kingfisher P	*Ceryle alcyon*			x	x											
Black-and-White Warbler	*Mniotilta varia*	x	x	x	x			x			x	x	e	x		x
Black-backed Woodpecker SC	*Picoides arcticus*		x	x						x				x		x
Black-capped Chickadee	*Parus atricapillus*		x	x	x				x	x		x		x		x
Black-throated Blue Warbler P	*Dendroica caerulescens*	x	x	x						x	x	x		x		x
Black-throated Green Warbler P	*Dendroica virens*	x	x	x			x	x		x	x	x		x		x
Blackburnian Warbler P	*Dendroica fusca*	x	x	x	e		x	x		x	x			x		x
Blackpoll Warbler P	*Dendroica striata*	x	x	x				x			x					x
Blue Jay	*Cyanocitta cristata*		x	x			x	x		x			x	x		x
Blue-headed Vireo	*Vireo solitarius*	x	x	x			x	x	e	x	x		x	x		x
Boreal Chickadee P	*Parus hudsonicus*		x	x				x		x				x		x
Brown Creeper	*Certhia Americana*		x	x				x		x			x	x		x
Canada Goose	*Branta canadensis*		x	x					x							
Canada Warbler P	*Wilsonia canadensis*	x	x	x			x	x	e	x				x		x

Common Name	Scientific Name	NTMB	NBD	WMWMA	ASS	BMSMM	BSB	BSS	DSBPFIF	LSFF	MPBFF	NH	NWCS	RSNHF	SGSS	LCFC
Cedar Waxwing	*Bombycilla cedrorum*		x	x									x			x
Chestnut-sided Warbler	*Dendroica pennsylvanica*	x	x	x	x	e			x			e	x	x		x
Chimney Swift	*Chaetura pelagica*	x		x									x			x
Chipping Sparrow	*Spizella passerina*	x	x	x				r						x		r
Common Grackle	*Quiscalus quiscula*		x	x	x				x							
Common Loon E, P	*Gavia immer*		x	x												
Common Merganser	*Mergus merganser*			x												
Common Raven	*Corvus corax*		x	x	x			x								
Common Snipe	*Gallinago gallinago*		x	x			x		x				x			x
Common Yellowthroat	*Geothlypis trichas*	x	x	x	x	x	x	r	x	x			x		x	x
Cooper's Hawk SC	*Accipiter cooperii*		w													
Dark-eyed Junco	*Junco hyemalis*		x	x				x		x				x		x
Downy Woodpecker	*Picoides pubescens*		x	x						x			x			x
Eastern Kingbird	*Tyrannus tyrannus*	x		x					x							
Eastern Phoebe	*Sayornis phoebe*		x	x												
Eastern Wood Pewee P	*Contopus virens*	x	x	x								x		x		
Evening Grosbeak	*Coccothraustes vespertinus*		x	x						x						x
Golden-crowned Kinglet	*Regulus satrapa*		x	x	e		x	x		x				x		x
Gray Catbird	*Dumetella carolinensis*	x	x	x	x	e							x			x
Gray Jay SC	*Perisoreus canadensis*		x	w			x	x		x	x					x
Great Blue Heron RU	*Ardea herodias*		x	x												
Great Crested Flycatcher	*Myiarchus crinitus*	x	x													
Great Horned Owl	*Bubo virginianus*		x	x												
Green Heron	*Butorides striatus*			x												
Indigo Bunting	*Passerina cyanea*	x		x												
Hairy Woodpecker	*Picoides villosus*		x	x								x				
Hermit Thrush	*Catharus guttatus*		x	x			x	x		x	x	x		x		x
Hooded Merganser	*Lophodytes cucullatus*			x					x							
Least Flycatcher P	*Empidonax minimus*	x	x	x								x				
Lincoln's Sparrow	*Melospiza lincolnii*	x		x					x							
Magnolia Warbler	*Dendroica magnolia*	x	x	x	x		x	x	x	x	x		x	x		x
Mallard	*Anas platyrhynchos*		x			x										
Mourning Dove	*Zenaida macroura*		x	x									x	x		
Mourning Warbler	*Oporornis philadelphia*	x	x							x		e		x		x
Nashville Warbler P	*Vermivora ruficapilla*	x	x	x	x	x	x	x	x	x				x		x
Northern Flicker	*Colaptes auratus*		x	x				x	x					x		x
Northern Goshawk	*Accipiter gentilis*			x										x		
Northern Parula P	*Parula americana*	x	x	x	x		x	x		x			x	x		x
Northern Saw-whet Owl	*Aegolius acadicus*		x	x												
Northern Waterthrush	*Seiurus noveboracensis*	x	x	x	x	e	x	x	x	e			x	x		x
Olive-sided Flycatcher P	*Contopus borealis*	x	x	x			x	x					x			x
Osprey E, P	*Pandion haliaetus*		x	x												
Ovenbird	*Seiurus aurocapillus*	x	x	x						x		x		x		x
Palm Warbler	*Dendroica palmarum*	x	x				x	x	x							x
Philadelphia Vireo RU	*Vireo philadelphicus*	x	x													

Common Name	Scientific Name	NTMB	NBD	WMWMA	ASS	BMSMM	BSB	BSS	DSBPFIF	LSFF	MPBFF	NH	NWCS	RSNHF	SGSS	LCFC
Pied-billed Grebe SC	*Podilymbus podiceps*			x					x							
Pileated Woodpecker	*Dryocopus pileatus*		x	x						x		x				x
Purple Finch P	*Carpodacus purpureus*		x	x			x	x		x	x			x		x
Red-breasted Nuthatch	*Sitta Canadensis*		x	x			x	x		x				x		x
Red-eyed Vireo	*Vireo olivaceus*	x	x	x	x		x		x	x		x		x		x
Red-tailed Hawk	*Buteo jamaicensis*		x	w												
Red-winged Blackbird	*Agelaius phoeniceus*		x	x	x	x			x				x		x	x
Ring-necked Duck	*Aythya collaris*			x					x							
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x	x													
Ruby-crowned Kinglet	*Regulus calendula*		x	x	x	x	x	x	x	x			e			x
Ruby-throated Hummingbird	*Archilochus colubris*	x	x	x										x		
Ruffed Grouse P	*Bonasa umbellus*		x	x				x								
Rusty Blackbird SC	*Euphagus carolinus*		x	x	x	x		x	x				x			x
Scarlet Tanager	*Piranga olivacea*	x	x	x								x		x		
Sharp-shinned Hawk	*Accipiter striatus*		x					x								x
Song Sparrow	*Melospiza melodia*		x	x	x				x							
Spotted Sandpiper	*Actitis macularia*		w													
Spruce Grouse E, P	*Dendragapus canadensis*		x	w			x			x						x
Swainson's Thrush	*Catharus ustulatus*	x	x	x			x	x		x	x	x				x
Swamp Sparrow	*Melospiza georgiana*		x	x	x	x			x				x		x	x
Tree Swallow	*Tachycineta bicolor*		x	x	x	x			x				x			x
Turkey Vulture RU	*Cathartes aura*			x												
Veery P	*Catharus fuscescens*	x	x	x	x			x	e			x		x		x
Warbling Vireo	*Vireo gilvus*	x	x	x										x		
White-breasted Nuthatch	*Sitta carolinensis*			x								x				
White-throated Sparrow	*Zonotrichia albicollis*		x	x	x		x	x	x	x	x		x	x	x	x
White-winged Crossbill	*Loxia leucoptera*		x	x				x								x
Wild Turkey	*Meleagris gallopavo*		x	x												
Willow Flycatcher	*Empidonax traillii*	x	w		x											
Winter Wren	*Troglodytes troglodytes*		x	x	x		x	x	e	x	x	x	x	x	x	x
Wood Duck	*Aix sponsa*			x												
Yellow Warbler	*Dendroica petechia*	x	w	x	x											
Yellow-bellied Flycatcher	*Empidonax flaviventris*	x	x	x			x	x	x	x			x	x		x
Yellow-bellied Sapsucker P	*Sphyrapicus varius*		x	x	x			x	x	e		x		x		x
Yellow-rumped Warbler	*Dendroica coronata*		x	x	x		x	x	x	x	x		x	x		x

Column Headings

NTMB – Neotropical Migratory Bird
NBD - Nulhegan Basin Division
WMWMA – West Mountain WMA
ASS – Alluvial Shrub Swamp
BMSMM - Beaver Meadow/Sedge Meadow/Marsh
BSB - Black Spruce Bog
BSS - Black Spruce Swamp
DSBPFIF - Dwarf Shrub Bog/Poor Fen/Intermediate Fen
LSFF - Lowland Spruce-Fir Forest
MPBFF - Montane Paper Birch-Fir Forest
NH – Northern Hardwoods
NWCS – Northern White Cedar Swamp
RSNHF - Red Spruce Northern Hardwood Forest
SGSS – Sweet Gale Shoreline Swamp
LCFC – Lowland Conifer Forest Complex

Cell Contents
E – listed by the state of Vermont as endangered (category established by law)
T – listed by the state as threatened (category established by law)
SC – listed by the state as a species of special concern (informational category)
RU – listed by the state as rare or uncommon (informational categories)
P – Partners in Flight priority species for Physiographic Area 28
x– observed in designated area or natural community
x– observed in designated natural community during a primary point count
w – observed in adjacent portion of the Wenlock WMA
r - observed in regenerating harvest block of designated natural community
e – observed at edge of designated natural community

Note: species not associated with a natural community were either detected flying over the area, in an unidentified natural community, along roads, or in recently harvested forests

The area's avifauna includes natural community generalists and natural community specialists. Primary point count results show that 16 species occurred in 5 or more natural community types (lowland conifer forest complex excluded to avoid redundancy). Almost half of the 16 generalists (7) were among the most frequently encountered in 3 or more natural community types. All members of this group are conifer-forest associates: Blackburnian Warbler, Blue-headed Vireo, Golden-crowned Kinglet, Magnolia Warbler, Nashville Warbler, Yellow-bellied Flycatcher, and Yellow-rumped Warbler. While these species appeared to make little distinction among conifer forest types, six species with more northerly ranges showed greater selectivity. This group of rare Vermont breeders included: Bay-breasted Warbler, Black-backed Woodpecker, Boreal Chickadee, Gray Jay, Palm Warbler, and Spruce Grouse. These and 27 other species were detected during primary point counts in only one or two natural community types. Within the study area, they might be considered natural community specialists.

The list of observed species includes 39 neotropical migratory birds, including one not reported for Vermont in the state's atlas of breeding birds (Palm Warbler). This figure represents 75% of the total number of neotropical migrants appearing in a recent inventory of the Mahoosuc Rangely Lakes subsection of the Northern Appalachian/Boreal Forest Ecoregion (Anderson et al. 1998). Birds that winter in the tropics dominated the characteristic species lists for all upland forests. Three such lists were composed entirely of neotropical migrants, while the fourth contained a single, temperate zone migrant.

During primary point counts, lowland spruce-fir forests contained more species (31) than any other single natural community. This natural community type also featured the highest proportion of state- or PIF-listed species at 0.35. The entire complex of lowland conifer forests (lowland spruce-fir, northern white cedar swamp, black spruce swamp, and black spruce bog) harbored 52 species, 17 of which are state- and/or PIF-listed.

In the uplands, red spruce-northern hardwood forests contained the greatest diversity of birds, supporting both softwood and hardwood associates. Among non-forested wetlands, alluvial shrub swamps ranked high for diversity, while the dwarf shrub bog/poor fen/intermediate fen complex contained four species found in no other natural community type. Marshes and shoreline swamps contained the fewest species, with 6 observed in each, a partial reflection of relatively low sampling intensity in these small, isolated areas.

Appendix 1 contains results from all points surveyed within each natural community type, including secondary points located near management-related disturbance and points located near the transition zone between two natural community types. Unless otherwise specified, the following results and discussion pertain to primary point counts only.

Table 5. Natural community listing of ranked values for proportionate representation of state- and/or PIF-listed species (P), and Shannon's diversity index (H). Ranks appear in parentheses.

Natural Community Type	P	H
Lowland spruce-fir forest	0.35 (1)	2.18 (1)
Northern hardwoods	0.35 (1)	1.66 (5)
Red spruce-northern hardwood forest	0.32 (4)	1.76 (3)
Alluvial shrub swamp	0.16 (8)	2.06 (2)
Beaver meadow/sedge meadow/marsh	0.33 (3)	1.55 (7)
Black spruce swamp	0.30 (5)	1.66 (5)
Montane paper birch-fir forest	0.27 (7)	1.73 (4)
Black spruce bog	0.28 (6)	1.43 (8)
Dwarf shrub bog/poor fen/intermediate fen complex	0.15 (9)	1.23 (9)
Northern white cedar swamp	0.14 (10)	-
Sweet gale shoreline swamp	0.00 (11)	-

Alluvial Shrub Swamp

Alluvial shrub swamps contained 25 species, 4 of which appear on the PIF priority list (Table 6). The proportion of species that are listed (0.16) ranked eighth among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked second.

Characteristic species, counted in the 50-m circle at 20% or more of the stations, were: American Redstart, Red-eyed Vireo, Tree Swallow, Song Sparrow, Alder Flycatcher, Black-capped Chickadee, Northern Waterthrush, and Swamp Sparrow. Veeries, Chestnut-sided Warblers, and Common Yellowthroats all frequently occurred beyond 50 m in relatively high numbers. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included: Belted Kingfisher, Magnolia Warbler, Rusty Blackbird, Winter Wren, and Yellow-rumped Warbler.

Twenty-five neotropical migrants that are absent from these lists have been identified as potential breeders in alluvial shrub swamps (Anderson et al. 1998). *The Atlas of Breeding Birds of Vermont* (Laughlin and Kibbe 1985) and the *Atlas of Breeding Birds in New Hampshire* (Foss 1994) show 16 of the 25 to be inhabitants of the region. They are: Black-billed Cuckoo (*Coccyzus erythropthalmus*), Canada Warbler, Eastern Kingbird, House Wren (*Troglodytes aedon),* Least Flycatcher, Lincoln's Sparrow, Northern Rough-winged Swallow (*Stelgidopteryx serripennis),* Palm Warbler, Philadelphia Vireo, Rose-breasted Grosbeak, Ruby-throated Hummingbird, Tennessee Warbler (*Vermivora peregrina*), Warbling Vireo, Wilson's Warbler (*Wilsonia pusilla*), and Wood Thrush (*Hylocicla mustelina*).

Table 6. Frequency of occurrence and relative abundance of birds in alluvial shrub swamps (n = 6 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
American Redstart	0.67	0.67	0.67	0.83
Red-eyed Vireo	0.67	1.00	0.67	1.67
Tree Swallow	0.33	0.33	0.67	0.67
Song Sparrow	0.33	0.50	0.50	1.00
Alder Flycatcher	0.33	0.50	0.33	0.83
Black-capped Chickadee	0.33	0.33	0.33	0.50
Northern Waterthrush	0.33	0.50	0.33	0.50
Swamp Sparrow	0.33	0.67	0.33	1.00
American Goldfinch	0.17	0.17	0.33	0.33
Black-and-White Warbler	0.17	0.17	0.17	0.17
Chestnut-sided Warbler	0.17	0.67	0.17	0.83
Common Yellowthroat	0.17	0.83	0.17	1.00
Nashville Warbler *	0.17	0.17	0.17	0.17
Ruby-crowned Kinglet	0.17	0.17	0.17	0.17
Willow Flycatcher	0.17	0.17	0.17	0.17
American Robin	0.00	0.17	0.00	0.17
Common Grackle	0.00	0.17	0.00	0.17
Common Raven	0.00	0.17	0.00	0.17
Gray Catbird	0.00	0.17	0.00	0.17
Northern Parula *	0.00	0.17	0.00	0.17
Red-winged Blackbird	0.00	0.17	0.00	0.17
Veery *	0.00	0.67	0.00	1.00
White-throated Sparrow	0.00	0.17	0.00	0.17
Yellow Warbler	0.00	0.17	0.00	0.17
Yellow-bellied Sapsucker *	0.00	0.17	0.00	0.17

Beaver Meadow/Sedge Meadow/Marsh Complex

Only 6 species were counted at the four stations representing this complex (Table 7). The proportion of species identified as conservation priorities (0.33) ranked third among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked seventh.

The five characteristic species were: Red-winged Blackbird, Rusty Blackbird, Nashville Warbler, Swamp Sparrow, and Tree Swallow. Alder Flycatchers were common in the shrubs surrounding these openings. Chestnut-sided Warblers, Gray Catbirds, and Northern Waterthrushes also occupied this transition zone. At one survey point, I observed a Mallard in the open water. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included American Goldfinch and Ruby-crowned Kinglet.

Table 7. Frequency of occurrence and relative abundance of birds in the beaver meadow/sedge meadow/marsh complex (n = 4 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Red-winged Blackbird	0.25	0.25	0.50	0.50
Rusty Blackbird *	0.25	0.25	0.50	0.50
Nashville Warbler *	0.25	0.25	0.25	0.25
Swamp Sparrow	0.25	0.25	0.25	0.25
Tree Swallow	0.25	0.25	0.25	0.25
Common Yellowthroat	0.00	0.25	0.00	0.25

Anderson et al. (1998) associated Lincoln's Sparrow with tussock sedge meadows and Mourning Warblers with cattail marshes in the Connecticut River Watershed. Loso et al. (1996) reported marsh/wet meadow nesting by Great Blue Heron, Black-backed Woodpecker, Hairy Woodpecker, Northern Parula, and Common Grackle on the McConnell Tract, a Conservation Fund property that abuts the Nulhegan Basin Division. They also encountered Chimney Swift and Northern Flicker in this natural community type.

Black Spruce Bog

Black spruce bogs contained 18 species, including 5 state- and/or PIF-listed birds (Table 8). The proportion of species that are listed (0.28) ranked sixth among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked eighth.

The characteristic species were: Nashville Warbler, Yellow-bellied Flycatcher, Golden-crowned Kinglet, Blue-headed Vireo, White-throated Sparrow, and Yellow-rumped Warbler. Of these six species, all but the White-throated Sparrow were also characteristic of two or more other natural community types. Though infrequently detected within 50 m of the point count stations, Hermit Thrushes, Magnolia Warblers, and Northern Parulas also occurred in black spruce bogs in relatively high numbers. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included: Alder Flycatcher, Black-throated Green Warbler, Blue Jay, Canada Warbler, Common Snipe, Northern Waterthrush, Olive-sided Flycatcher, Purple Finch, and Red-breasted Nuthatch.

Other potential members of the black spruce bog bird community include Gray Catbird, Lincoln's Sparrow and six warbler species: Palm, Tennessee, Wilson's, Bay-breasted, Black-and-White, and Mourning (Anderson et al. 1998).

Table 8. Frequency of occurrence and relative abundance of birds in black spruce bogs (n = 6 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Nashville Warbler *	0.67	1.00	0.67	2.00
Yellow-bellied Flycatcher	0.50	1.00	0.67	1.83
Golden-crowned Kinglet	0.50	0.83	0.50	0.83
Blue-headed Vireo	0.33	0.67	0.33	0.67
White-throated Sparrow	0.33	0.67	0.33	0.83
Yellow-rumped Warbler	0.33	0.67	0.33	0.67
Blackburnian Warbler *	0.17	0.33	0.17	0.33
Hermit Thrush	0.17	0.83	0.17	1.17
Northern Parula *	0.17	0.50	0.17	0.50
Common Yellowthroat	0.00	0.17	0.00	0.17
Gray Jay *	0.00	0.17	0.00	0.17
Magnolia Warbler	0.00	0.50	0.00	0.50
Palm Warbler	0.00	0.17	0.00	0.17
Red-eyed Vireo	0.00	0.17	0.00	0.17
Ruby-crowned Kinglet	0.00	0.17	0.00	0.17
Spruce Grouse *	0.00	0.17	0.00	0.17
Swainson's Thrush	0.00	0.33	0.00	0.33
Winter Wren	0.00	0.17	0.00	0.17

Black Spruce Swamp

Black spruce swamps contained 20 species, including 6 identified as species of conservation concern (Table 9). The proportion of listed species (0.30) ranked fifth among the 11 natural community types. The bird community's Shannon diversity index ranked fifth, as well.

