Selected Wildlife and Habitat Characteristics of Two River Valleys in the Boreal Forest of Québec-Labrador

Final 2001 Field Report

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Introduction

In reviewing the effect of military training activities at Canadian Forces Base Goose Bay, the Environmental Review Panel made a recommendation to the Institute for Environmental Monitoring and Research (IEMR) establish studies aimed at describing river valley resources and monitoring programs to evaluate the impacts of the low-level flying program on wildlife resources within them. This objectives of this preliminary year of work were to develop experimental design; evaluate two proposed river valleys for comparative studies; and to develop co-operation with aboriginal communities in order to incorporate their concerns and traditional knowledge. Previous work and workshops (Parker 2000) noted that river valleys had greater frequencies of military jet over flights and proposed possible study designs for assessing potential impacts of long term exposure to the greater frequency of overflights. This report deals with a preliminary assessment of the baseline relative abundance of possible affected species, logistics of research and recommendations for future research in river valley ecosystems.

The adoption of the control-impact study design and the selection of two matched pairs of control and treatment river valley sites, the identification of valued ecosystem components (VEC) species for possible study and a research plan for the River Valley Ecosystem Project (Parker 2000) were the result of preliminary feasibility and scientific workshops convened since 1999. The matched pairs of control and treatment river valleys include Little Mecatina River (Treatment) and St. Augustin River (Control), and Kenamu River (Treatment) and Anne Marie Lake (Control). Valued ecosystem component species were identified based upon anticipated vulnerability to noise and visual stimuli as a result of the low-level training program, aboriginal concerns and the practicality for study. Future studies may be incorporated into the River Valley Ecosystems Project to examine toxicity of airborne contaminants within overflown river valleys and their possible implications on exposed food chains.

The focus of the first year of the project is to describe the wildlife and habitat characteristics at the Little Mecatina River and St. Augustin River sites and assess their suitability for further study. In

September 2000 Jacques Whitford Environment Limited (JWEL) was contracted to examine the suitability of 20 km stretches of both the Little Mecatina River and the St. Augustin River, to select potential sites for base camps at each river. JWEL (2000) identified potential study areas, produced initial habitat classification maps and recommended that these study areas appeared appropriate to conduct the studies outlined in the two River Valley Ecosystems workshops. However, the work was limited in quantitative and qualitative description of wildlife populations and plant communities. The goal of the 2001 field program was to obtain general information on the wildlife communities within the study areas at Little Mecatina and St. Augustin River valleys and to validate vegetation community characteristics.

The goal for the reconnaissance program of 2001 was to obtain baseline information on 2 stretches of rivers, including inventories, community similarity, and noise levels within those river valleys in anticipation of future university-led studies of cause-and-effect relationships of low-level overflights on selected wildlife species and/or wildlife communities. Specific objectives of this year's field program were to 1) determine the relative distribution, abundance, and diversity of forest songbirds and small mammals, 2) quantify the structure and composition of the main habitat types, 3) relate songbird and small mammal abundance (presence and absence) and diversity to habitat types and structures, 4) provide a reconnaissance of other wildlife species, and 5) to provide a measure of the noise dosage at both the Little Mecatina and St. Augustin river valley study areas.

Noise levels were measured to quantify the variability of noise levels associated with low-level over flights and background noise levels at both study sites. Analyses of DND flight track data (Jung and Parr, 2000) show that the Little Mecatina River valley has been a heavily used corridor for training pilots en route to or from the Practice Target Area (PTA).

We report quantitative measures of songbird and small mammal populations and communities and qualitative observations of other wildlife species at the two River Valley Ecosystems Project study areas. Recommendations on the suitability of the study areas, taxa suitable for future study and potential research themes are presented.