Two priority species, Nashville Warbler and Blackpoll Warbler, were among the most characteristic of this natural community. Other characteristic species were: Golden-crowned Kinglet, Yellow-bellied Flycatcher, Brown Creeper, Blue-headed Vireo, Magnolia Warbler, Northern Waterthrush, and Yellow-rumped Warbler. In harvested areas, regenerating black spruce swamps contained 5 species not detected in mature stands: Common Yellow-throat, Palm Warbler, Ruby-crowned Kinglet, Alder Flycatcher, and Chipping Sparrow. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included: Black-throated Green Warbler, Boreal Chickadee, Common Raven, Dark-eyed Junco, Gray Jay, Olive-sided Flycatcher, Purple Finch, Red-breasted Nuthatch, Ruffed Grouse, Sharp-shinned Hawk, White-winged Crossbill, and Yellow-bellied Sapsucker.

Additional species found in softwood swamps on the McConnell Tract include: Pileated Woodpecker, Hermit Thrush, Cedar Waxwing, and Pine Siskin (*Carduelis pinus*) (Loso et al. 1996).

Table 9. Frequency of occurrence and relative abundance of birds in black spruce swamps (n = 8 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Golden-crowned Kinglet	0.75	0.75	0.75	0.75
Yellow-bellied Flycatcher	0.50	0.63	0.75	1.13
Nashville Warbler *	0.38	0.50	0.38	0.75
Blackpoll Warbler *	0.25	0.25	0.38	0.38
Brown Creeper	0.25	0.25	0.38	0.38
Blue-headed Vireo	0.25	0.38	0.25	0.38
Magnolia Warbler	0.25	0.63	0.25	0.63
Northern Waterthrush	0.25	0.25	0.25	0.25
Yellow-rumped Warbler	0.25	0.63	0.25	0.63
Black-and-White Warbler	0.13	0.13	0.13	0.13
Blackburnian Warbler *	0.13	0.13	0.13	0.13
Canada Warbler *	0.13	0.25	0.13	0.25
Hermit Thrush	0.13	0.50	0.13	0.75
Northern Parula *	0.13	0.13	0.13	0.13
Rusty Blackbird *	0.13	0.13	0.13	0.13
White-throated Sparrow	0.13	0.38	0.13	0.50
Winter Wren	0.13	0.25	0.13	0.50
Blue Jay	0.00	0.38	0.00	0.38
Northern Flicker	0.00	0.13	0.00	0.13
Swainson's Thrush	0.00	0.50	0.00	0.50

Dwarf Shrub Bog/Poor Fen/Intermediate Fen Complex

The dwarf shrub bog/poor fen/intermediate fen complex contained 20 species, 3 of them listed by the state and/or PIF (Table 10). The proportion of listed species (0.15) ranked ninth among the 11 natural community types. The bird community's Shannon diversity index also ranked ninth.

One species characteristic of this natural community, Lincoln's Sparrow, occurred in no other natural community. The two other characteristic species, Swamp Sparrow and Common Yellowthroat, were associated with a wide variety of wetland types. American Bitterns and Pied-billed Grebes, though not detected during point counts, were regularly and exclusively observed near points located in this complex. Species occupying the shrubby margins included Alder Flycatcher, Common Yellowthroat, Veery, Winter Wren, and Canada Warbler. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included: Chestnut-sided Warbler, Common Grackle, Eastern Kingbird, Palm Warbler, and Red-eyed Vireo. At Dennis Pond, Ospreys were observed soaring over the open water, which contained American Black Duck, Canada Goose, Ring-necked Duck, and Hooded Merganser. This species was not observed elsewhere in the study area.

A list of neotropical migrants that utilize leatherleaf bogs, presented by Anderson et al. (1998), includes seven species not found in dwarf shrub bogs during this investigation:

Tennessee Warbler, Wilson's Warbler, Black-and-White Warbler, Gray Catbird, Mourning Warbler, Northern Parula, and Olive-sided Flycatcher (Anderson et al. 1998).

Table 10. Frequency of occurrence and relative abundance of birds in the dwarf shrub bog/poor fen/intermediate fen complex (n = 10 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Lincoln's Sparrow	0.40	0.50	0.40	0.90
Swamp Sparrow	0.30	0.50	0.60	1.10
Common Yellowthroat	0.20	0.50	0.20	0.90
White-throated Sparrow	0.10	0.20	0.20	0.50
American Goldfinch	0.10	0.20	0.10	0.30
Common Snipe	0.10	0.20	0.10	0.20
Magnolia Warbler	0.10	0.10	0.10	0.10
Nashville Warbler *	0.10	0.20	0.10	0.30
Red-winged Blackbird	0.10	0.20	0.10	0.50
Rusty Blackbird *	0.10	0.10	0.10	0.10
Song Sparrow	0.10	0.30	0.10	0.30
Alder Flycatcher	0.00	0.10	0.00	0.10
Black-capped Chickadee	0.00	0.10	0.00	0.10
Northern Flicker	0.00	0.10	0.00	0.10
Northern Waterthrush	0.00	0.20	0.00	0.30
Ruby-crowned Kinglet	0.00	0.10	0.00	0.10
Tree Swallow	0.00	0.10	0.00	0.20
Yellow-bellied Flycatcher	0.00	0.10	0.00	0.10
Yellow-bellied Sapsucker *	0.00	0.10	0.00	0.10
Yellow-rumped Warbler	0.00	0.10	0.00	0.20

Lowland Spruce-fir Forest

Lowland spruce-fir forests contained 31 species, including 11 that appear on state and/or PIF priority lists (Table 11). The proportion of listed species (0.35) ranked first, in a tie with northern hardwood forests, among the 11 natural community types. The bird community's Shannon diversity index ranked first, as well. Relative to other natural community types, the bird conservation value of lowland spruce-fir forests during the breeding season is exceptionally high.

Nine birds are characteristic of this community, including three priority species: Bay-breasted Warbler, Northern Parula, and Blackburnian Warbler. The remaining six also characterize the closely related black spruce swamp. These are Yellow-rumped Warbler, Golden-crowned Kinglet, Magnolia Warbler, Blue-headed Vireo, Brown Creeper, and Yellow-bellied Flycatcher. Winter Wrens and White-throated Sparrows are common in this community, as well. The lowland spruce-fir species list contains an unusually large number of boreal birds considered "specialties" by recreational bird-watchers. This highly prized group includes: Bay-breasted Warbler, Gray Jay, Black-backed Woodpecker, Boreal Chickadee, and Spruce Grouse. Additional species detected between point counts, during area searches, or in secondary sites

within this natural community included: American Robin, Black-capped Chickadee, Canada Warbler, and Dark-eyed Junco. Yellow-bellied Sapsucker and Northern Waterthrush appeared at the open/shrubby wetland edge of lowland spruce-fir

Table 11. Frequency of occurrence and relative abundance of birds in lowland spruce-fir forests (n = 9 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Yellow-rumped Warbler	0.78	0.78	1.00	1.11
Golden-crowned Kinglet	0.56	0.67	0.56	0.67
Magnolia Warbler	0.44	0.56	0.44	0.67
Blue-headed Vireo	0.33	0.56	0.44	0.78
Brown Creeper	0.33	0.44	0.33	0.44
Northern Parula *	0.33	0.44	0.33	0.44
Yellow-bellied Flycatcher	0.33	0.78	0.33	0.78
Bay-breasted Warbler *	0.22	0.22	0.22	0.22
Blackburnian Warbler *	0.22	0.22	0.22	0.22
Gray Jay *	0.11	0.33	0.33	0.56
Black-backed Woodpecker *	0.11	0.11	0.22	0.22
Purple Finch *	0.11	0.11	0.22	0.22
Black-throated Blue Warbler *	0.11	0.11	0.11	0.11
Blue Jay	0.11	0.44	0.11	0.56
Common Yellowthroat	0.11	0.11	0.11	0.11
Downy Woodpecker	0.11	0.11	0.11	0.11
Hermit Thrush	0.11	0.33	0.11	0.33
Mourning Warbler	0.11	0.11	0.11	0.11
Nashville Warbler *	0.11	0.33	0.11	0.33
Ovenbird	0.11	0.11	0.11	0.11
Red-eyed Vireo	0.11	0.11	0.11	0.11
Ruby-crowned Kinglet	0.11	0.22	0.11	0.22
Swainson's Thrush	0.11	0.33	0.11	0.33
Winter Wren	0.11	0.78	0.11	0.78
Black-throated Green Warbler *	0.00	0.22	0.00	0.22
Boreal Chickadee *	0.00	0.11	0.00	0.11
Evening Grosbeak	0.00	0.22	0.00	0.33
Pileated Woodpecker	0.00	0.11	0.00	0.11
Red-breasted Nuthatch	0.00	0.33	0.00	0.33
Spruce Grouse *	0.00	0.11	0.00	0.11
White-throated Sparrow	0.00	0.67	0.00	0.89

Montane Paper Birch-fir Forest

This forest type was represented by a single West Mountain site, which was surveyed on a drizzly morning. It contained 11 species, 3 of which are PIF-listed (Table 12). The proportion

of species that are listed (0.27) ranked seventh among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked fourth.

Table 12. Frequency of occurrence and relative abundance of birds in a montane birch-fir forest (n = 4 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Magnolia Warbler	0.50	0.50	0.50	0.50
Yellow-rumped Warbler	0.50	0.75	0.50	1.00
Black-and-White Warbler	0.25	0.25	0.25	0.25
Black-throated Green Warbler *	0.25	0.25	0.25	0.25
Blackburnian Warbler *	0.25	0.25	0.25	0.25
Blue-headed Vireo	0.25	0.50	0.25	0.50
Black-throated Blue Warbler *	0.00	0.25	0.00	0.25
Hermit Thrush	0.00	0.25	0.00	0.25
Swainson's Thrush	0.00	0.25	0.00	0.25
White-throated Sparrow	0.00	0.25	0.00	0.50
Winter Wren	0.00	0.25	0.00	0.25

Five out of six characteristic species were neotropical migrants: Magnolia Warbler, Black-and-White Warbler, Black-throated Green Warbler, BlackburnianWarbler, and Blue-headed Vireo. The sixth characteristic species, Yellow-rumped Warbler, is primarily a temperate zone migrant, though it winters as far south as Panama. Between listening stations, I observed an American Redstart. On a visit to a degraded example of this forest type on Lewis Mountain, I encountered several Blackpoll Warblers, two Gray Jays, and a Purple Finch.

Rimmer and McFarland (2000) list nine additional species as common members of Vermont's montane forest bird community. They are: Red-breasted Nuthatch, Brown Creeper, Golden-crowned Kinglet, Swainson's Thrush, American Robin, Nashville Warbler, White-throated Sparrow, Dark-eyed Junco, and Bicknell's Thrush. Although there does not appear to be suitable Bicknell's Thrush habitat in the study area, this species of special management concern was observed on two nearby mountains (Gore and Seneca) in June of 2000.

Northern Hardwoods

Northern hardwoods contained 17 species, 6 of which are PIF-listed (Table 13). The proportion of species that are listed (0.35) ranked first in a tie with lowland spruce-fir forests among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked fifth.

The characteristic species were all neotropical migrants: Red-eyed Vireo, American Redstart, and Black-throated Blue Warbler. Ovenbirds and Black-throated Green Warblers frequently occurred beyond 50 m in relatively high numbers. Additional species detected between point counts, during area searches, or in secondary sites within this natural community type included Black-and-White Warbler and Hairy Woodpecker. Hairy Woodpecker and Least Flycatcher occurred in no other natural community type. One small, northern hardwood canopy gap, formed by a selective harvest, contained a Mourning Warbler and a Chestnut-sided Warbler.

Table 13. Frequency of occurrence and relative abundance of birds in northern hardwoods (n = 13 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Red-eyed Vireo	0.69	0.92	0.77	2.23
American Redstart	0.38	0.69	0.62	1.00
Black-throated Blue Warbler *	0.31	0.54	0.31	0.69
Ovenbird	0.15	0.62	0.15	0.69
Black-throated Green Warbler *	0.08	0.85	0.08	1.46
Least Flycatcher *	0.08	0.15	0.08	0.23
Pileated Woodpecker	0.08	0.08	0.08	0.08
Veery *	0.08	0.15	0.08	0.15
White-breasted Nuthatch	0.08	0.08	0.08	0.08
Yellow-bellied Sapsucker *	0.08	0.08	0.08	0.15
American Robin	0.00	0.08	0.00	0.08
Black-capped Chickadee	0.00	0.08	0.00	0.08
Eastern Wood Pewee *	0.00	0.08	0.00	0.08
Hermit Thrush	0.00	0.23	0.00	0.23
Scarlet Tanager	0.00	0.15	0.00	0.15
Swainson's Thrush	0.00	0.08	0.00	0.08
Winter Wren	0.00	0.08	0.00	0.08

This mature, northern hardwood association corresponds closely with previous research conducted in Vermont (Thompson and Capen 1988), New Hampshire (Holmes and Sherry 1988), and Maine (Hagan et al. 1997). However, the conspicuous absence of Wood Thrush and Rose-breasted Grosbeak from our list indicates the need for further investigation of this natural community type in the study area.

Northern White Cedar Swamp

Northern white cedar swamps contained 21 species, 3 of which are state- and/or PIF-listed (Table 14). The proportion of species that are listed (0.14) ranked tenth among the eleven natural communities surveyed.

Due to the low number of survey points in this community type (3), I have not identified characteristic species. However, Swamp Sparrow, Common Yellowthroat, Magnolia Warbler, and Northern Waterthrush were among the most widespread and abundant. Two species detected at the edge of cedar swamps were Black-and-White Warbler, and Ruby-crowned Kinglet. I also observed Blue-headed Vireo, Mourning Dove, and Chimney Swift between point counts.

A more extensive bird survey of northern white cedar swamps elsewhere in Vermont found five additional neotropical migrants in relatively high numbers. They were: Canada Warbler, Nashville Warbler, Swainson's Thrush, Veery, and Hermit Thrush (Sorenson et al. 1998). The same survey turned up the state- and PIF-listed Cape May Warbler (*Dendroica tigrina*), a species identified as a cedar swamp associate by Anderson et al. (1998).

Table 14. Frequency of occurrence and relative abundance of birds in northern white cedar swamps (n = 3 points). Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Swamp Sparrow	1.00	1.00	1.33	1.67
Common Yellowthroat	1.00	1.33	1.00	1.33
Magnolia Warbler	0.67	0.67	0.67	0.67
Northern Waterthrush	0.67	0.67	0.67	1.00
White-throated Sparrow	0.33	0.67	0.67	1.33
Yellow-bellied Flycatcher	0.33	1.00	0.67	1.33
Yellow-rumped Warbler	0.33	0.33	0.67	0.67
Brown Creeper	0.33	0.33	0.33	0.33
Cedar Waxwing	0.33	0.33	0.33	1.00
Chestnut-sided Warbler	0.33	0.33	0.33	0.33
Common Snipe	0.33	0.67	0.33	0.67
Downy Woodpecker	0.33	0.33	0.33	0.33
Gray Catbird	0.33	0.33	0.33	0.33
Northern Parula *	0.33	0.33	0.33	0.33
Red-winged Blackbird	0.33	0.33	0.33	0.33
Rusty Blackbird *	0.33	0.33	0.33	0.33
Tree Swallow	0.33	0.33	0.33	0.33
American Robin	0.00	0.67	0.00	0.67
Blue Jay	0.00	0.33	0.00	0.33
Olive-sided Flycatcher *	0.00	0.33	0.00	0.33
Winter Wren	0.00	0.33	0.00	0.33

Red Spruce Northern Hardwood Forest

Red spruce northern hardwood forests contained 25 species, 8 of which are of special management interest (Table 15). The proportion of species that are state- and/or PIF-listed (0.32) ranked fourth among the eleven natural communities surveyed. The bird community's Shannon diversity index ranked third.

A mix of deciduous- and conifer-forest associates make up the characteristic species list for red spruce-northern hardwood forests. Two of the species, Ovenbird and Black-throated Blue Warbler, were among the most common birds at northern hardwood point count stations. Four others, Yellow-bellied Flycatcher, Blackburnian Warbler, Northern Parula, and Yellow-rumped Warbler, appear on the characteristic species list for lowland spruce-fir forests. All six are neotropical migrants.

Black-throated Green Warblers and Red-breasted Nuthatches frequently occurred beyond 50 m in relatively high numbers. Additional species, detected between point counts, during area searches, or in secondary sites within this natural community, included: American Goldfinch, American Robin, Black-backed Woodpecker, Blue Jay, Boreal Chickadee, Chestnut-sided Warbler, Chipping Sparrow, Eastern Wood Pewee, Mourning Dove, Northern Flicker, Ruby-crowned Kinglet, Scarlet Tanager, Veery, Warbling Vireo, Northern Goshawk, and Ruby-

Sweet Gale Shoreline Swamp

I placed one survey station in a sweet gale shoreline swamp, bordering Wheeler Pond. Six species occurred in this natural community, none of them identified as conservation priorities (Table 6). The proportion of species that are listed (0) ranked last among the eleven natural communities surveyed. Relative to other natural community types, the bird conservation value of sweet gale shoreline swamps during the breeding season is low. All species but the Winter Wren were counted in both the alluvial shrub swamp and dwarf shrub bog/poor fen/intermediate fen complex. Winter Wrens occurred in eight other natural community types.

Table 16. Frequency of occurrence and relative abundance of birds in a sweet gale shoreline swamp (n = 13 points).

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Red-winged Blackbird	1.00	1.00	4.00	5.00
Common Yellowthroat	1.00	1.00	2.00	2.00
Swamp Sparrow	1.00	1.00	2.00	3.00
Alder Flycatcher	1.00	1.00	1.00	1.00
Northern Waterthrush	0.00	1.00	0.00	1.00
Winter Wren	0.00	1.00	0.00	1.00

Lowland Conifer Forest Complex

I combined the lowland conifer forest types (black spruce bog, black spruce swamp, lowland spruce-fir forest, and northern white cedar swamp) into a single complex for three main reasons. First, these natural communities contained many of the same bird species. Second, as a group, they best represent the boreal qualities that distinguish the study area from nearly all other areas in the state. Finally, grouping them provides land managers with an efficient means of identifying outstanding bird habitat. Unlike individual communities, whose boundaries may be subtle and difficult to discern, the lowland conifer forest complex can be readily and inexpensively identified using just a few GIS coverages.

We detected 46 species in the lowland conifer forest complex during primary point counts (Table 17), plus 6 more at other times (Table 5). The sum (52) represents 50% of the total number of species observed in the study area in 2000. One-third of the lowland conifer bird community (17 species) appears on state and/or PIF priority lists. Species characteristic of the lowland conifer forest complex were: Golden-crowned Kinglet, Yellow-rumped Warbler, Yellow-bellied Flycatcher, Magnolia Warbler, Nashville Warbler, Blue-headed Vireo, Brown Creeper, and Northern Parula.

The single June sighting of a White-winged Crossbill, made in a black spruce swamp, does not adequately represent the importance of lowland conifer forests to this unusual species. White-winged Crossbills are nomadic birds that breed when and where they encounter an abundant cone crop (Benkman 1990). The study area's bumper yield in 2000 drew congregations of this bird, but not until after the close of the sampling period. During July, White-winged Crossbills flocked in large numbers throughout the lowland conifer forests, particularly in the Nulhegan Basin (B. Engstrom, pers. comm.).

throated Hummingbird. Northern Goshawk and Ruby-throated Hummingbird were observed in no other natural community.

This description of the red spruce-northern hardwood bird community is largely consistent with those generated by other investigators in northern New England mixedwood forests (e.g. Thompson and Capen 1988, Hagan and Grove 1999). Swainson's Thrush appears to be the only notable exception. Hagan and Grove (1999) found this species in low numbers in mixed forests of central Maine and in relatively high numbers in mixed forests of northern Maine. In our study, Swainson's Thrushes were absent from red spruce-northern hardwoods and were concentrated in distinctly boreal habitats. These findings suggest that the probability of detecting Swainson's Thrush in mixed forests increases with latitude, perhaps due to a corresponding increase in the importance of conifer.

Table 15. Frequency of occurrence and relative abundance of birds in red spruce-northern hardwood forests (n = 7 points). Bold type designates characteristic species. Asterisks designate priority species.