Study Area

Our sampling sites were in the valleys of two large rivers which run through southern Labrador and eastern Québec and drain into the Gulf of Saint Lawrence: the Little Mecatina River (51.8°N, 60.1°W) and St. Augustin River (52.0°N, 59.3°W). The Little Mecatina River experienced regular over flights by low-level military training aircraft operating out of Goose Bay, Labrador (53.3°N, 60.3°W), while the St. Augustin River was outside of the Military Training Area and was not overflown. There are no roads or communities within 100 km of the study sites. We investigated wildlife and habitat characteristics on 15 km stretches of each river valley (Figure 1). The two stretches of river valleys were about 60 km apart and similar in latitude, topography, climate and river characteristics (flow rates, morphology, substrate, and width). Both river stretches were within deep U-shaped valleys that were > 3000 m wide and bordered by steep, rocky hills (Figures 2 and 3).

The study was conducted at a transitional zone between the Boreal Shield and Taiga Shield ecoregions, approximately 160 km south of Goose Bay, Labrador. Forest composition in the river valleys was typical of high-latitude boreal forest and taiga (forest-tundra) regions in Quebec-Labrador, and predominately consisted of open conifer-lichen woodlands and limited closed canopy conifer forests. Small patches (< 10 ha) of shade-intolerant hardwoods were common on steep, rocky hillsides. Open conifer-lichen woodlands likely had been closed conifer forest prior to fire. Riparian zones adjacent to open-conifer lichen woodlands maintained a narrow (50 - 100 m) band of closed canopy conifer forest. Closed canopy conifer forests were mature to old aged and dominated by black spruce (*Picea mariana*). Other common tree species included white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), tamarack (*Larix laricina*), trembling aspen (*Populus tremuloides*) and white birch (*Betula papyrifera*). A narrow (5 - 10 m) band of alders (*Alnus crispa* and *A. rugosa*) and willows (*Salix* spp.) fringed the rivers. Dominant shrub and ground vegetation included Labrador tea (*Ledum groenlandicum*), laurel (*Kalmia augustifolia* and *K. polifolia*), pin cherry (*Prunus pensylvanica*), sweetgale (*Myrica gale*), mountain maple (*Acer spicatum*), various berries (*Viburnum* spp. and *Vaccinium* spp.), lichens (*Cladonia* spp.) and mosses (*Hylocomium* spp. and *Sphagnum* spp.). Habitats on the plateau between the river valleys included numerous bogs, fens, lakes, ponds, and extensive tracts (> 50 km^2) of open conifer-lichen woodlands, recently burned areas, and closed canopy conifer forest. The study area bordered the Perhumid High Boreal and Low Sub-Arctic ecoclimatic regions (Ecoregions Working Group 1989); winters are cold and snowy, with snow cover extending from October until late-May, summers are cool, rainy and short. Site-specific vegetation communities could not be assessed based on preliminary mapping and available data.

Methods

Study Design and Site Selection

A control-impact study design was used, following the recommendations of the IEMR Scientific Review Committee. The Little Mecatina River study area (hereafter, Mecatina) is exposed to over-flight activity and is the treatment (impact) site. The St. Augustin River (hereafter, Augustin) is outside the low level training area and is the control site. A factorial approach to analysis was used, with RIVER (Mecatina and Augustin), HABITAT (open conifer-lichen woodland and closed canopy conifer forest) and SITE (riparian and interior) as the factors examined.

Sampling stations (*n* = 190) were distributed among the two rivers and the open conifer-lichen woodlands and closed canopy conifer forests. At Mecatina, 60 stations in open conifer and 38 in closed conifer forest were sampled. At Augustin, 62 stations in open conifer and 30 in closed conifer forest were sampled. Limited distribution of closed canopy conifer forests precluded balanced sample design. Lack of recent burns, hardwood forest and wetlands (bogs and fens) classes in the study areas precluded these from quantitative sampling.

Sampling plots were located initially through aerial reconnaissance and subsequent ground verification. We chose sites that appeared similar in age, structure, stem density, topography, and vegetation composition within habitat-type and between the two river valleys.

Figures 2 and 3 show the spatial extent of the sampling stations along each river valley. Because of potential riparian effects on birds and small mammals, we used paired sampling stations to sample in the riparian (50 m from the river) and interior (300 m from the river) zones (Naiman *et al.* 1993, Darveau *et al.* 2001). Sampling stations were a minimum of 250 m apart for songbird breeding bird surveys (Ralph *et al*. 1995). The 190 sampling stations were identified with flagging tape, given a unique alphanumeric code, and geo-referenced (Garmin 12XL, Appendix A). Point count stations were established to maximize the area of suitable closed canopy conifer forests sampled and to reduce travel distances between stations.