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Ovenbird	0.43	0.86	0.57	1.29
Yellow-bellied Flycatcher	0.29	0.57	0.43	0.86
Black-throated Blue Warbler *	0.29	0.43	0.29	0.57
Blackburnian Warbler *	0.29	0.43	0.29	0.57
Northern Parula *	0.29	0.57	0.29	0.57
Yellow-rumped Warbler	0.29	0.43	0.29	0.43
Golden-crowned Kinglet	0.14	0.14	0.29	0.29
American Redstart	0.14	0.14	0.14	0.14
Black-and-White Warbler	0.14	0.29	0.14	0.29
Black-throated Green Warbler *	0.14	0.71	0.14	0.86
Brown Creeper	0.14	0.14	0.14	0.14
Canada Warbler *	0.14	0.14	0.14	0.29
Magnolia Warbler	0.14	0.43	0.14	0.43
Purple Finch *	0.14	0.14	0.14	0.14
Red-eyed Vireo	0.14	0.43	0.14	0.57
Yellow-bellied Sapsucker *	0.14	0.29	0.14	0.29
Black-capped Chickadee	0.00	0.43	0.00	0.43
Blue-headed Vireo	0.00	0.43	0.00	0.57
Dark-eyed Junco	0.00	0.29	0.00	0.29
Hermit Thrush	0.00	0.43	0.00	0.43
Mourning Warbler	0.00	0.14	0.00	0.29
Nashville Warbler *	0.00	0.14	0.00	0.14
Red-breasted Nuthatch	0.00	0.57	0.00	0.71
White-throated Sparrow	0.00	0.29	0.00	0.29
Winter Wren	0.00	0.43	0.00	0.43

Table 17. Frequency of occurrence and relative abundance of birds in the lowland conifer forest complex (n = 26 points). Bold type designates characteristic species. Asterisks designate priority species.

Table 17. Frequency and relative abundance of birds in the lowland conifer forest complex (n = 26).

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Golden-crowned Kinglet	0.54	0.65	0.54	0.65
Yellow-rumped Warbler	0.46	0.65	0.58	0.81
Yellow-bellied Flycatcher	0.42	0.81	0.58	1.19
Magnolia Warbler	0.31	0.58	0.31	0.62
Nashville Warbler *	0.31	0.54	0.31	0.92
Blue-headed Vireo	0.27	0.46	0.31	0.54
Brown Creeper	0.23	0.27	0.27	0.31
Northern Parula *	0.23	0.35	0.23	0.35
White-throated Sparrow	0.15	0.58	0.19	0.81
Blackburnian Warbler *	0.15	0.19	0.15	0.19
Northern Waterthrush	0.15	0.15	0.15	0.19
Swamp Sparrow	0.12	0.12	0.15	0.19
Common Yellowthroat	0.12	0.19	0.12	0.23
Hermit Thrush	0.12	0.46	0.12	0.62
Blackpoll Warbler *	0.08	0.08	0.12	0.12
Bay-breasted Warbler *	0.08	0.08	0.08	0.08
Downy Woodpecker	0.08	0.08	0.08	0.08
Rusty Blackbird *	0.08	0.08	0.08	0.08
Winter Wren	0.08	0.42	0.08	0.50
Gray Jay *	0.04	0.15	0.12	0.23
Black-backed Woodpecker *	0.04	0.04	0.08	0.08
Purple Finch *	0.04	0.04	0.08	0.08
Black-and-white Warbler	0.04	0.04	0.04	0.04
Black-throated Blue Warbler *	0.04	0.04	0.04	0.04
Blue Jay	0.04	0.31	0.04	0.35
Canada Warbler *	0.04	0.08	0.04	0.08
Cedar Waxwing	0.04	0.04	0.04	0.12
Chestnut-sided Warbler	0.04	0.04	0.04	0.04
Common Snipe	0.04	0.08	0.04	0.08
Gray Catbird	0.04	0.04	0.04	0.04
Mourning Warbler	0.04	0.04	0.04	0.04
Ovenbird	0.04	0.04	0.04	0.04
Ruby-crowned Kinglet	0.04	0.12	0.04	0.12
Swainson's Thrush	0.04	0.35	0.04	0.35
Tree Swallow	0.04	0.04	0.04	0.04
American Robin	0.00	0.08	0.00	0.08
Black-throated Green Warbler *	0.00	0.08	0.00	0.08
Boreal Chickadee *	0.00	0.04	0.00	0.04
Evening Grosbeak	0.00	0.08	0.00	0.12
Northern Flicker	0.00	0.04	0.00	0.04
Olive-sided Flycatcher *	0.00	0.04	0.00	0.04
Palm Warbler	0.00	0.04	0.00	0.04
Pileated Woodpecker	0.00	0.04	0.00	0.04
Red-breasted Nuthatch	0.00	0.08	0.00	0.08
Red-eyed Vireo	0.00	0.12	0.00	0.12
Spruce Grouse *	0.00	0.08	0.00	0.08

As a whole, the lowland conifer bird community documented in this study closely resembles Maine's mature softwood avifauna, as reported by Hagan and Grove (1999). Their records, made over four years in study areas spanning close to 30 townships, included only six species not detected in the lowland conifers of the Nulhegan-West Mountain area. They were: Three-toed Woodpecker (*Picoides tridactylus*), Wilson's Warbler, Black-billed Cuckoo, Hairy Woodpecker, Philadelphia Vireo, and American Redstart. Most of these occurred at only 1 out of 50 points. The first two are exceedingly rare, if present at all as breeders in northeastern Vermont.

Priority Species Mapping

Appendix 6 contains preliminary distribution maps for all but one of the state- and/or PIF-listed species observed in the study area during 2000. The missing species, Philadelphia Vireo, was observed by a skilled volunteer somewhere along Stone Bridge Road. Of the mapped species, Nashville Warbler, Black-throated Green Warbler, and Black-throated Blue Warbler were most frequently observed with 41, 31, and 30 locations, respectively. At the other extreme, five non-vocal or secretive species were detected at two or fewer locations. These were: Great Blue Heron, Spruce Grouse, Turkey Vulture, Osprey, and Cooper's Hawk. For additional rare species locations, land stewards are referred to results from the Vermont Department of Fish and Wildlife's periodic Spruce Grouse survey and Weinhagen's thesis, "Nest-site selection by Black-backed Woodpeckers in Northeastern Vermont" (1998).

Management Considerations

Forest Management

Past timber management has altered the age, extent, connectivity, and composition of forests in the Nulhegan Basin-West Mountain region. Today's forests are younger and more fragmented than they were before the era of timber management. They also contain a lower proportion of softwoods, due to their replacement by hardwoods following harvest (Loso et al. 1996). These changes have played a major role in shaping the bird community that now exists in the study area. Results from other managed forests point to enduring effects of the area's historic land use.

Logging roads and regenerating clearcuts favor edge-dwelling and early successional species at the expense of birds that inhabit mature forests. Documented effects of timber activity on forest birds include: reduced abundance from habitat loss (Welsh and Healy 1993, Lent and Capen 1995, Hagan et al. 1997), avoidance of logging roads (Ortega and Capen 1999), low pairing success (Hagan et al. 1996), reduced brood density (Buford and Capen 1999), and reduced dispersal between isolated forest fragments (Schmiegelow et al. 1997). Research conducted in northern New Hampshire indicates that clearcut harvesting can also result in elevated nest predation in adjacent forests (King et al. 1996). This finding contradicts results from the boreal mixedwood of western Canada, where two separate studies found no effect of clearcut edge on artificial nest predation (Bayne and Hobson 1997, Cotterill 1996).

Only two of the 23 forest birds identified as conservation priorities exhibit preference for forests that are in the early stages of regeneration (Table 18). One of these, Nashville Warbler, was among the most frequently encountered birds in the study area. Nine priority species utilize sapling to pole-sized stands, most in combination with older forest types. Five from this group and five others occur in semi-open forests, in which partial cutting or natural disturbance has created structural heterogeneity.

Table18. Seral stage associations of forest-dwelling bird species identified as conservation priorities by the state of Vermont and/or Partners in Flight. An x designates preferred habitat.

Species	Regeneration to seedling	Sapling to pole-sized	Semi-open or disturbed forest	Intermediate age	Mature
American Woodcock	x	x			
Bay-breasted Warbler			x	x	x
Black-backed Woodpecker					x
Black-throated Blue Warbler			x	x	x
Black-throated Green Warbler				x	x
Blackburnian Warbler				x	x
Blackpoll Warbler		x		x	
Boreal Chickadee				x	x
Canada Warbler		x		x	x
Cooper's Hawk				x	x
Eastern Wood Pewee					x
Gray Jay					x
Least Flycatcher				x	x
Nashville Warbler	x	x	x		
Northern Parula			x		x
Olive-sided Flycatcher			x	x	x
Philadelphia Vireo		x	x	x	
Purple Finch			x	x	x
Ruffed Grouse		x	x	x	x
Rusty Blackbird		x	x	x	x
Spruce Grouse		x		x	
Veery		x	x	x	
Yellow-bellied Sapsucker				x	x
Totals	2	9	10	17	17

Designations are based primarily on DeGraaf et al (1992), Hagan and Grove (1999), and Thompson and Capen (1988); supporting information comes from Altman and Sallabanks (2000), Avery (1995), Boag and Schroeder (1992), Briskie (1994), Hunt and Eliason (1999), Moskoff (1995), Moskoff and Robinson (1996), Williams (1996), and Wootton (1996).

Most priority species that inhabit woodlands (74%) are associated with intermediate to mature forests. One species of special concern to the state, Black-backed Woodpecker, shows an almost exclusive preference for old-growth balsam fir forests in Newfoundland (Setteringtonton et al. 2000). In Essex County, Black-backed Woodpeckers choose nest sites where snag density and within-stand disturbance levels are high (Weinhagen 1998). These two features characterize old-growth spruce-fir forests in the Northeast (DeGraaf et al. 1992).

This analysis of habitat use by priority species supports previous investigations that have demonstrated the high conservation value of large forest reserves. Earlier studies have shown that extensive tracts of mature forest contain the highest number of rare birds (Robbins et al. 1989), as well as the greatest abundance and variety of area-sensitive (Askins et al. 1987,

Freemark and Collins 1989) and resident species (Freemark and Merriam 1986). Additional evidence indicates that a forest reserve's bird conservation value increases as it grows older. A study conducted in Finland's boreal forest found a positive relationship between breeding bird density and forest age (Helle 1985).

Restoration of large, continuous blocks of mature forest would considerably advance the bird protection goals expressed by the state of Vermont, the US Fish and Wildlife Service, and Partners in Flight. Restoration plans should give priority to lowland conifer and red spruce-northern hardwood forests, because of their importance to avian conservation and their historic replacement by regenerating hardwoods. The working forest that surrounds the Nulhegan Basin Division and the West Mountain WMA, and extends through northern New Hampshire and Maine, provides extensive habitat for most early and mid-successional species. Road and trail networks throughout the region ensure long-term availability of edge environments, as well. The landscape component at greatest risk in this matrix is unmanaged, late-successional forest.

Although restoration of lowland conifer forests is likely to achieve the greatest good for the most species of management concern, the compatibility of softwood maturation and Spruce Grouse conservation is uncertain. In the Nulhegan Basin, this state-endangered species prefers relatively young, dense spruce-fir stands with tree height under 15 m (Pence et al. 1990). Such forests historically succeeded fire (Boag and Schroeder 1992), outbreaks of spruce budworm (Kuceral and Orr 1990) and age-induced canopy breakup (DeGraaf et al. 1992). Recently cut conifer stands, where site conditions or harvest techniques have discouraged the establishment of hardwoods, have apparently provided suitable Spruce Grouse habitat through decades of timber management. Conifer recovery in harvested areas may continue to support Spruce Grouse for many years into the future. Eventually, forest senescence and the return of a natural disturbance regime to the area's softwoods may once again fully provide for the needs of this bird. However, in the absence of canopy breakup or significant natural disturbance, controlled burns or limited harvests could one day be warranted to support Vermont's isolated population. A combination of group selection and high-density shelterwood approaches may best simulate blowdown disturbance, while ensuring spruce-fir regeneration (DeGraaf et al. 1992).

Resolving the conflict between the needs of Spruce Grouse and other species of management concern requires further study. Future investigations should focus on the landscape components and disturbance agents that favor the reproduction and survival of Spruce Grouse in northern New England and adjacent Canadian provinces. Surveys conducted by the Vermont Department of Fish and Wildlife provide a strong, local foundation for this work. Demographic and genetic studies are also needed to shed light on the insular population's long-term viability.

Whether created by natural or prescribed disturbance, small forest openings are likely to benefit priority species, besides Spruce Grouse, that favor heterogeneous habitat structure. The most notable examples are Rusty Blackbird and Olive-sided Flycatcher. Compared to Spruce Grouse, however, these species are associated more with patchy structure than with young forest, per se. Because streams and non-forested wetlands form a structural mosaic throughout the area, prescriptive treatments should be based primarily on expected benefits to Spruce Grouse.

Even minimal canopy removal ($\leq$10%) can suppress productivity for interior forest birds (Buford and Capen 1999). Therefore, plans to support early-successional specialists should be administered with an aim to maintain the overall connectivity of mature forest. Land managers can adjust the shape, size, and spatial arrangement of forest treatments to minimize negative

impacts associated with edge creation. The low edge-to-area ratio of circular shapes makes them preferable to elongated or convoluted shapes (Forman 1995). The concentration of young forest treatments in more fragmented parts of the landscape further minimizes their effect on mature forest bids (Thompson et al. 1992). Beyond these general guidelines, the development of site-appropriate standards for size and configuration may take years of follow-up research. It will be especially challenging to balance the area and connectivity needs of Spruce Grouse and mature spruce-fir specialists like Gray Jay and Black-backed Woodpecker.

Riparian forests deserve special protection, as well, because they safeguard aquatic environments (Gregory et al. 1991) and support especially high levels of avian diversity and abundance (Gates and Giffen 1991, LaRue et al. 1995). Forested buffer strips facilitate avian dispersal (Machtans et al. 1996) and reduces songbird turnover in connected forest patches (Schmiegelow et al. 1997). Studies conducted throughout North American temperate forests show that the bird conservation value of riparian buffers increases substantially with width (Stauffer and Best 1980, Triquet et al. 1995, Darveau et al. 1995). A forested width of 100 m may represent a critical threshold for the conservation of area-sensitive species in predominantly forested landscapes (Lambert and Hannon 2000).

Road Management

Where roads follow the margins of lakes, streams, and wetlands, the quality of riparian habitat is already degraded. In these areas, roadway revegetation would benefit the native bird community. Road closure or the conversion of roads to trails would increase the extent and continuity of nesting and foraging habitat in a terrestrial zone that can be uniquely productive for birds. Converting upland roads may not benefit birds to the same degree. But even here, a reduced road network would enhance habitat connectivity for area-sensitive birds, while alleviating the threat of roadside nest predation. Finally, increasing the size of roadless areas would protect natural communities from sedimentation and exotic plant invasion (Trombulak and Frissell 2000). These two processes shape bird communities through gradual alteration of habitat structure and composition.

Public Use

The addition of the Nulhegan Basin Division and the West Mountain WMA to the system of federal and state conservation lands is expected to result in increased public use of these areas. Efforts to manage hunting, trapping, fishing, and wildlife observation should take into account potential effects on bird populations.

Hunting

Except for American Woodcock, Ruffed Grouse, and Wild Turkey, hunting is not expected to have a direct influence on terrestrial bird numbers. However, management of game habitat could have far-reaching effects on nongame birds. For this reason, plans to cut forest or maintain early successional habitat for game birds, white-tailed deer (*Odocoileus virginianus*), or moose (*Alces alces*) should specifically address compatibility with the conservation needs of forest-dependent species. A landscape-level perspective will further enable managers to strike an acceptable balance between the requirements of game and nongame animals. When viewed in the context of surrounding lands, which are managed under an active harvest regime, the need to restore late-successional habitat becomes clear.

Mature conifer forests in the Nulhegan Basin are not only important to regional bird conservation, they also play a vital role in the management of the region's deer population. The Basin contains the largest deer wintering area in the state. Each year, deer throughout the region leave mixed and deciduous forests to congregate beneath the thermal cover provided by the Nulhegan's mature softwoods. Their dependence on lowland conifer forests presents an exceptional opportunity to coordinate game and nongame management programs. The recovery of recently logged portions of this area should benefit both deer and birds.

Trapping

Trapping will influence bird populations indirectly, through the regulation of beaver numbers. Changes in water levels and flow rates associated with beaver activity govern the plant communities that, in turn, underlie patterns of bird distribution and abundance. Trapping policies that maintain existing wetland structure will best sustain the bird communities documented by this study in marshes, fens, and shrub swamps.

Fishing

Management of fishing activity may also be designed to support the area's native bird life. Poisonous lead sinkers, which can be ingested accidentally by ducks, geese, Belted Kingfishers, and Common Loons, pose a serious health risk to these birds. In New England, lead sinker ingestion accounts for more than half of all adult loon mortality (Pokras and Chafel 1992). Abandoned fishing line also endangers water birds through the risk of entanglement. Informative signs, posted at points of open-water access, would reduce these threats. Fishing parties should also have opportunities to exchange their lead sinkers for non-lead alternatives at boat landings and information centers. The construction, maintenance, and protective signage of nesting platforms for loons will also help protect this state-endangered bird. Finally, boating access to water bodies should be provided for in a manner that protects as much shoreline as possible. Shoreline protection benefits loons and other water birds, passerines that utilize riparian areas, and other groups of wildlife.

Wildlife-viewing

The Nulhegan and West Mountain lands have been a destination for bird-watchers since long before they were conserved. No other area in Vermont provides comparable opportunities to view boreal bird species. Increased attention focused on the two properties promises to raise the level of wildlife-viewing traffic. The establishment of a wildlife sighting report system would provide land managers with useful information concerning the occurrence and distribution of species, avian and otherwise. Despite the value of the wildlife-watching community as an informational resource, increased foot and vehicular traffic could compromise the integrity of critical breeding areas. Repeated encroachment on nest sites represents the primary threat. For this reason, discretion should be exercised in the public identification of sensitive breeding areas. Land managers might consider board walks and observation platforms as precautionary measures to minimize impacts in easily accessible and popular areas. This strategy has already been effectively employed in Mollie Beattie Bog. Barring roads to unauthorized vehicular traffic represents another means of protecting critical habitat from being degraded by high visitation.

Future Research and Monitoring

Management plans for the Nulhegan Basin Division and the West Mountain WMA must integrate current knowledge of the area's bird life in order to achieve stated conservation

objectives. Ongoing stewardship should respond to necessary developments in this understanding. Continued study of the area's bird life will accomplish three objectives: improvement of species lists and distribution maps, measurement of bird population trends, and assessment of management strategies. Each of these areas deserves individual attention.

The species lists and distribution maps produced in the survey's first year are incomplete due to the temporal and geographic constraints of the survey design. A four-season bird inventory conducted between 1996 and 1999 on forest lands in nearby East Charleston, Vermont identified 138 species (Benoit 2000). When the 14 one-time sightings are removed from the East Charleston list, the resulting figure (124) closely approximates the number of bird species considered regular members of New Hampshire's Hubbard Brook Experimental Forest (122) (Holmes and Likens 1999). Many of the approximately twenty species missing from the Nulhegan/West Mountain list are refueling migrants or winter visitors to the area. To overlook them underestimates the area's function as stopover and wintering habitat. Other missing species are almost certainly infrequent or sparsely distributed breeders.

Annual fluctuations in bird numbers may result from changes in food supply. Fluctuations may be particularly pronounced for insectivorous birds breeding in spruce-fir forests, where budworm outbreaks periodically support higher abundance levels. Cape May Warbler and Tennessee Warbler are among the undetected species whose numbers may increase substantially during years of high prey availability (Morris et al. 1958). Future surveys with improved seasonal and geographic coverage may add these and other species to the preliminary inventory.

Continued bird surveys will also allow land stewards to monitor the status of bird populations over time. A comprehensive monitoring program would add roadside and harvest-block survey stations to the existing system of point counts. After five consecutive years of monitoring, a power analysis can reveal whether annual, biennial, or triennial surveys should be pursued to strike an optimal balance between information and efficiency (Pence 1996). A thoughtfully designed monitoring program will reveal more than fluctuations in bird numbers. It will demonstrate effects of management practices.

Land management that responds to changing conditions, using site-specific and up-to-date information, is most effective at achieving conservation goals (Walters 1986). Practitioners of adaptive management evaluate effects of stewardship activity by identifying and measuring ecological indicators. These evaluations provide a basis on which future management decisions are made. Decisions based on a one-year survey of a dynamic landscape risk expenditure of financial and human resources on strategies that achieve limited success. Because bird communities can be efficiently monitored in a wide variety of wetland and terrestrial settings, they provide a useful and economical benchmark for the refinement of management strategies.

Conclusion

Although the limitations of short-term field study compel further investigation, this report provides an initial framework for bird conservation in the Nulhegan Basin Division and the West Mountain WMA. Lowland conifer forests warrant primary consideration. This complex supports an exceptionally rich avifauna that includes a high proportion of priority species, most of them associated with older forests. Logging of spruce and fir has compromised the value of lowland conifer to a number of boreal birds unique to the region. The greatest opportunity to restore a continuous, mature softwood forest lies in the heart of the Nulhegan Basin, north of

route 105 and south of the Tin Shack/Eagle's Nest Road junction. This area encompasses several natural communities of regional importance, including: Big Swamp, Blowdown Bogs, Mollie Beattie Bog, Bog Tributary Swamp, and the Lower Yellow Branch Spruce-fir Flats. The Paul Stream valley also contains outstanding examples of lowland conifer. A single stand near Walker Dam contained 6 priority species.

A coarse-filter strategy applied to the lowland conifer forest complex will improve prospects for mature softwood associates like Bay-breasted Warbler, Gray Jay, Boreal Chickadee, and Black-backed Woodpecker. Conserving the state-endangered Spruce Grouse may require a fine-filter approach, particularly after regenerating harvest blocks have matured. Ultimately, a bird conservation plan that balances the needs of early- and late-successional species will recognize the importance of natural disturbance in creating habitat heterogeneity.

The mixed composition of red spruce-northern hardwood forests makes them a valuable component of the northeastern Vermont landscape, as well. This forest type attracted birds associated with both hardwoods and softwoods, ranking high in measures of avian diversity and proportionate representation of priority species. Northern hardwoods also contained a high proportion of PIF-listed species, although the diversity index was somewhat lower than other upland forest types. All upland bird communities were distinguished by a preponderance of neotropical migrants.

Among the non-forested wetlands, alluvial shrub swamps featured outstanding bird diversity, while marshes contained the highest proportion of listed species. The dwarf shrub bog/poor fen/intermediate fen complex is remarkable, as well, for the number of species (4) found exclusively in this community type. Together, these natural communities substantially enrich a native avifauna that is otherwise dominated by forest-dwelling birds.

The Nulhegan Basin Division and the West Mountain WMA offer regionally significant breeding and non-breeding opportunities to a diverse group of birds. The US Fish and Wildlife Service and the Vermont Agency of Natural Resources can enhance the ecological value of these lands by allowing natural processes to prevail. Ecosystem maturation and natural disturbance will restore a landscape that features both connectivity and natural heterogeneity. The recovery of these two features represents the greatest promise for conserving northeastern Vermont's native birds.

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Appendix 1. Point count results from primary and secondary point count stations, organized by natural community type; n represents number of points surveyed. Bold type designates species that occurred within 50 m at greater than 20% of the point count stations. Asterisks designate species identified as conservation priorities

Alluvial Shrub Swamp (n = 12)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Alder Flycatcher	0.42	0.58	0.50	1.08
Northern Waterthrush	0.42	0.50	0.42	0.58
Swamp Sparrow	0.42	0.67	0.42	1.42
American Redstart	0.33	0.33	0.33	0.42
Common Yellowthroat	0.33	0.75	0.33	0.92
Red-eyed Vireo	0.33	0.50	0.33	0.83
Tree Swallow	0.17	0.17	0.33	0.33
Song Sparrow	0.17	0.25	0.25	0.50
Black-capped Chickadee	0.17	0.17	0.17	0.25
Nashville Warbler *	0.17	0.25	0.17	0.33
American Goldfinch	0.08	0.08	0.17	0.17
Magnolia Warbler	0.08	0.08	0.17	0.17
Black-and-White Warbler	0.08	0.08	0.08	0.08
Chestnut-sided Warbler	0.08	0.33	0.08	0.42
Northern Parula *	0.08	0.17	0.08	0.17
Ruby-crowned Kinglet	0.08	0.08	0.08	0.08
Rusty Blackbird *	0.08	0.08	0.08	0.08
Willow Flycatcher	0.08	0.08	0.08	0.08
Winter Wren	0.08	0.08	0.08	0.08
Yellow-rumped Warbler	0.08	0.17	0.08	0.17
American Robin	0.00	0.08	0.00	0.08
Belted Kingfisher *	0.00	0.08	0.00	0.08
Common Grackle	0.00	0.08	0.00	0.08
Common Raven	0.00	0.08	0.00	0.08
Gray Catbird	0.00	0.08	0.00	0.08
Red-winged Blackbird	0.00	0.08	0.00	0.08
Veery *	0.00	0.33	0.00	0.50
White-throated Sparrow	0.00	0.17	0.00	0.25
Yellow Warbler	0.00	0.08	0.00	0.08
Yellow-bellied Sapsucker *	0.00	0.08	0.00	0.08

Beaver Meadow/Sedge Meadow/Marsh (n = 5)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Swamp Sparrow	0.40	0.40	0.40	0.40
Common Yellowthroat	0.20	0.40	0.40	0.60
Red-winged Blackbird	0.20	0.20	0.40	0.40
Rusty Blackbird *	0.20	0.20	0.40	0.40
Alder Flycatcher	0.20	0.20	0.20	0.40
Nashville Warbler *	0.20	0.20	0.20	0.20
Tree Swallow	0.20	0.20	0.20	0.20
American Goldfinch	0.00	0.20	0.00	0.20
Ruby-crowned Kinglet	0.00	0.20	0.00	0.20

Black Spruce Bog (n = 7)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Nashville Warbler *	0.71	1.00	0.71	2.29
Yellow-bellied Flycatcher	0.57	1.00	0.71	1.71
Golden-crowned Kinglet	0.57	0.86	0.57	0.86
Blue-headed Vireo	0.29	0.71	0.29	0.71
White-throated Sparrow	0.29	0.71	0.29	0.86
Yellow-rumped Warbler	0.29	0.71	0.29	0.71
Common Yellowthroat	0.14	0.29	0.29	0.43
Blackburnian Warbler *	0.14	0.29	0.14	0.29
Hermit Thrush	0.14	0.86	0.14	1.14
Northern Parula *	0.14	0.43	0.14	0.43
Gray Jay *	0.00	0.14	0.00	0.14
Magnolia Warbler	0.00	0.57	0.00	0.57
Palm Warbler	0.00	0.14	0.00	0.14
Purple Finch *	0.00	0.14	0.00	0.14
Red-eyed Vireo	0.00	0.14	0.00	0.14
Ruby-crowned Kinglet	0.00	0.14	0.00	0.14
Spruce Grouse *	0.00	0.14	0.00	0.14
Swainson's Thrush	0.00	0.29	0.00	0.29
Winter Wren	0.00	0.14	0.00	0.14

Black Spruce Swamp (n = 11)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Golden-crowned Kinglet	0.73	0.73	0.73	0.73
Yellow-rumped Warbler	0.45	0.73	0.45	0.73
Yellow-bellied Flycatcher	0.36	0.64	0.55	1.00
Nashville Warbler *	0.36	0.45	0.36	0.64
Magnolia Warbler	0.27	0.55	0.27	0.64
Blackpoll Warbler *	0.18	0.18	0.27	0.27
Blue-headed Vireo	0.18	0.27	0.18	0.27
Brown Creeper	0.18	0.27	0.18	0.27
Northern Waterthrush	0.18	0.18	0.18	0.18
White-throated Sparrow	0.18	0.55	0.18	0.64
Winter Wren	0.18	0.27	0.18	0.45
Black-and-White Warbler	0.09	0.09	0.09	0.09
Blackburnian Warbler *	0.09	0.09	0.09	0.09
Canada Warbler *	0.09	0.18	0.09	0.18
Hermit Thrush	0.09	0.55	0.09	0.82
Northern Parula *	0.09	0.09	0.09	0.09
Palm Warbler	0.09	0.09	0.09	0.09
Rusty Blackbird *	0.09	0.09	0.09	0.09
Blue Jay	0.00	0.27	0.00	0.27
Northern Flicker	0.00	0.09	0.00	0.09
Purple Finch *	0.00	0.09	0.00	0.09
Swainson's Thrush	0.00	0.45	0.00	0.55
Yellow-bellied Sapsucker *	0.00	0.18	0.00	0.18

Dwarf Shrub Bog/Poor Fen/Intermediate Fen Complex (n = 12)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Swamp Sparrow	0.42	0.58	0.67	1.08
Lincoln's Sparrow	0.42	0.50	0.42	0.83
Common Yellowthroat	0.33	0.58	0.33	1.08
Red-winged Blackbird	0.17	0.25	0.33	0.83
Palm Warbler	0.08	0.08	0.17	0.17
White-throated Sparrow	0.08	0.17	0.17	0.42
American Goldfinch	0.08	0.17	0.08	0.25
Common Snipe	0.08	0.17	0.08	0.17
Eastern Kingbird	0.08	0.08	0.08	0.08
Magnolia Warbler	0.08	0.08	0.08	0.08
Nashville Warbler *	0.08	0.17	0.08	0.25
Rusty Blackbird *	0.08	0.08	0.08	0.08
Song Sparrow	0.08	0.25	0.08	0.25
Alder Flycatcher	0.00	0.17	0.00	0.17
Black-capped Chickadee	0.00	0.08	0.00	0.08
Chestnut-sided Warbler	0.00	0.08	0.00	0.08
Northern Flicker	0.00	0.08	0.00	0.08
Northern Waterthrush	0.00	0.25	0.00	0.33
Pied-billed Grebe	0.00	0.08	0.00	0.08
Ruby-crowned Kinglet	0.00	0.08	0.00	0.08
Tree Swallow	0.00	0.08	0.00	0.17
Yellow-bellied Flycatcher	0.00	0.08	0.00	0.08
Yellow-bellied Sapsucker *	0.00	0.08	0.00	0.08
Yellow-rumped Warbler	0.00	0.08	0.00	0.17

Lowland Spruce-fir Forest (n=11)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Yellow-rumped Warbler	0.82	0.82	1.00	1.09
Golden-crowned Kinglet	0.55	0.64	0.55	0.64
Brown Creeper	0.45	0.55	0.45	0.55
Magnolia Warbler	0.45	0.64	0.45	0.64
Northern Parula *	0.45	0.55	0.45	0.64
Blue-headed Vireo	0.36	0.55	0.55	0.82
Bay-breasted Warbler *	0.27	0.27	0.27	0.27
Yellow-bellied Flycatcher	0.27	0.73	0.27	0.73
Black-backed Woodpecker *	0.18	0.18	0.27	0.27
Blackburnian Warbler *	0.18	0.18	0.18	0.18
Hermit Thrush	0.18	0.45	0.18	0.55
Gray Jay *	0.09	0.27	0.27	0.45
Purple Finch *	0.09	0.09	0.18	0.18
Red-breasted Nuthatch	0.09	0.36	0.18	0.45
White-throated Sparrow	0.09	0.73	0.18	1.09
American Robin	0.09	0.09	0.09	0.09
Black-capped Chickadee	0.09	0.09	0.09	0.09
Black-throated Blue Warbler *	0.09	0.09	0.09	0.09
Blue Jay	0.09	0.36	0.09	0.45
Common Yellowthroat	0.09	0.09	0.09	0.09
Downy Woodpecker	0.09	0.09	0.09	0.09
Mourning Warbler	0.09	0.09	0.09	0.09
Nashville Warbler *	0.09	0.45	0.09	0.45
Ovenbird	0.09	0.09	0.09	0.09
Red-eyed Vireo	0.09	0.09	0.09	0.09
Ruby-crowned Kinglet	0.09	0.18	0.09	0.18
Swainson's Thrush	0.09	0.27	0.09	0.27
Winter Wren	0.09	0.73	0.09	0.73
Black-throated Green Warbler *	0.00	0.18	0.00	0.18
Boreal Chickadee *	0.00	0.09	0.00	0.09
Canada Warbler *	0.00	0.09	0.00	0.09
Dark-eyed Junco	0.00	0.09	0.00	0.09
Evening Grosbeak	0.00	0.27	0.00	0.36
Pileated Woodpecker	0.00	0.09	0.00	0.09
Spruce Grouse *	0.00	0.09	0.00	0.09

Montane Paper Birch-fir Forest (n = 4)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Magnolia Warbler	0.50	0.50	0.50	0.50
Yellow-rumped Warbler	0.50	0.75	0.50	1.00
Black-and-White Warbler	0.25	0.25	0.25	0.25
Black-throated Green Warbler *	0.25	0.25	0.25	0.25
Blackburnian Warbler *	0.25	0.25	0.25	0.25
Blue-headed Vireo	0.25	0.50	0.25	0.50
Black-throated Blue Warbler *	0.00	0.25	0.00	0.25
Hermit Thrush	0.00	0.25	0.00	0.25
Swainson's Thrush	0.00	0.25	0.00	0.25
White-throated Sparrow	0.00	0.25	0.00	0.50
Winter Wren	0.00	0.25	0.00	0.25

Northern Hardwoods (n = 14)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Red-eyed Vireo	0.71	0.93	0.79	2.21
American Redstart	0.43	0.71	0.64	1.00
Black-throated Blue Warbler *	0.36	0.57	0.29	0.71
Ovenbird	0.21	0.64	0.21	0.71
Black-throated Green Warbler *	0.07	0.86	0.07	1.43
Least Flycatcher *	0.07	0.21	0.07	0.29
Pileated Woodpecker	0.07	0.07	0.07	0.07
Scarlet Tanager	0.07	0.21	0.07	0.21
Veery *	0.07	0.14	0.07	0.14
White-breasted Nuthatch	0.07	0.07	0.07	0.07
Yellow-bellied Sapsucker *	0.07	0.07	0.07	0.14
American Robin	0.00	0.07	0.00	0.07
Black-capped Chickadee	0.00	0.07	0.00	0.07
Eastern Wood Pewee *	0.00	0.07	0.00	0.07
Hermit Thrush	0.00	0.29	0.00	0.36
Swainson's Thrush	0.00	0.07	0.00	0.07
Winter Wren	0.00	0.14	0.00	0.14

Northern White Cedar Swamp (n = 3)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Swamp Sparrow	1.00	1.00	1.33	1.67
Common Yellowthroat	1.00	1.33	1.00	1.33
Magnolia Warbler	0.67	0.67	0.67	0.67
Northern Waterthrush	0.67	0.67	0.67	1.00
White-throated Sparrow	0.33	0.67	0.67	1.33
Yellow-bellied Flycatcher	0.33	1.00	0.67	1.33
Yellow-rumped Warbler	0.33	0.33	0.67	0.67
Brown Creeper	0.33	0.33	0.33	0.33
Cedar Waxwing	0.33	0.33	0.33	1.00
Chestnut-sided Warbler	0.33	0.33	0.33	0.33
Common Snipe	0.33	0.67	0.33	0.67
Downy Woodpecker	0.33	0.33	0.33	0.33
Gray Catbird	0.33	0.33	0.33	0.33
Northern Parula *	0.33	0.33	0.33	0.33
Red-winged Blackbird	0.33	0.33	0.33	0.33
Rusty Blackbird *	0.33	0.33	0.33	0.33
Tree Swallow	0.33	0.33	0.33	0.33
American Robin	0.00	0.67	0.00	0.67
Blue Jay	0.00	0.33	0.00	0.33
Olive-sided Flycatcher *	0.00	0.33	0.00	0.33
Winter Wren	0.00	0.33	0.00	0.33

Red Spruce-Northern Hardwood Forest (n = 14)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Magnolia Warbler	0.43	0.57	0.64	0.79
Black-throated Blue Warbler *	0.43	0.86	0.43	1.07
Canada Warbler *	0.36	0.50	0.43	0.64
Nashville Warbler *	0.29	0.36	0.36	0.64
Ovenbird	0.29	0.71	0.36	1.07
Black-and-White Warbler	0.29	0.43	0.29	0.43
Red-eyed Vireo	0.29	0.57	0.29	0.64
Yellow-bellied Flycatcher	0.21	0.43	0.29	0.71
Black-capped Chickadee	0.21	0.43	0.21	0.50
Chestnut-sided Warbler	0.21	0.29	0.21	0.43
Northern Parula *	0.21	0.50	0.21	0.50
Black-throated Green Warbler *	0.14	0.50	0.14	0.64
Blackburnian Warbler *	0.14	0.29	0.14	0.36
Yellow-bellied Sapsucker *	0.14	0.36	0.14	0.36
Yellow-rumped Warbler	0.14	0.43	0.14	0.43
Golden-crowned Kinglet	0.07	0.07	0.14	0.14
American Redstart	0.07	0.07	0.07	0.07
Brown Creeper	0.07	0.07	0.07	0.07
Hermit Thrush	0.07	0.43	0.07	0.50
Northern Waterthrush	0.07	0.14	0.07	0.14
Purple Finch *	0.07	0.07	0.07	0.07
Ruby-throated Hummingbird	0.07	0.07	0.07	0.07
Veery *	0.07	0.14	0.07	0.14
American Goldfinch	0.00	0.07	0.00	0.07
American Robin	0.00	0.07	0.00	0.07
Blue-headed Vireo	0.00	0.29	0.00	0.36
Dark-eyed Junco	0.00	0.14	0.00	0.14
Mourning Warbler	0.00	0.07	0.00	0.14
Northern Flicker	0.00	0.07	0.00	0.07
Red-breasted Nuthatch	0.00	0.50	0.00	0.57
Scarlet Tanager	0.00	0.07	0.00	0.07
Warbling Vireo	0.00	0.07	0.00	0.07
White-throated Sparrow	0.00	0.50	0.00	0.57
Winter Wren	0.00	0.29	0.00	0.29

Sweet Gale Shoreline Swamp (n = 1)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Red-winged Blackbird	1.00	1.00	4.00	5.00
Common Yellowthroat	1.00	1.00	2.00	2.00
Swamp Sparrow	1.00	1.00	2.00	3.00
Alder Flycatcher	1.00	1.00	1.00	1.00
Northern Waterthrush	0.00	1.00	0.00	1.00
Winter Wren	0.00	1.00	0.00	1.00

Lowland Conifer Forest Complex (n = 32)

Species	Frequency		Relative Abundance	
	within 50 m	overall	within 50 m	overall
Golden-crowned Kinglet	0.56	0.66	0.56	0.66
Yellow-rumped Warbler	0.53	0.72	0.63	0.81
Yellow-bellied Flycatcher	0.38	0.78	0.50	1.09
Magnolia Warbler	0.31	0.59	0.31	0.41
Nashville Warbler *	0.31	0.53	0.31	0.88
Blue-headed Vireo	0.25	0.44	0.31	0.53
Brown Creeper	0.25	0.28	0.28	0.31
Northern Parula *	0.25	0.34	0.25	0.38
White-throated Sparrow	0.19	0.66	0.25	0.88
Common Yellowthroat	0.13	0.19	0.19	0.25
Blackburnian Warbler *	0.13	0.16	0.13	0.16
Hermit Thrush	0.13	0.53	0.13	0.81
Northern Waterthrush	0.13	0.13	0.13	0.16
Swamp Sparrow	0.09	0.09	0.13	0.16
Bay-breasted Warbler *	0.09	0.09	0.09	0.09
Winter Wren	0.09	0.41	0.09	0.47
Black-backed Woodpecker *	0.06	0.06	0.09	0.09
Blackpoll Warbler *	0.06	0.06	0.09	0.09
Downy Woodpecker	0.06	0.06	0.06	0.06
Rusty Blackbird *	0.06	0.06	0.06	0.06
Gray Jay *	0.03	0.13	0.09	0.19
Purple Finch *	0.03	0.09	0.06	0.13
Red-breasted Nuthatch	0.03	0.13	0.06	0.16
American Robin	0.03	0.09	0.03	0.09
Black-and-white Warbler	0.03	0.03	0.03	0.03
Black-capped Chickadee	0.03	0.03	0.03	0.03
Black-throated Blue Warbler *	0.03	0.03	0.03	0.03
Blue Jay	0.03	0.25	0.03	0.28
Canada Warbler *	0.03	0.09	0.03	0.09
Cedar Waxwing	0.03	0.03	0.03	0.09
Chestnut-sided Warbler	0.03	0.03	0.03	0.03
Common Snipe	0.03	0.06	0.03	0.06
Gray Catbird	0.03	0.03	0.03	0.03
Mourning Warbler	0.03	0.03	0.03	0.03
Olive-sided Flycatcher *	0.03	0.06	0.03	0.06
Ovenbird	0.03	0.03	0.03	0.03
Palm Warbler	0.03	0.06	0.03	0.06
Red-eyed Vireo	0.03	0.06	0.03	0.06
Red-winged Blackbird	0.03	0.03	0.03	0.03
Ruby-crowned Kinglet	0.03	0.09	0.03	0.09
Swainson's Thrush	0.03	0.31	0.03	0.34
Tree Swallow	0.03	0.03	0.03	0.03
Black-throated Green Warbler *	0.00	0.06	0.00	0.06
Boreal Chickadee *	0.00	0.03	0.00	0.03
Dark-eyed Junco	0.00	0.03	0.00	0.03
Evening Grosbeak	0.00	0.09	0.00	0.13
Northern Flicker	0.00	0.03	0.00	0.03
Pileated Woodpecker	0.00	0.03	0.00	0.03
Spruce Grouse *	0.00	0.06	0.00	0.06
Yellow-bellied Sapsucker *	0.00	0.06	0.00	0.06

Appendix 2. Scientific names for plant species mentioned in report.