Sampling stations were used to survey songbird communities (Ralph *et al.* 1995), with a minimum of 30 stations per habitat type sampled. A sub-sample consisting of 96 stations were used to survey small mammal communities and habitat characteristics. The sub-sample was divided equally among rivers and habitat types (n = 24 sampling stations in open conifer and closed conifer forest, at both Mecatina and Augustin). Appendix A provides the characteristics quantified at each station.

Habitat Characteristics

Habitat was sampled in nested 0.04 ha and 0.1 ha circular plots centred on the sampling station. Structural and ground cover composition were measured. Structural components measured included shrubs, trees, and snags. Saplings (< 5 cm diameter at breast height [DBH]), small trees (5 – 9.9 cm DBH), trees (10 - 25 cm DBH), big trees (> 25 cm DBH), snags (standing dead and 10 - 25 cm DBH), and big snags (> 25 cm DBH) were counted within the 0.1 ha plot. Due to the large number of shrubs encountered, they were counted in the smaller, nested 0.04 ha plot. Species, DBH and relative height were noted for trees, snags, and shrubs. Snags were classified following the decay class scheme of Thomson *et al*. (1999).

Ground cover composition was estimated as a percentage in five random 1 m^2 plots within 20 m of the centre of each sampling station. Ground cover classifications included: bare ground (rock, sand, or soil), mosses, lichens, coarse woody debris, leaf litter (duff), woody vegetation and non-woody vegetation. To reduce observer bias in estimating percentages of ground cover composition, one person performed all of the classifications. The mean of the five 1-m2 plots for each sampling station was used in analyses.

Songbirds

Songbirds were surveyed by the point count method at 190 sampling stations, following the methodology of Ralph *et al*. (1995), Parker *et al*. 1994, Dobkin and Rich (1998), Thompson *et al.* (1999), Siegel *et al*. (2001) and N. Simon (pers. comm.). Each point count station was surveyed twice between 20 June and 19 July 2001, consistent with the breeding season for high-latitude forest songbirds in the Labrador area (Simon *et al.* 2000, Thompson *et al.* 1999, B. Turner, pers. comm., J. Huot, pers. comm.). Two trained observers surveyed different points simultaneously. Each observer waited 1 min after arriving at each station to minimize disturbance effects. All birds seen or heard within 50 m and beyond 50 m during a 5 min sampling period were recorded on the datasheet (Appendix B). To reduce bias due to structurally diverse habitats (Schiek 1997) and to accurately census birds in the riparian zone, a 50 m fixed-radius point count was used to sample birds. We did not survey during rain or if wind exceeded 20 km/hr. All bird sampling occurred prior to 10:30 ADT. An index of abundance for each species per sampling station was calculated by using the largest value at the 50 m distance radius from the 2 visits (Thompson *et al*. 1999). Community-level indices of density, species richness and species diversity were calculated for each sampling station.

Small Mammals

During August, we snap - trapped small mammals at 96 of the sampling stations. Trapping was conducted on the habitat sample plots. Trapping grids (4 x 5 trapping stations each) were centred on each point count station to ensure the greatest overlap with the 0.1 ha circular plot used for habitat sampling. Figure 5 illustrates the juxtaposition of trapping grids in relation to the songbird point count station and boundaries of vegetation sampling. Each trapping station within the 4 x 5 grid contained 2 Victor™ snap traps (Woodstream, Lititz, PA) baited with a mixture of rolled oats and peanut butter. Traps were placed within 2 m of each individual station marker and set over 3 consecutive days. Traps were checked each day, reset and re-baited as needed and results were recorded on datasheets (Appendix C).

Carcasses were placed in plastic bags and labelled (grid, trap day and date). Animals were identified to species by pelage and morphological characteristics (Banfield 1974), weighed to the nearest 0.1 g and necropsied to confirm gender and reproductive status. Skulls were collected and species positively identified by dentition (Banfield 1974). Species presence per trapping grid was based on the 3-day trap session. Community-level indices (abundance, species richness, and species diversity) were calculated for each trapping grid.