Common Name	Scientific Name
Balsam fir	*Abies balsamea*
Black spruce	*Picea mariana*
Northern white cedar	*Thuja occidentalis*
Paper birch	*Betula papyrifera*
Red spruce	*Picea rubens*
Sweet gale	*Myrica gale*

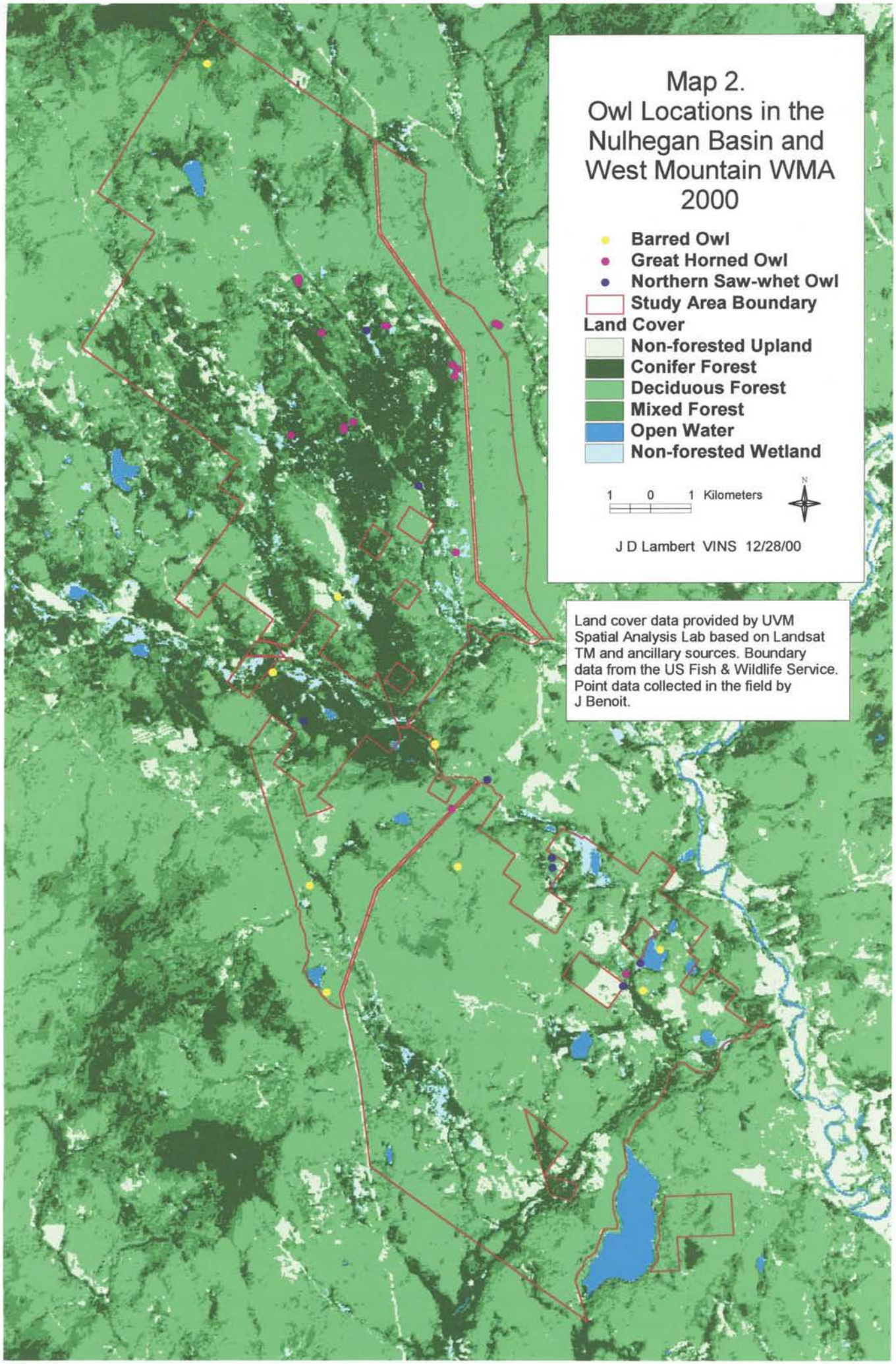
Appendix 3. Location of owl playback stations in UTM zone 19, North American Datum 1927. WS = West Mountain South, WN = West Mountain North, NW=Nulhegan West, NE = Nulhegan East.

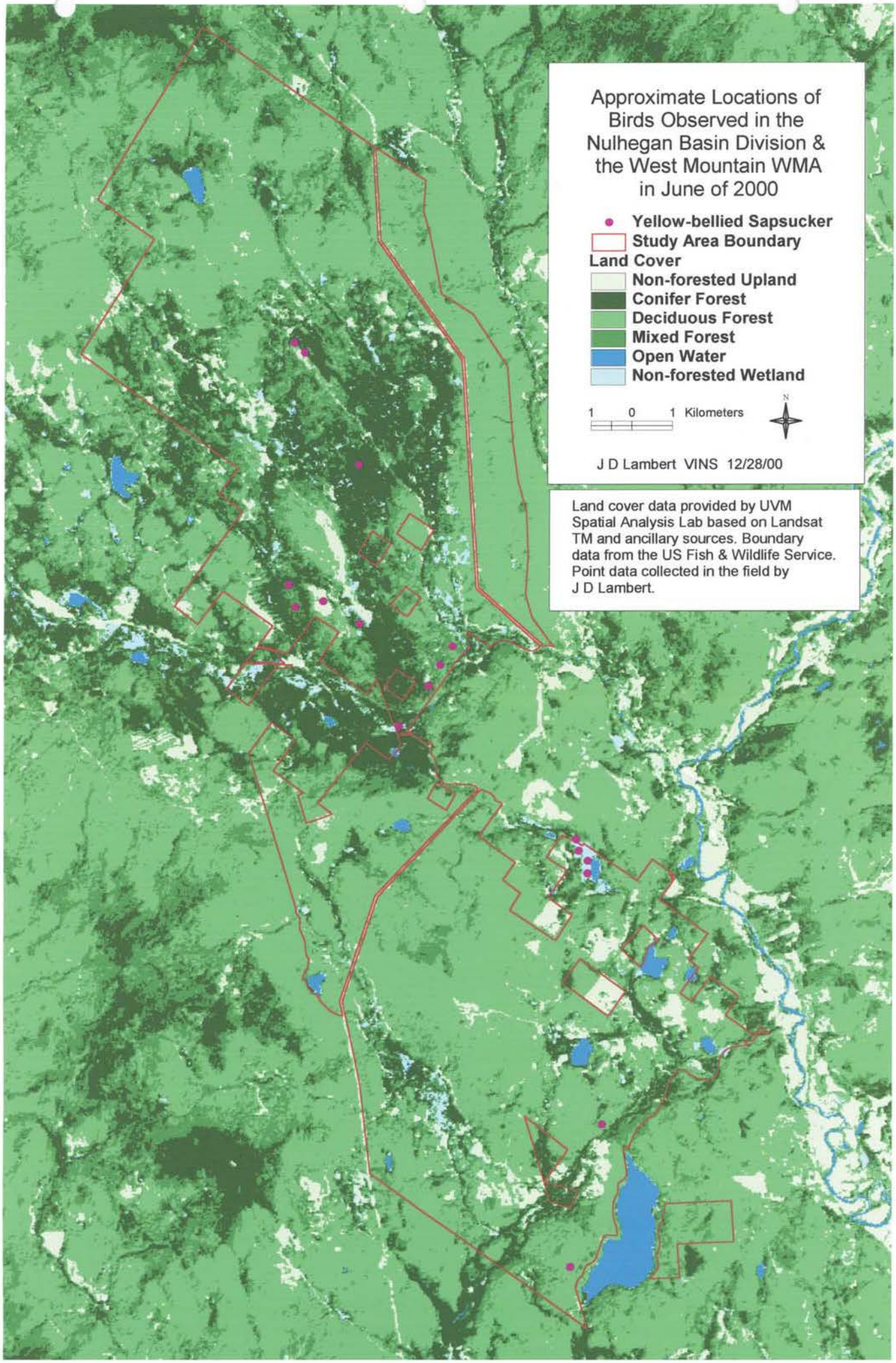
Point	m East	m North	Point	m East	m North
ws16	283905	4952012	nw16	281085	4967066
ws15	283608	4950360	nw15	279864	4968120
ws14	285248	4949869	nw14	279144	4969604
ws13	285910	4948211	nw13	278709	4974017
ws12	287447	4947691	nw12	280141	4975066
ws11	288818	4948607	nw11	282862	4975988
ws9	287870	4952713	nw10	281604	4974635
ws8	287646	4951113	nw9	280916	4973230
ws7	287384	4949490	nw7	279730	4971144
ws6	289983	4950004	nw6	280781	4969947
ws5	289574	4951714	nw5	282214	4967992
ws4	289255	4946936	nw4	282537	4965783
ws3	290815	4947837	nw3	283467	4964764
ws2	291176	4951000	nw2	283517	4963194
ws1	292640	4951624	nw1	283071	4961785
wn13	290101	4953328	ne15	286848	4965656
wn12	288901	4956495	ne14	286782	4968689
wn11	287017	4958112	ne13	285741	4970545
wn10	285592	4959206	ne12	284808	4973032
wn9	286058	4956191	ne11	283895	4974143
wn8	285506	4957552	ne10	282979	4972940
wn7	284130	4955759	ne9	282834	4971441
wn6	283222	4953348	ne8	284446	4969653
wn5	282320	4954575	ne7	282537	4969635
wn4	282372	4956234	ne6	283863	4967754
wn3	282194	4958098	ne5	285535	4967288
wn2	281533	4959545	ne3	285492	4965610
wn1	281830	4961246	ne2	286385	4964077
			ne1	287303	4962294

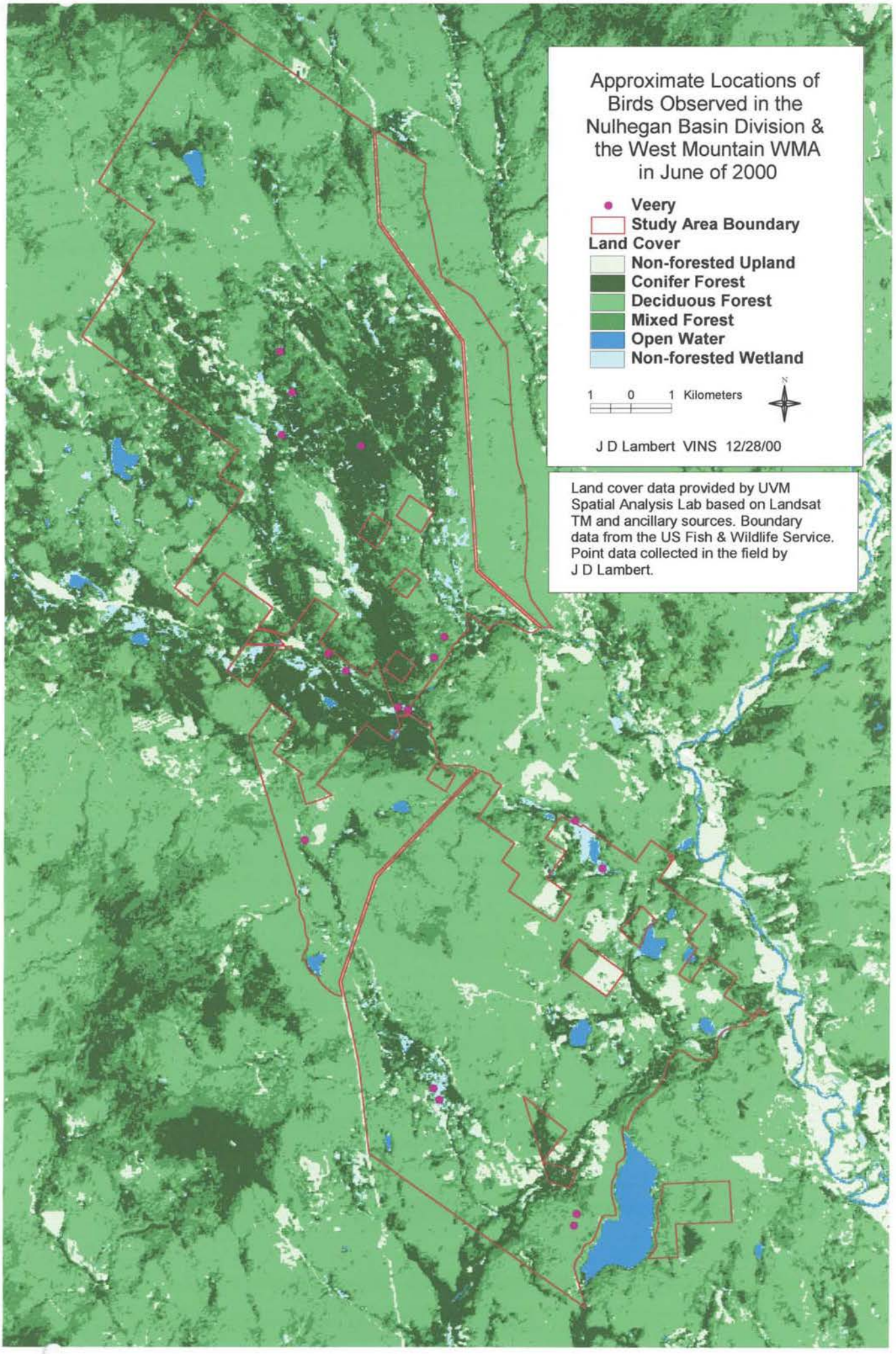
Appendix 4. Location of point count stations in UTM zone 19, North American Datum 1927. NUL = Nulhegan, WMT = West Mountain.

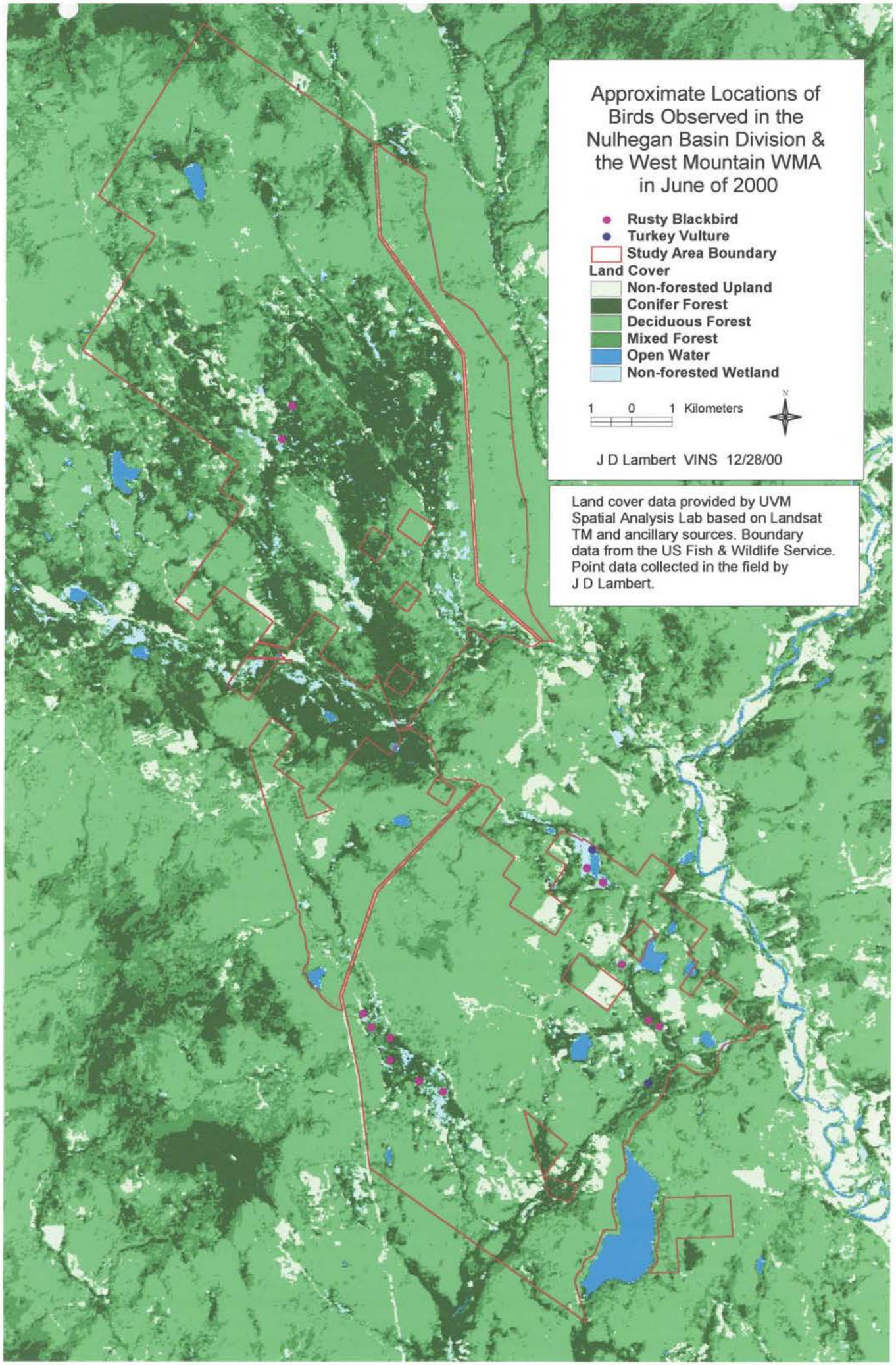
POINT	m East	m North	POINT	m East	m North
NUL001	282687	4969721	NUL047	284709	4961535
NUL002	282676	4969479	NUL048	284598	4961806
NUL003	282923	4969465	NUL049	284568	4962061
NUL004	282915	4969225	NUL050	284449	4962276
NUL005	283164	4969203	NUL051	284200	4962279
NUL006	283154	4968957	NUL052	283978	4962471
NUL007	283399	4968990	NUL053	283152	4961302
NUL008	283395	4968732	NUL054	283384	4961105
NUL009	283644	4968728	NUL055	283579	4960862
NUL010	282503	4962669	WMT001	289673	4955685
NUL011	282425	4962945	WMT002	289294	4956049
NUL012	282363	4963217	WMT003	289312	4956361
NUL013	282283	4963502	WMT004	289103	4956621
NUL014	282153	4963768	WMT005	289047	4956896
NUL015	281925	4963515	WMT006	289293	4956690
NUL016	281918	4963248	WMT007	289444	4956505
NUL017	282078	4962949	WMT008	290471	4953620
NUL018	282285	4962764	WMT009	290050	4953628
NUL019	282947	4961607	WMT010	290221	4953401
NUL020	285060	4959808	WMT011	290216	4953163
NUL021	284824	4959882	WMT012	290347	4952722
NUL022	285456	4960592	WMT013	290483	4952485
NUL023	285605	4960843	WMT014	290645	4952228
NUL024	285753	4961101	WMT015	290910	4952060
NUL025	285895	4961370	WMT016	285593	4953986
NUL026	286026	4961605	WMT017	285328	4954012
NUL027	286222	4961819	WMT018	285103	4954074
NUL028	284658	4967244	WMT019	284842	4954141
NUL029	282282	4968846	WMT020	288474	4946339
NUL030	282536	4967817	WMT021	288555	4946594
NUL031	282236	4966772	WMT022	288621	4946865
NUL032	280007	4968178	WMT023	288698	4947146
NUL033	279901	4968391	WMT024	288922	4946921
NUL034	280134	4968360	WMT025	289860	4950167
NUL035	280238	4968137	WMT026	289623	4950006
NUL036	280373	4967902	WMT027	289392	4949831
NUL037	282188	4971788	WMT028	282339	4955441
NUL038	282102	4971987	WMT029	284298	4952053
NUL039	282016	4972158	WMT030	284140	4952314
NUL040	281926	4972344	WMT031	284281	4951497
NUL041	281833	4972531	WMT032	285438	4950116
NUL042	281736	4972727	WMT033	285306	4950406
NUL043	281626	4972918	WMT034	284998	4950691
NUL044	281529	4973120	WMT035	284930	4950884
NUL045	281421	4973327	WMT036	285693	4950097
NUL046	284572	4961279	WMT037	285873	4950259

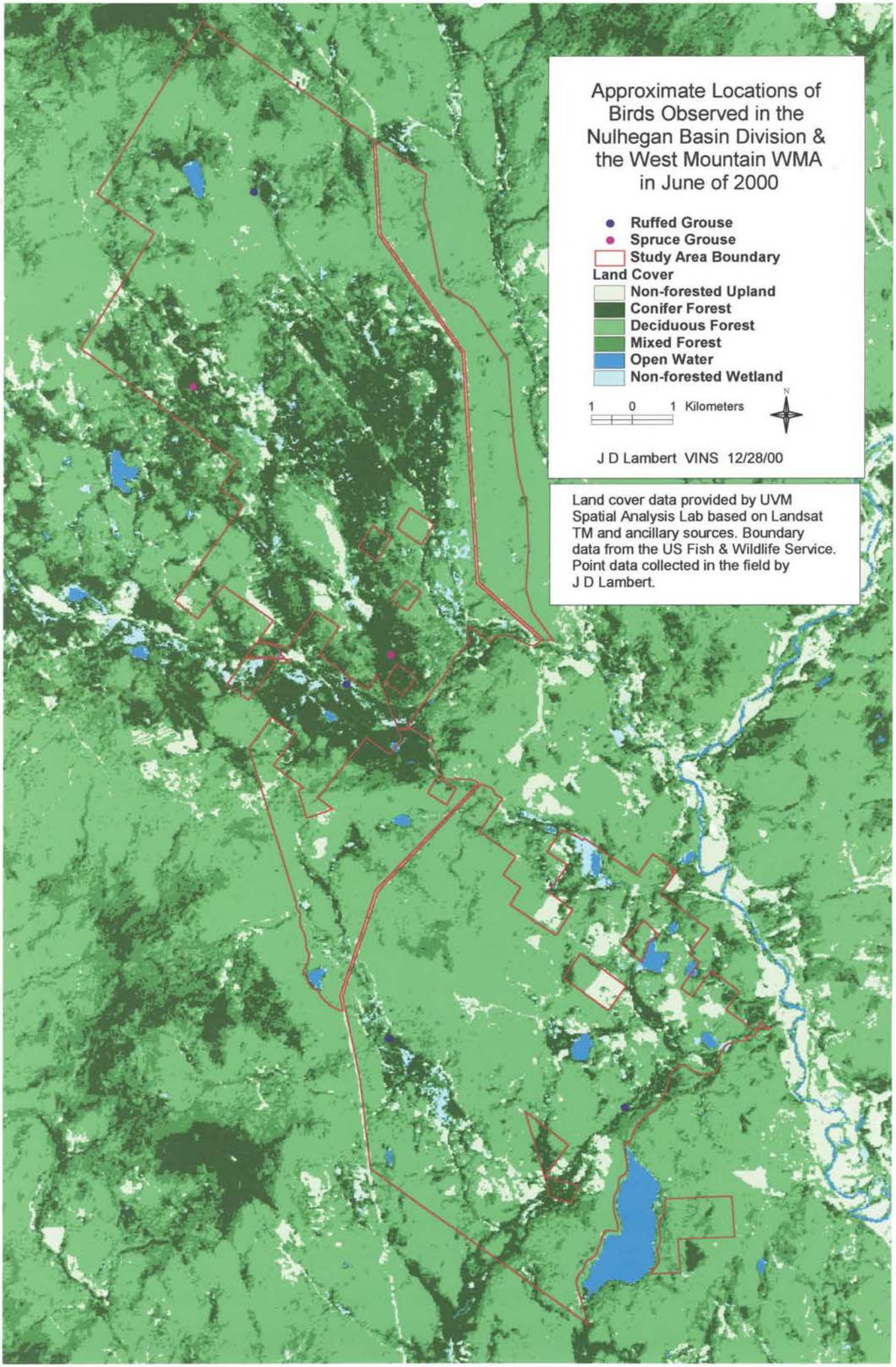
Appendix 5. Preliminary distribution maps for 29 bird species identified by the state of Vermont and/or Partners in Flight as conservation priorities. In most cases, points represent the location from which one or more individuals were detected, not the actual position of the observed bird(s). Quantitative data are contained in the GIS and relational database files, provided as a complement to this report.

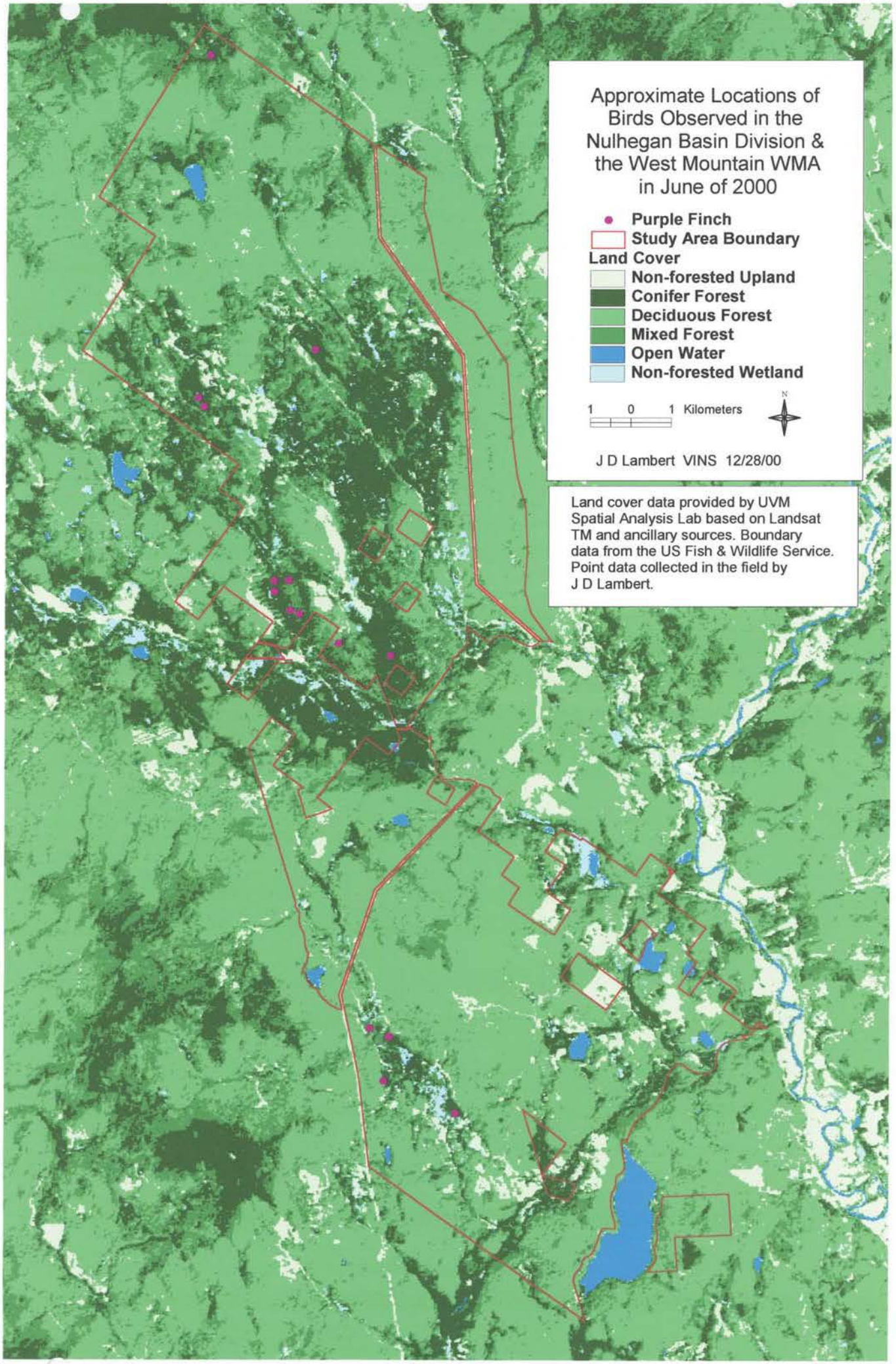

Map 2.
Owl Locations in the
Nulhegan Basin and
West Mountain WMA
2000
Barred Owl
Great Horned Owl
Northern Saw-whet Owl
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J Benoit.

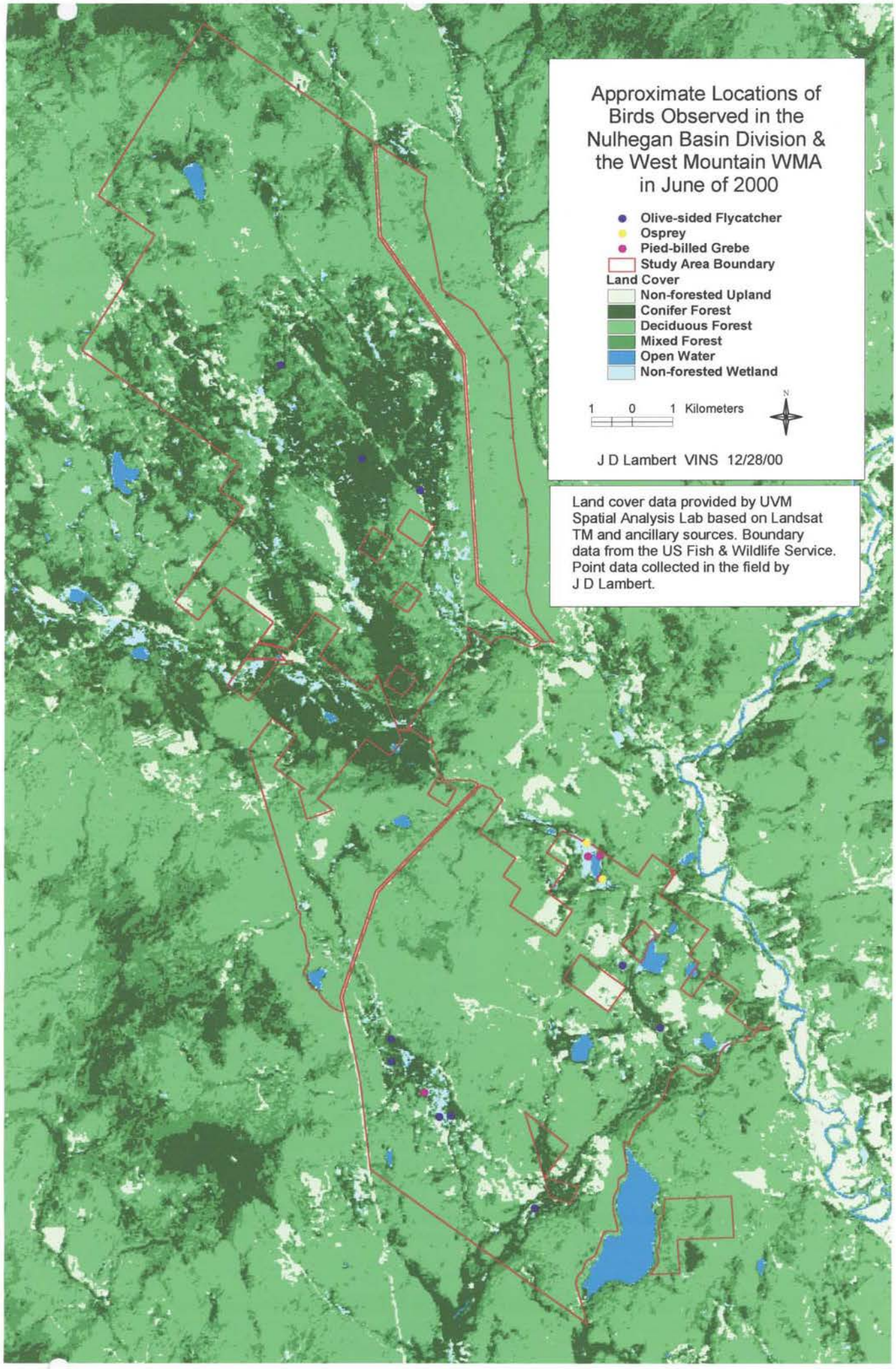

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Yellow-bellied Sapsucker
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

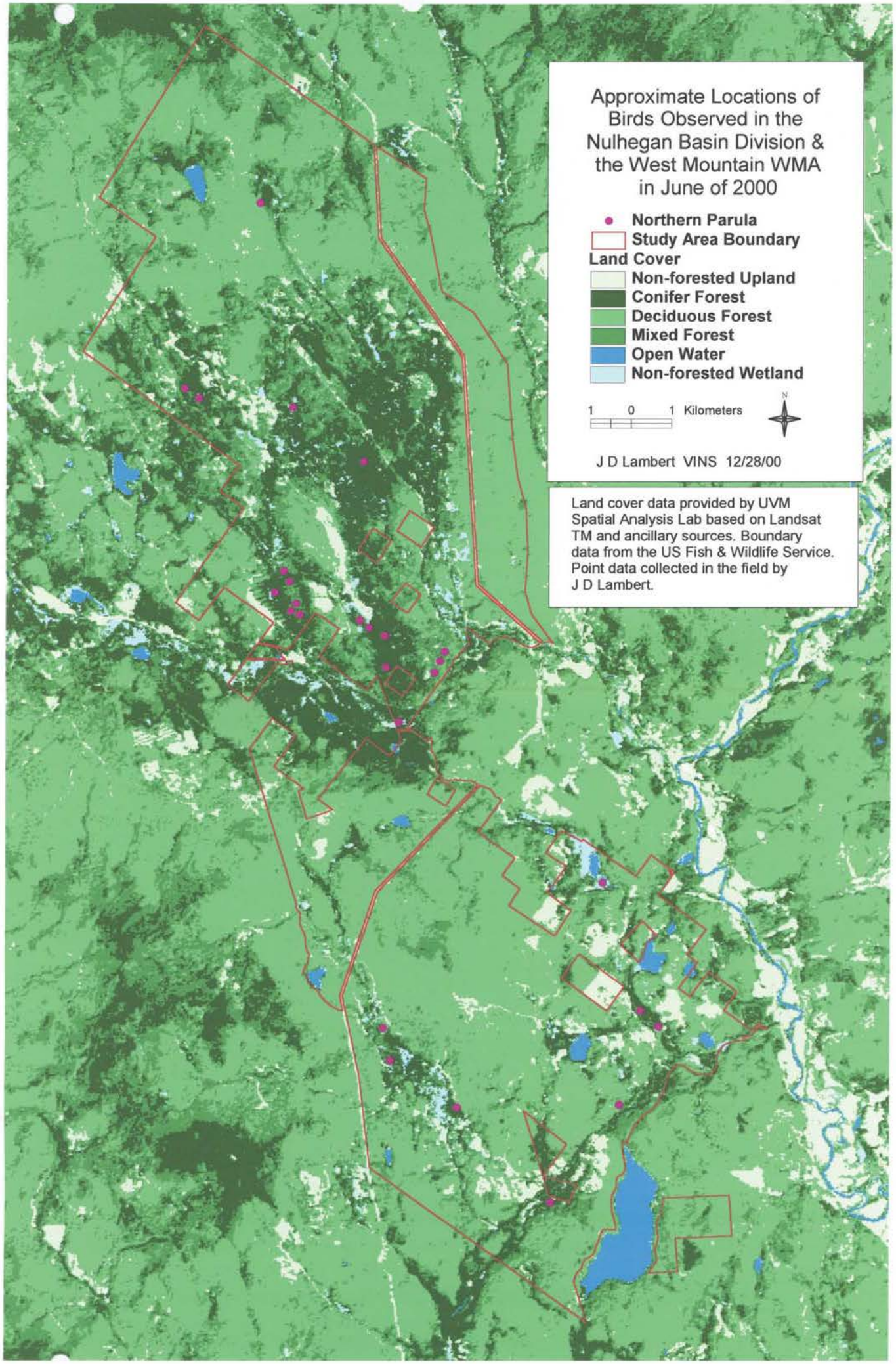

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Veery
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

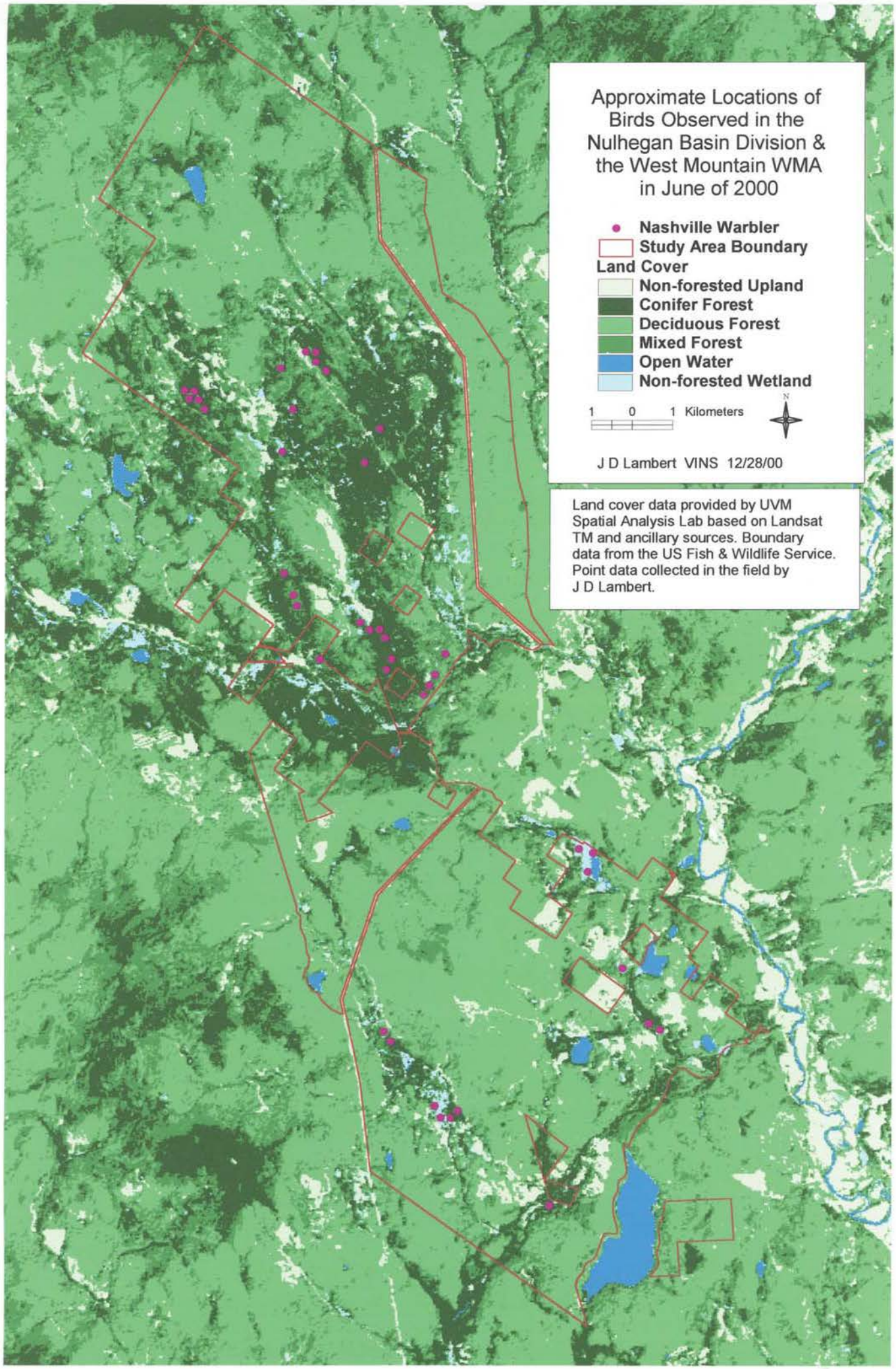

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Rusty Blackbird
Turkey Vulture
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