Incidental Observations

Field crews of 6 persons worked 29 days at the Little Mecatina River and 33 days St. Augustin River study areas. Crews travelled by boat an average of 20 km per day on the rivers and walked an average of 12 km per day through the woods each 8-hour day. Field crews recorded incidental observations of wildlife and signs (e.g. tracks, trails, scat, browse, nests, etc.). In particular, the field crew noted incidental observations of Little Brown Bats (*Myotis lucifugus*), Snowshoe Hare (*Lepus americanus*), Red Squirrel (*Tamiasciurus hudsonicus*), Beaver (*Castor canadensis*), Marten (*Martes americana*), Black Bear (*Ursus americana*), Moose (*Alces alces*), Ruffed Grouse (*Bonasa umbellus*), Spruce Grouse (*Dendragapus canadensis*), Tree Swallows (*Tachycineta bicolor*), raptors and waterfowl, because of their potential for subsequent study. Trips to the study areas via aircraft and one detailed helicopter reconnaissance of both study areas provided an opportunity to note large mammal and waterfowl species or the sign of other species (Beaver lodges and raptor nests). These qualitative data were used to estimate abundance and suitability for further investigation at the study areas.

Sound Measurements

Noise measurements were recorded with a programmable digital logging Sound Level Meter (824 SLM; Larson Davis, Provo, UT with Larson Davis' Light-weight Environmental Recording configuration). This setup includes a weatherproof assembly for the preamplifier and microphone, a Pelican™ case housing the instrument and rechargeable sealed lead acid cells. The system was modified to allow for a week of continuous data logging on a 12-hour daily recording schedule with additional batteries.

The sound meter was placed in the middle of the spatial extent of songbird point count stations. The microphone was placed at a height of 2.5 m and no modifications were employed to account for relative differences in local topography from the water level at each site. Sound pressure levels (decibels, dB) were recorded on a 10 or 12-hour period daily. The sound meter recorded and averaged noise dosage based on various parameters including (TWA, L_{MAX}, L_{MIN}, and A, C and Flat-weighting, Ln percentage values, 60 second time histories and 30 minute interval histories). An example of both a translated setup file and a 3-day duration report summary are included in Appendix D. All noise events that exceeded a threshold of 75 dBA (normal background noise levels) and/or 95 dBA counted and time-stamped. Upon exceeding thresholds, the unit provided a detailed 2-second noise signature of each triggered event. This additional exceedence file was needed to determine if a noise event was due to a low-level over flight (and not, for example, thunder) and to determine if the flight was a jet- or propeller-driven aircraft.

Recorded measurements were used to quantify the maximum, minimum, mean, median and the variability of noise levels associated with low-level military aircraft training. These data, when compared to background noise levels, provided a quantitative measure of the increase in noise levels associated with over flights and the associated variance.

Statistical Analyses

Habitat, songbird and small mammal data were analysed with ANOVA, given the factorial nature of the study design. For the three datasets, 1-way ANOVA was used to compare means and variance among river-habitat treatments, followed by pair wise comparisons (Tukey's Highly Significant Difference test) where significant *F*-values warranted. To provide greater resolution to differences among treatments, a 2-way ANOVA was used to test for differences in the main factors of RIVER (Mecatina and Augustin) and HABITAT (open conifer-lichen woodland and closed canopy conifer forest). The interaction (RIVER * HABITAT) was also tested.

We compared basic community-level indices (density, species richness, and species diversity) of all songbird species detected at least once within the 50 m radius using 1- and 2-way ANOVA. To compare songbird community indices and habitat characteristics, we calculated Pearson product-moment correlations (using Bonferroni-adjusted *P* values). As habitat data were collected at a sub-set of sampling stations, correlation analyses were conducted for only those stations where both habitat and songbird data were available (n = 96).

We tested for *a posteriori* differences in the distribution and habitat relationships of selected species of songbirds that were detected at a minimum of 10 (5%; Thompson *et al*. 1999, N. Simon, pers. comm.) of the sampling stations using the 1- and 2-way ANOVA. The dependent variable was the species' detection rate using the full data set from all 190 sampling stations.

No songbirds were detected at one-half of the sampling stations; therefore to test for habitat relationships of individual species, we restricted analyses to only those species detected at a minimum of 15% of the sampling stations based on species presence or absence. For these species we performed Multivariate Analysis of Variance (MANOVA) to test the combined effect of forest structural characteristics on the presence or absence of the species and to test the combined effect of ground cover composition on the presence or absence of the species. These MANOVA were followed by univariate 2-sample Student's *t*-tests between means of individual habitat variables and species presence or absence. These analyses were conducted only for sampling stations where songbird and habitat data were available ($n = 96$).

We compared community-level indices for small mammals (abundance, species richness, and species diversity) among treatments with 1- and 2-way ANOVA. We used Pearson product-moment correlations, using Bonferroni-adjusted *P* values to test among small mammal community indices and habitat characteristics. Distribution and habitat relationships of total small mammal captures and captures of Red-backed Voles (*Clethrionmys gapperi*) were examined used Correlation.

In most cases, dependent and independent variables were not normally distributed and required square root, logarithmic, and arcsine transformations to approximate normality and increase the homogeneity of variances. Statistical tests were performed on transformed data, but means (± SE) are reported in untransformed values. Due to the exploratory nature of the analyses and low sample sizes, we used an alpha level $P = 0.10$.

Results and Discussion

Habitat Characteristics

Five of the 8 habitat characteristics that described forest structure were statistically different between the two river valleys (Table 1). The mean density of shrubs, saplings, small trees and snags was greater at Mecatina than at Augustin ($P < 0.10$). The mean density of trees was greater at Augustin than at Mecatina ($P < 0.01$). In the Mecatina study area, the forests appeared to be younger and in earlier stages of succession than at the Augustin study area. Six of the forest structural characteristics measured differed among habitat types (Table 1). Mean densities of saplings, small trees, trees, big trees, snags, and big snags, were greater in closed canopy conifer forest than in open conifer-lichen woodland ($P < 0.01$); emphasizing the structural diversity and complexity of closed canopy forests. The RIVER * HABITAT interaction was significant for 4 of the forest structural characteristics (Table 1). The density of saplings and the percent of deciduous trees were significantly greater in open conifer-lichen woodlands at the Mecatina study area than at Augustin ($P < 0.05$), while means were not significantly different in the closed conifer forest at both study areas. The mean density of trees and snags was greater in the open conifer-lichen woodlands at the Augustin study area than at the Mecatina study area ($P < 0.01$), but not significantly different among the closed conifer forest at both study areas.

Ground cover composition was similar among the two study areas. The only differences observed were more bare ground and less woody (herbaceous) vegetation in the sampling stations at the Mecatina study area than at the Augustin study area ($P < 0.05$; Table 1), consistent with the observation of Mecatina being in earlier stages of succession. With the exception of woody and non-woody vegetation, all other ground cover constituents were different among the habitats (all $P < 0.05$). The most obvious difference being that lichen was the dominant ground cover in open conifer woodlands and moss was the most dominant ground cover in closed conifer forests. Coarse woody debris and leaf litter were greater in closed conifer forests than open conifer woodlands (Table 1).

Songbirds

A total of 1648 detections from 38 species of songbirds (Table 2) were recorded within 50 m of the point count stations. Nineteen species (Table 3) representing 92% of detections were recorded at 10 or more point count stations and used in the initial statistical analyses. Nine species (Table 4) were detected at 15 or more point count stations and used in detailed statistical analysis of species presence or absence in relation to habitat characteristics.

Community-Level Effects

Analyses of the songbird communities (abundance, species richness, and species diversity) suggested little difference between the two river valleys. Neither the density of songbirds (total detections), species richness, nor species diversity differed significantly when tested against the main treatment of RIVER ($P > 0.10$, Table 5). Density of songbirds and species richness differed among HABITAT classes ($P < 0.05$), but species diversity did not differ significantly. Density and species richness were marginally greater in closed conifer forests than open conifer-lichen woodlands in both river valleys. There was no significant RIVER * HABITAT interaction in the 2-way ANOVA for any of the three indices tested ($P > 0.10$, Table 5).