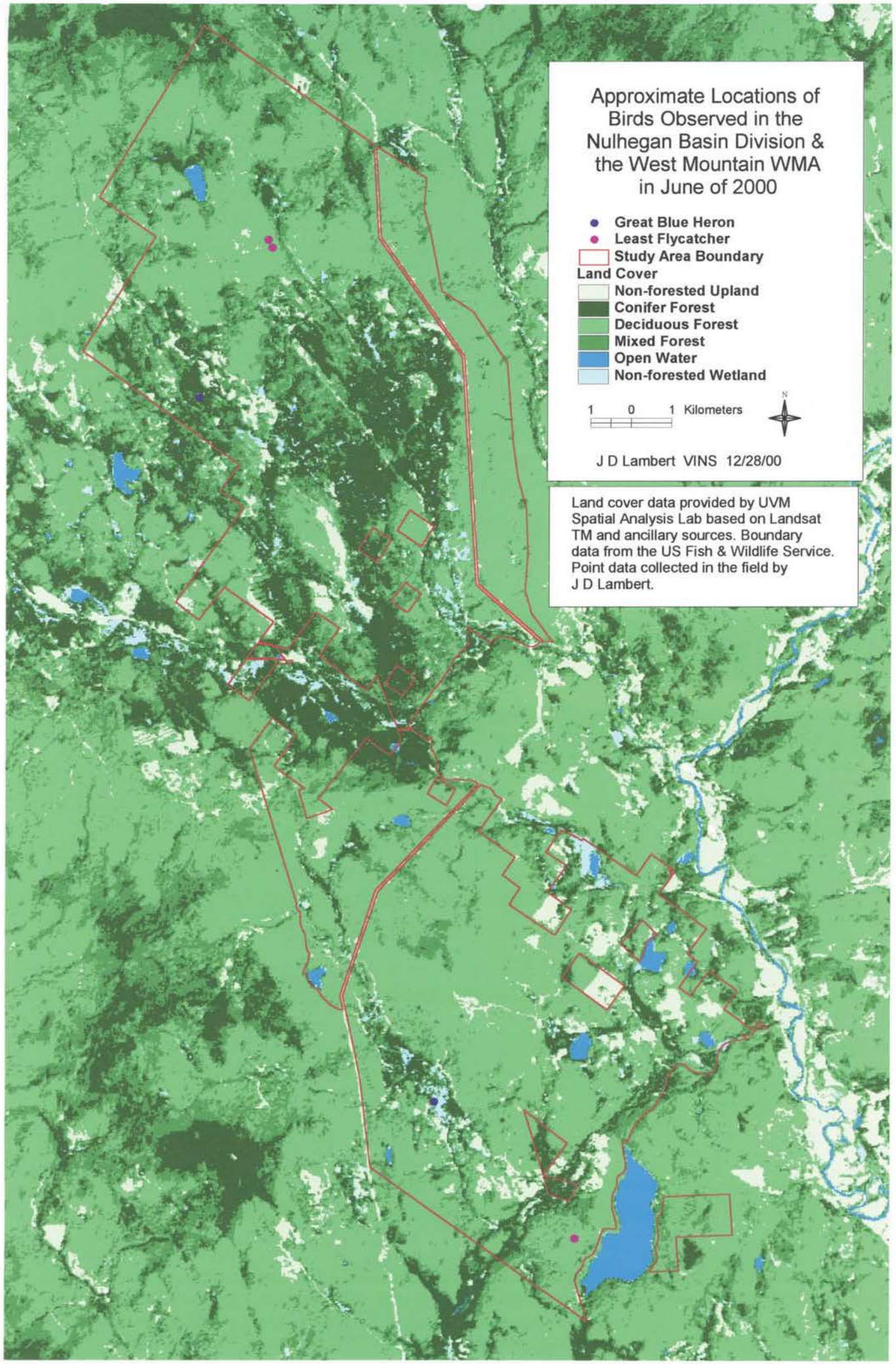

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Ruffed Grouse
Spruce Grouse
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

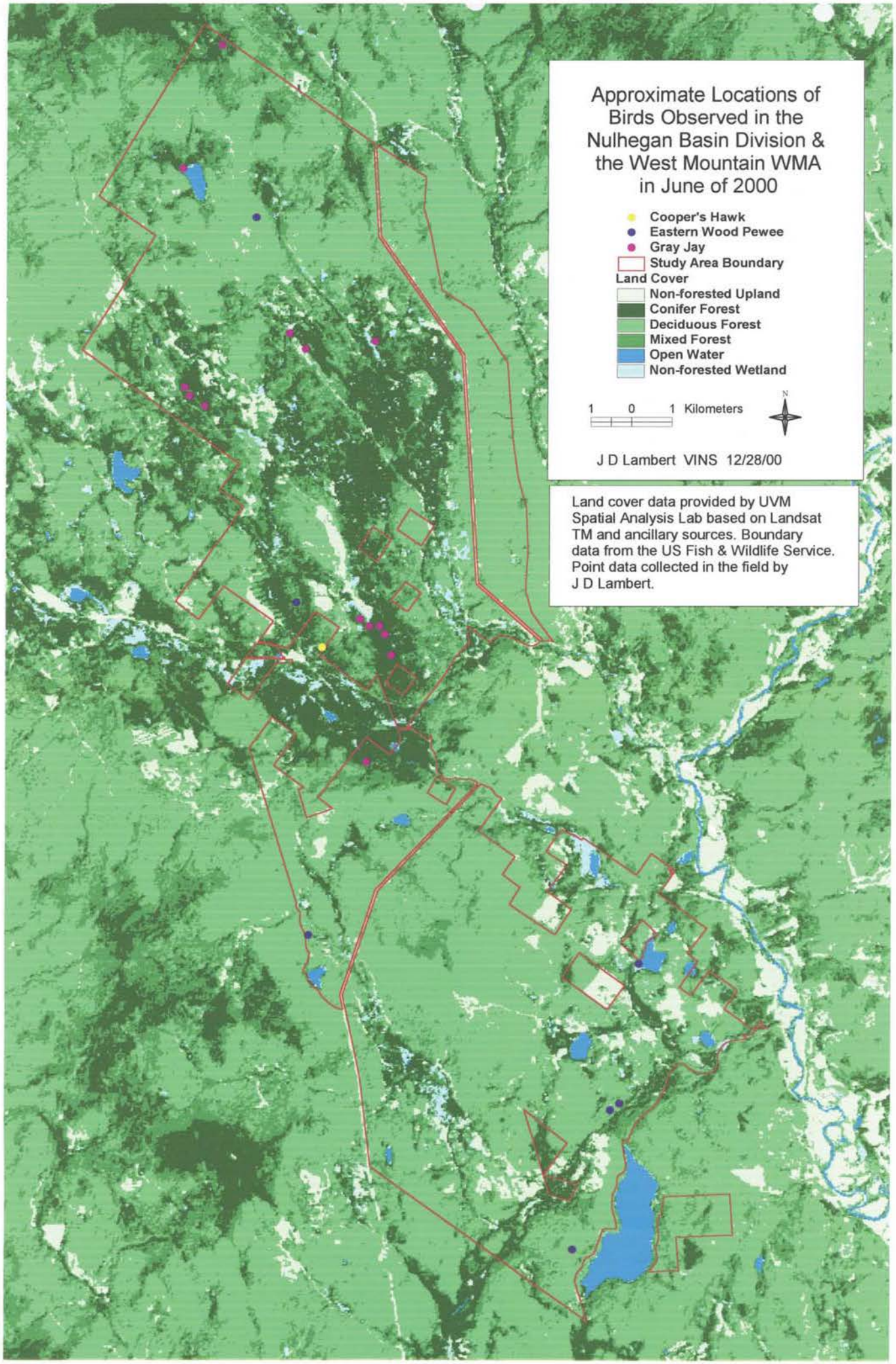

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Purple Finch
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

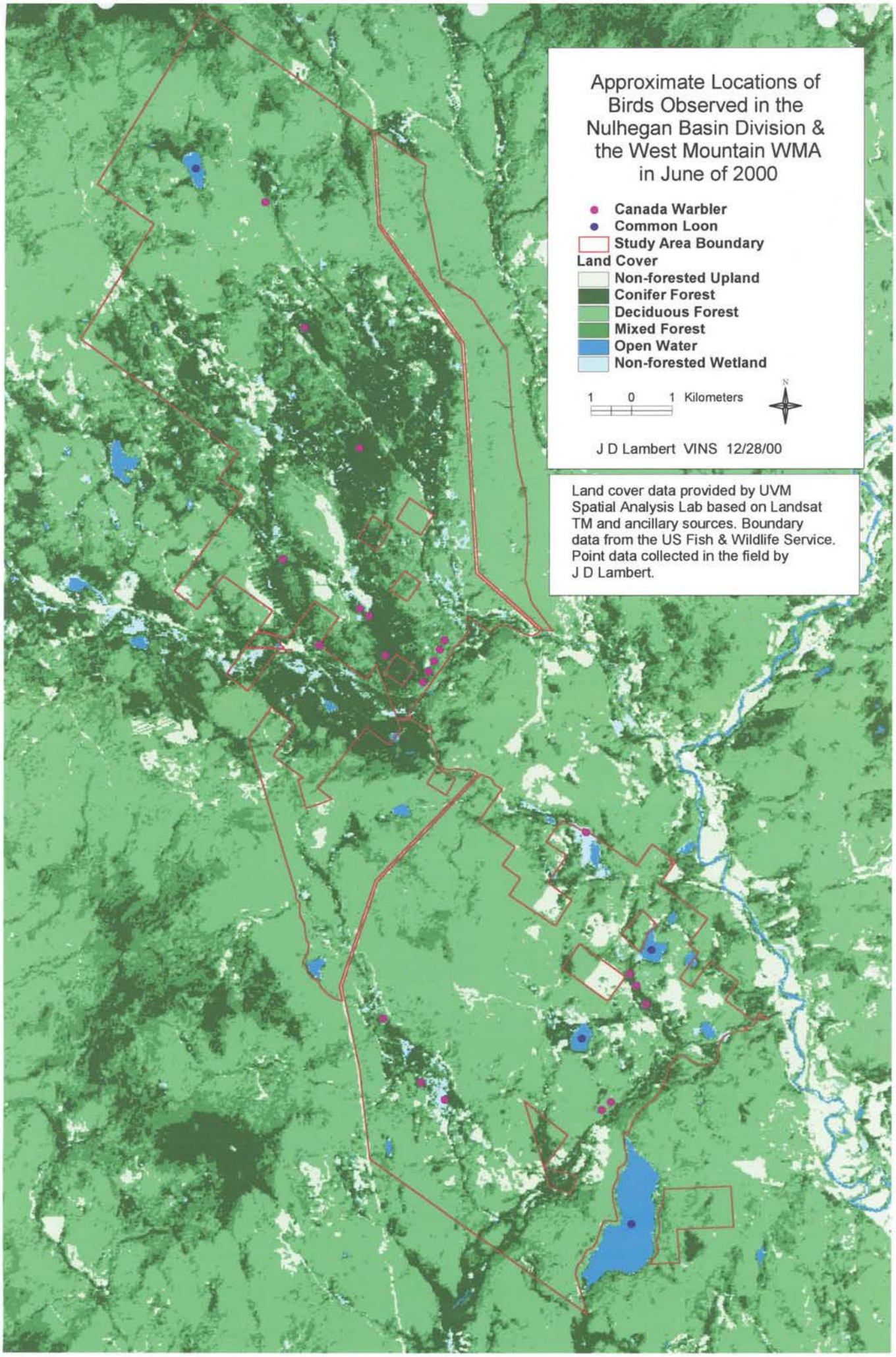

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Olive-sided Flycatcher
Osprey
Pied-billed Grebe
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

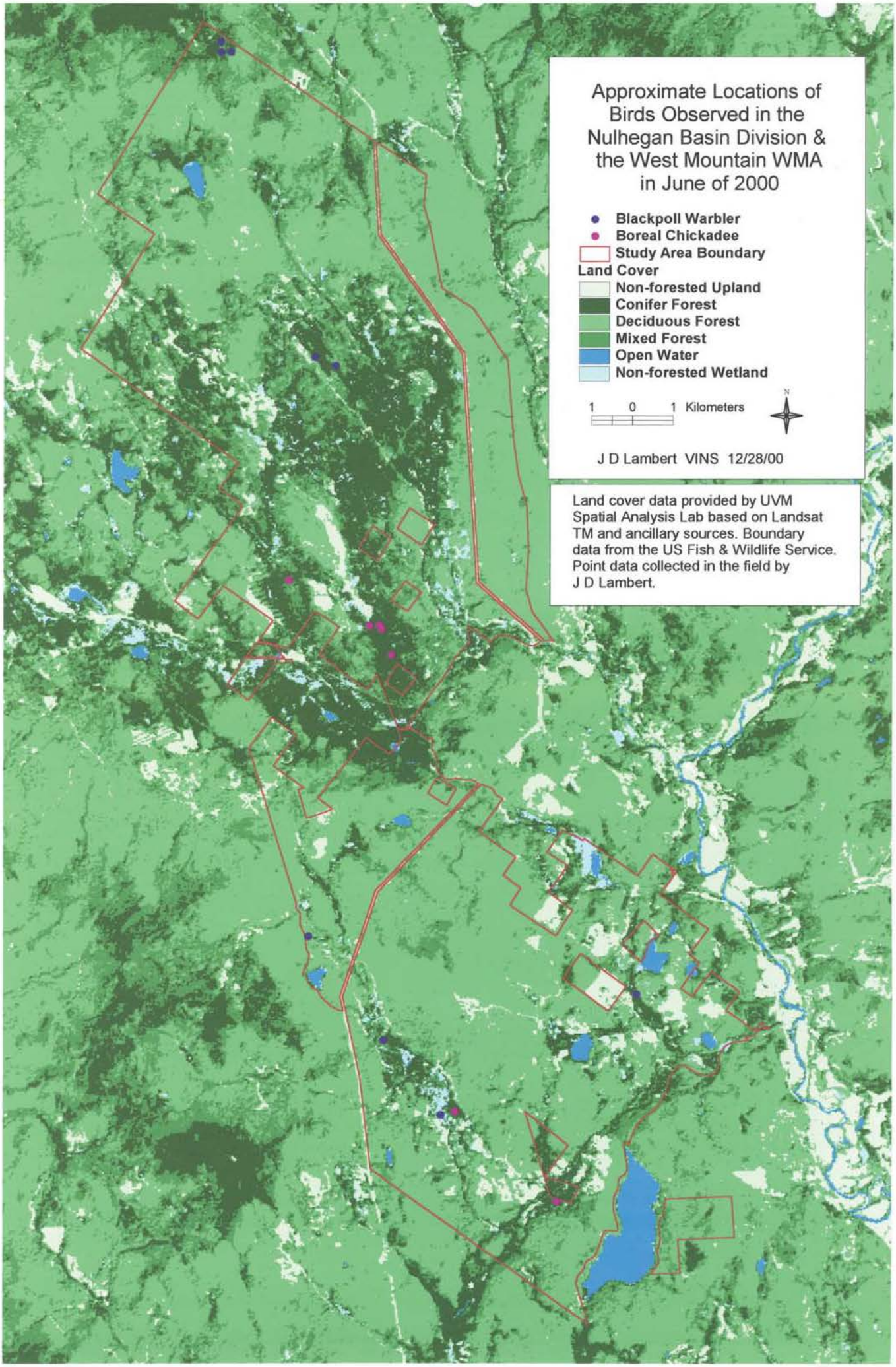

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Northern Parula
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

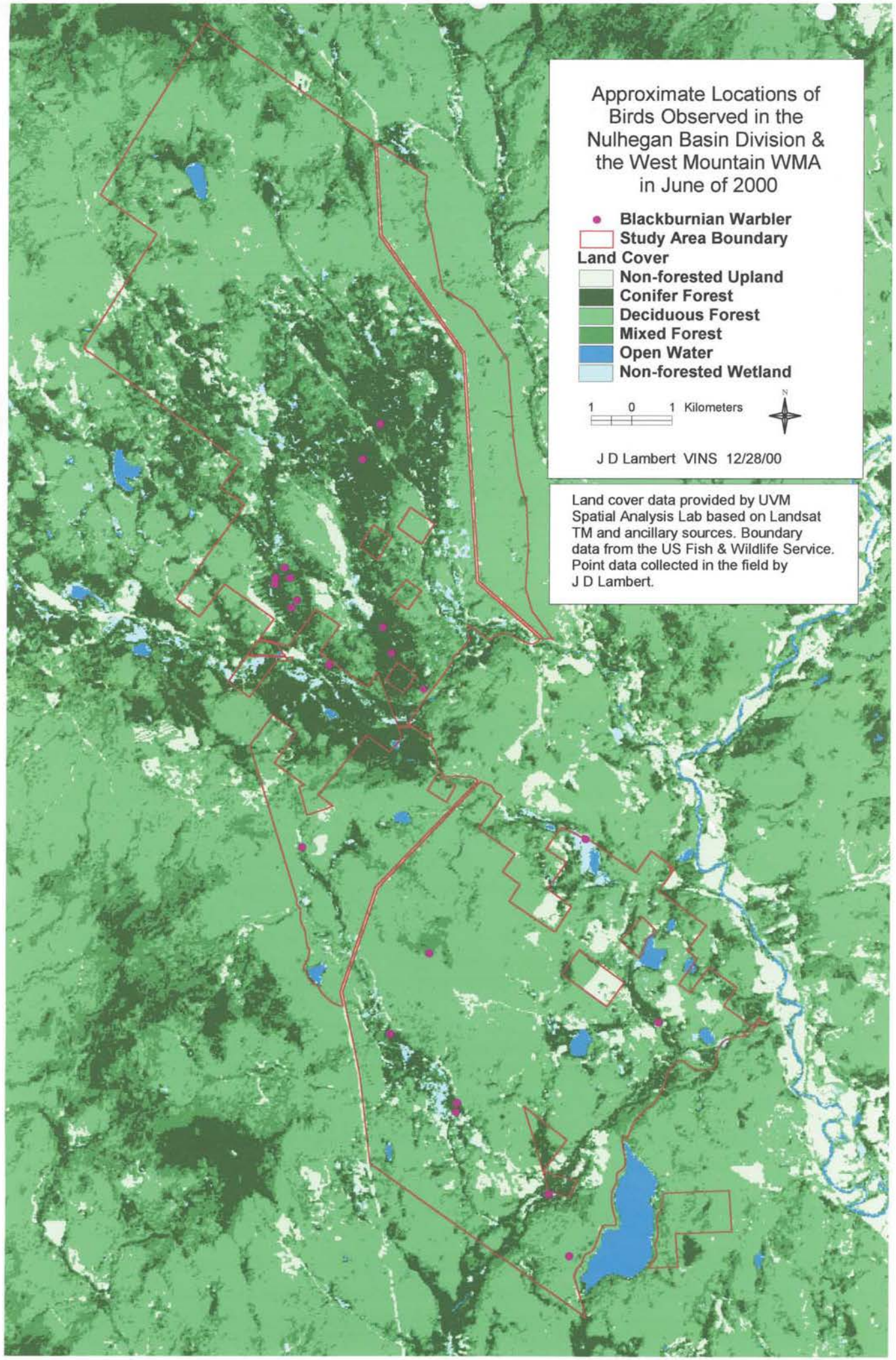

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Nashville Warbler
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