Correlation analysis of the relationship between habitat variables and songbird community indices indicated that there were significant correlations with habitat characteristics. Songbird density and shrub density was negatively correlated ($P < 0.05$, Table 6); sampling stations with fewer shrubs tended to have more songbird detections. No other forest structural characteristic was significantly correlated with songbird density. Species richness was negatively correlated to shrub density and positively correlated with tree and snag densities ($P < 0.10$, Table 6). Species diversity was positively correlated with the density of trees and snags ($P < 0.10$, Table 6).

Ground cover composition was correlated with community-level indices (Table 6). Density, species richness, and species diversity all were positively correlated with the percentage of coarse woody debris and leaf litter at the sampling stations, but negatively correlated with the percentage of lichen cover ($P < 0.10$, Table 6). Species diversity was positively correlated with the percentage of non-woody vegetation ($P<0.10$, Table 6).

The results of the community-level statistical tests suggested that there was no detectable effect of over flights on the songbird community indices measured, confounded by a significant habitat effect. Correlation analyses between community indices and habitat variables indicated that songbird community abundance and diversity was a function of habitat complexity (i.e. relatively well wooded with coarse woody debris). However, the correlations of habitat variables with measures of songbird community diversity were low, as illustrated by the low *r* values (Table 6).

<u>Effects on Individual Species</u>

Sample sizes were sufficient for 19 species to permit comparisons among river valleys and habitat sites. Of these, 9 species were detected more often at one river valley than at the other ($P < 0.10$, Table 3). Yellow-bellied Flycatcher, Ruby-crowned Kinglet, Fox Sparrow, White-throated Sparrow and White-crowned Sparrow were more numerous at Little Mecatina River (treatment site), while Boreal Chickadee, Tennessee Warbler, Magnolia Warbler and Black-throated Green Warbler were more numerous at St. Augustin River control site (Table 3).

HABITAT had a significant effect on the detection rates for some species, regardless of river valley. Nine species were detected more often in one habitat class than the other (all $P < 0.10$, Table 3). Boreal Chickadee, Golden-crowned Kinglet, Swainson's Thrush, Yellow-rumped Warbler, Black-throated Green Warbler and Northern Waterthrush were detected more often in closed conifer forests than open conifer-lichen woodlands. Hermit Thrush, Blackpoll Warbler, and White-throated Sparrow detection rates were greater in open conifer-lichen woodlands than closed conifer forests.

The 2-way ANOVA had significant RIVER * HABITAT interactions for five of the 19 species. Boreal Chickadee, Winter Wren, Ruby-crowned Kinglet, Black-throated Green Warbler and Northern

Waterthrush ($P < 0.10$, Table 3) had significant interaction effects due to river and habitat. The Northern Waterthrush and Boreal Chickadee were detected more often in closed conifer forests than open conifer-lichen woodlands at Mecatina River, but the converse occurred at St. Augustin River. This may reflect that these species are somewhat ubiquitous or that unmeasured variables are affecting this relationship. Due to limited number of site visits, there is a possibility of differences due to sampling error.

Detection rates (presence / absence ratios) for nine of the 38 species were suitable to analyse the effect of habitat variables on their presence or absence, irrespective of river valley or habitat type. The combined, multivariate effect of forest structural characteristics on the presence of a species was only found for only one species, White-throated Sparrow ($P < 0.05$, Table 4). The multivariate analysis of variance (MANOVA) model using ground cover composition showed a significant effect on the presence of four species: Swainson's Thrush, Yellow-rumped Warbler, Magnolia Warbler, and White-throated Sparrow ($P < 0.10$, Table 3). For these four species, ground cover composition was a better indicator of habitat suitability than forest structure, and ground cover composition effected species distribution.