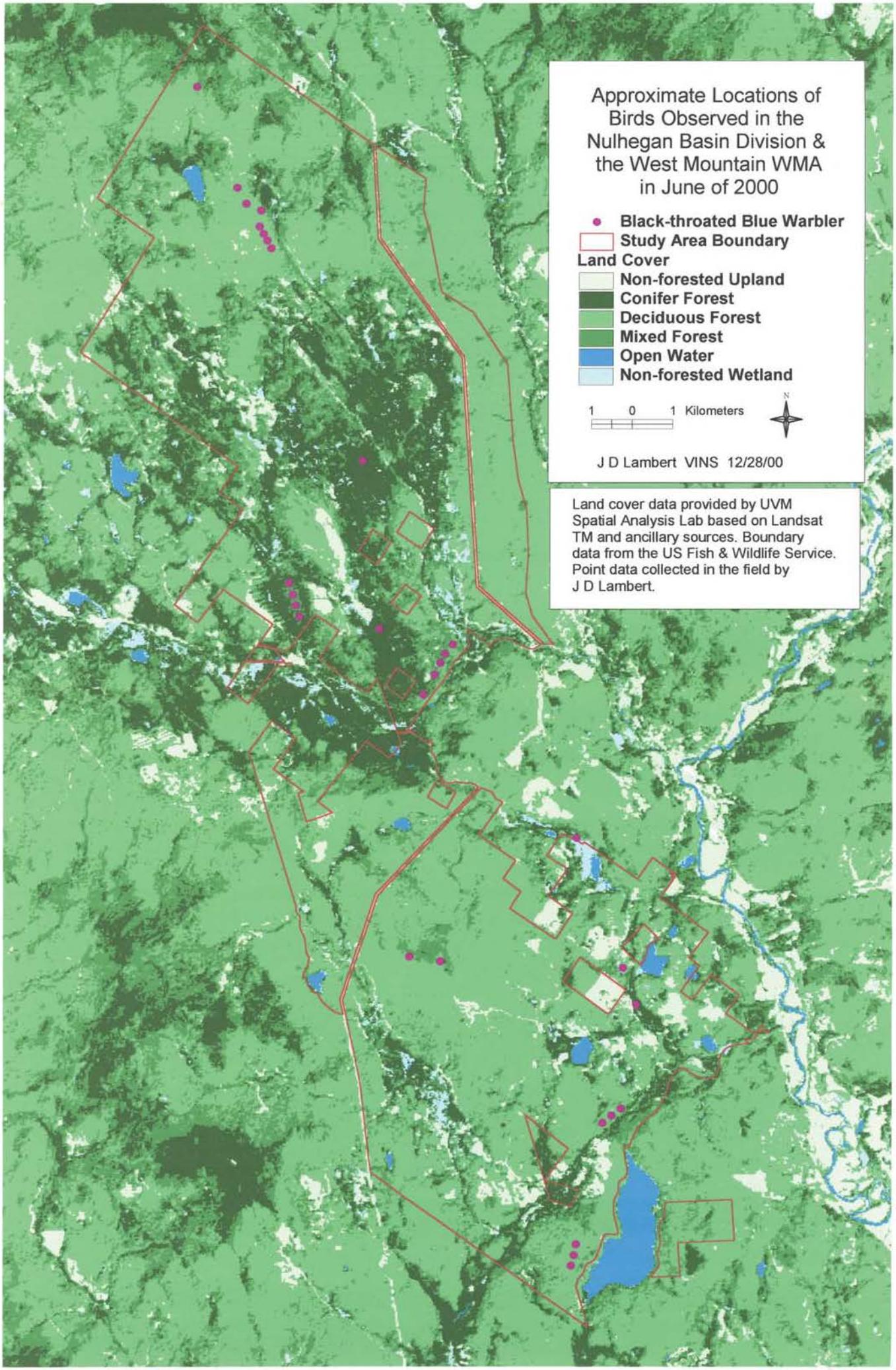

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Great Blue Heron
Least Flycatcher
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

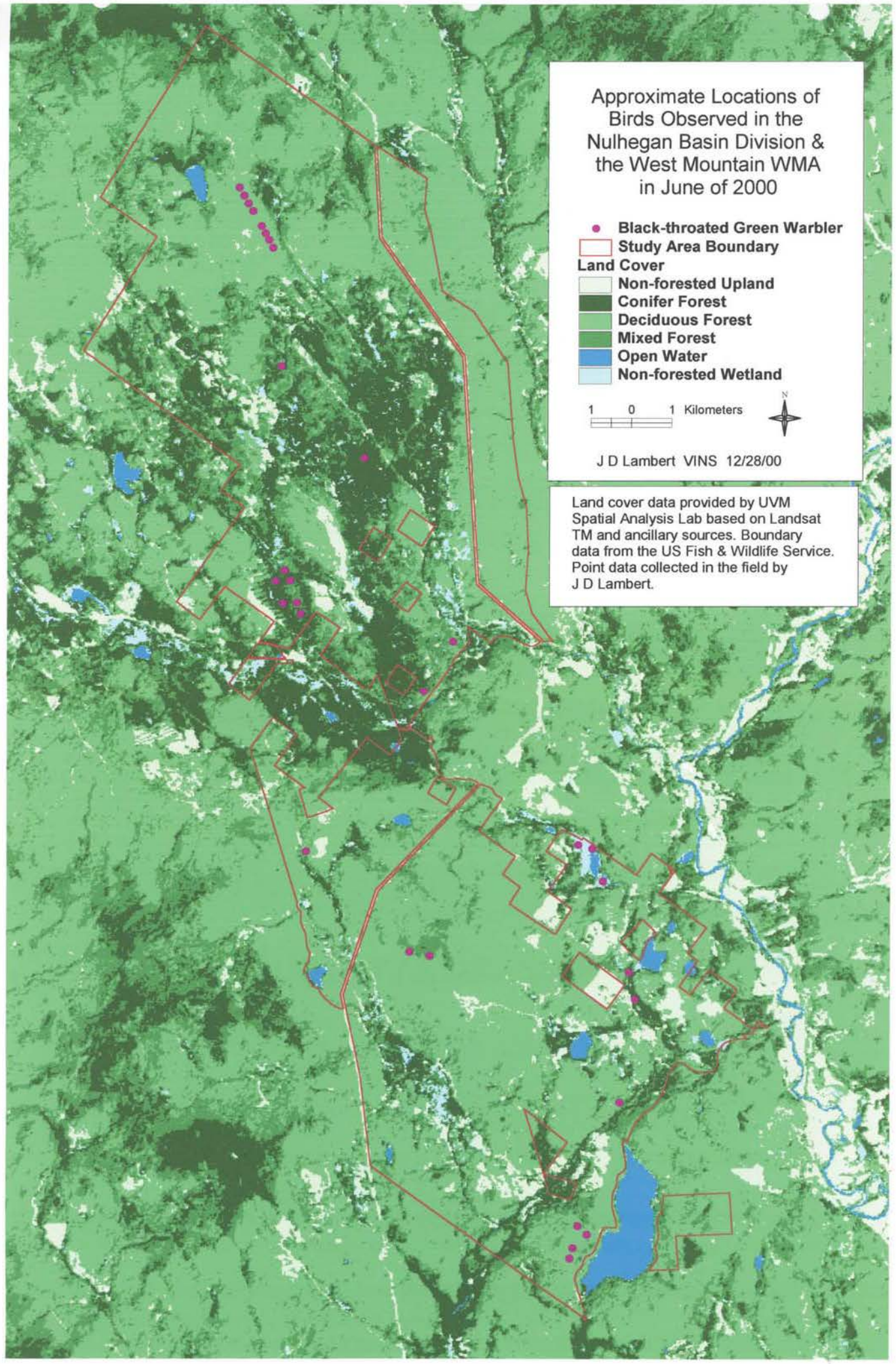

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Cooper's Hawk
Eastern Wood Pewee
Gray Jay
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

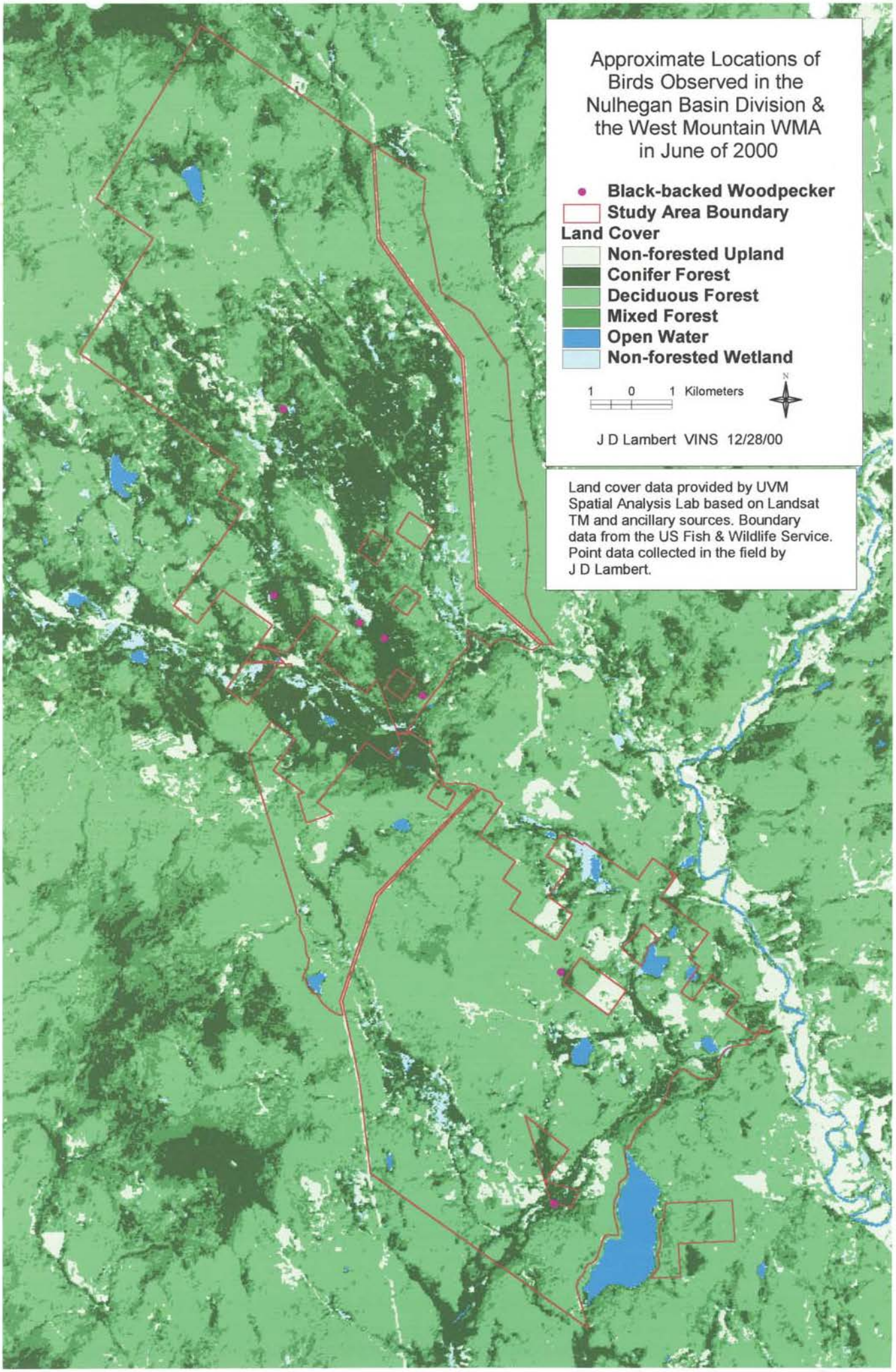

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Canada Warbler
Common Loon
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

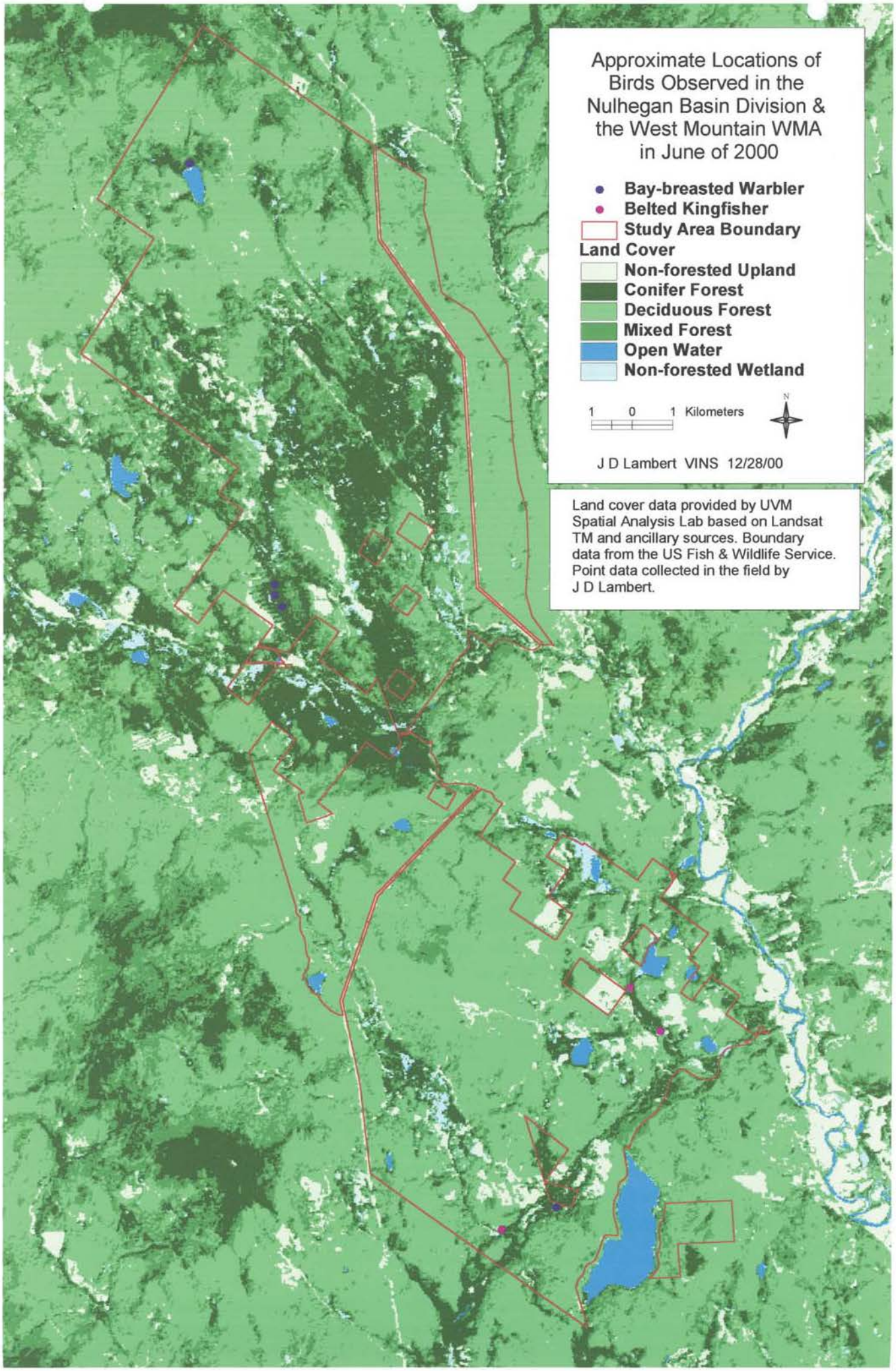

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Blackpoll Warbler
Boreal Chickadee
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.

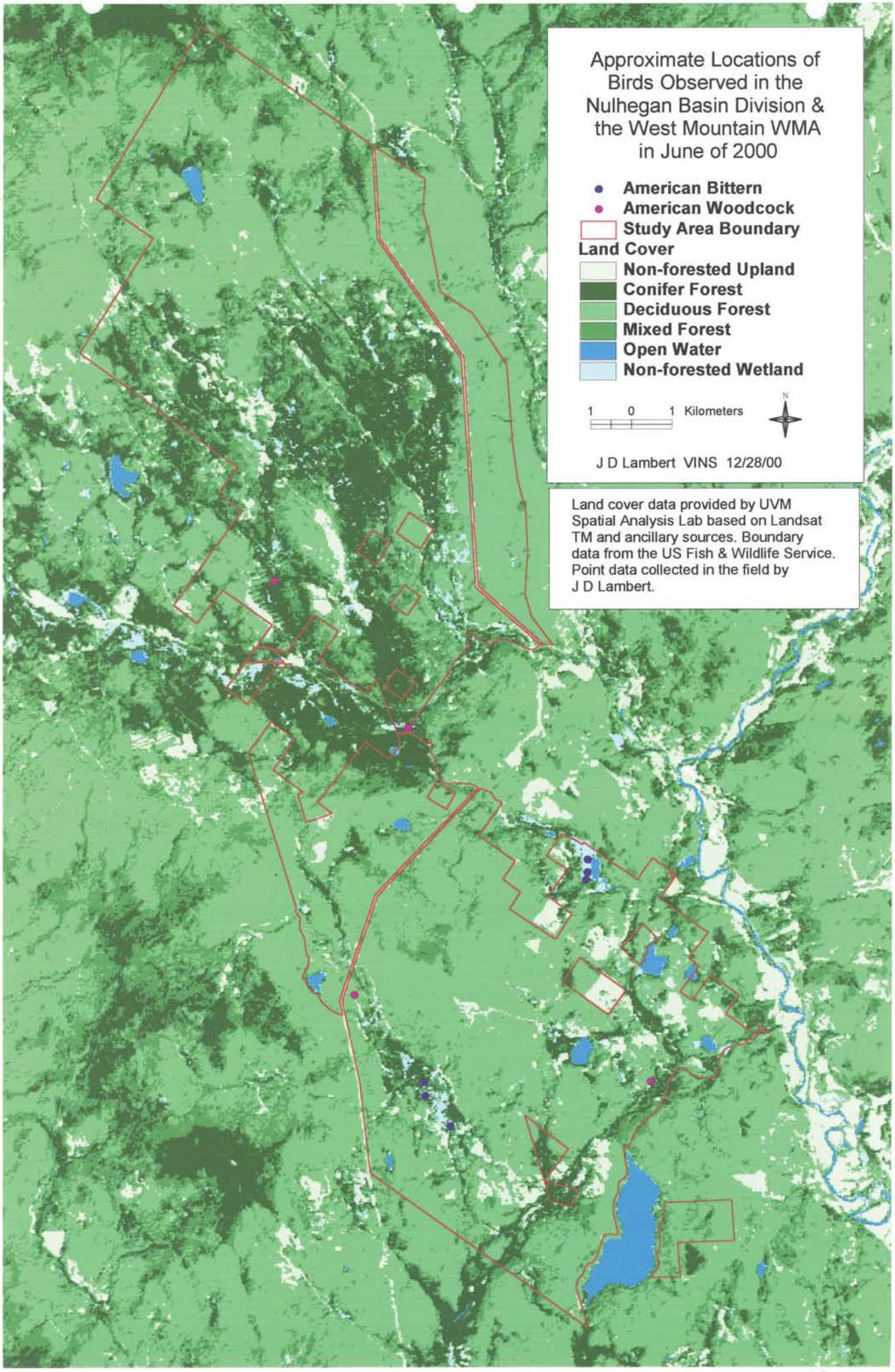

Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Blackburnian Warbler
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.


Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Black-throated Blue Warbler
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.


Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Black-throated Green Warbler
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.


Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Black-backed Woodpecker
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.


Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
Bay-breasted Warbler
Belted Kingfisher
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.


Approximate Locations of Birds Observed in the Nulhegan Basin Division & the West Mountain WMA in June of 2000
American Bittern
American Woodcock
Study Area Boundary
Land Cover
Non-forested Upland
Conifer Forest
Deciduous Forest
Mixed Forest
Open Water
Non-forested Wetland
1 0 1 Kilometers
N
J D Lambert VINS 12/28/00
Land cover data provided by UVM Spatial Analysis Lab based on Landsat TM and ancillary sources. Boundary data from the US Fish & Wildlife Service. Point data collected in the field by J D Lambert.