Those species less numerous at the treatment site (Mecatina) were mostly wood warblers (insectivores) and those more numerous at the treatment site consisted mostly of sparrows (seed eaters) and two insectivores (see Table 3). Further investigation at Mecatina may be required to determine if that site is less suitable to insectivores, particularly some species of wood warblers (Schwab *et al.* 2001, Whitaker and Montevecchi 1999). As our habitat analysis indicated significant differences in the habitats available at both study areas, it is not likely that differences were due to military over flights. Further study of the effect of low-level training activities on songbird behaviour and reproductive success may focus on insectivorous species such as wood warblers. Such studies need to carefully control habitat effects.

Small Mammals

We captured 183 small mammals representing 8 species (Table 8) during 11,088 trap nights (1.65 captures per 100 Trap Nights). 67% of captures were Red-backed Voles and 17% were Masked Shrew (*Sorex cinereus*). 60.4% of the trapping grids had captures (*n* = 96, Table 8). Capture rates were very low given the amount of trapping effort (11,088 trap nights). In similar studies of small mammal distribution in boreal forest habitats in Labrador (Simon *et al*. 1999) and Ontario (Jung, unpubl. data), capture rates were much higher. We do not know if the capture rates we observed were due to poor habitat quality or depressed small mammal populations in 2001, or possibly trapping methodology. Species composition and the relative community dominance of red-backed voles were consistent with Banfield (1974) and Simon *et al*. (1999).

Community-Level Effects

Community-level indices (abundance, species richness and species diversity) differed slightly between the two river valleys. Species richness and diversity were marginally higher at Augustin than at Mecatina ($P < 0.1$, Table 10). These differences can be attributed to the fact that four species (50%) were endemic to the Augustin study site, even though species-specific capture rates were low (Table 8). Abundance of small mammals differed against the main treatment of HABITAT ($P < 0.05$), but not species diversity, richness, or evenness. Small mammal captures were substantially higher in closed coniferous forests relative to open conifer woodlands. Unlike songbird communities, we did not observe any significant RIVER * HABITAT interactions in the small mammal 2-way ANOVA models ($P > 0.10$, Table 10).

Variables of forest structure were important factors in determining species abundance and species richness of small mammal communities, independent of river valley or habitat type. Species abundance and richness small mammals were positively correlated with density of big trees, snags and big snags ($P < 0.05$, Table 11). No other forest structural characteristic was significantly correlated with any of the small mammal community descriptors. Coarse woody debris and litter density were positively correlated with all three community-level indices ($P < 0.10$, Table 11). The percentage of lichen coverage was negatively correlated with small mammal abundance ($P < 0.05$). Small mammal community abundance and richness was clearly a function of habitat complexity: with higher degrees of structural complexity within the adjacent forest stands; stands with larger diameter trees, higher snag counts, and percentage of coarse woody debris being the most diverse and productive. Open conifer forests contained poorer small mammal communities in terms of abundance, species richness, and species diversity than closed conifer forests.

Effects on Individual Species

Due to the small sample sizes obtained for captured species comparisons among river valleys and habitat sites were only performed on Red-backed Vole, Masked Shrew, and Meadow Jumping Mouse (*Zapus hudsonius*). The main factor HABITAT had a significant effect on the capture rates of Red-backed Voles and Meadow Jumping Mice. Red-backed Voles were more frequently captured in closed conifer forests than open-conifer woodlands, whereas the converse was true for Meadow Jumping Mice. None of the small mammals exhibited RIVER * HABITAT interactions.

Correlation analysis of the relationship between habitat variables and Red-backed Vole captures and total capture of all small mammals indicated that these measures were sensitive to some habitat characteristics, regardless of river valley or habitat site. Total captures values (abundance) are reported in Table 11, however it is recognized that the results of this analysis is largely a function of Red-backed Voles abundance, given their disproportionate composition of the captures. A comparison of the response of Red-back Vole abundances to that of the aggregate of captured small mammals is presented in Table 12. Total captures and the capture of Red-backed Voles was significantly positively correlated with density of big trees, snags, big snags and coarse woody debris ($P < 0.001$, Table 12). Conversely, both were significantly negatively correlated with lichen coverage ($P < 0.05$, Table 12); those trapping grids with low lichen coverage tended to have more trapping success.

Incidental Wildlife Observations

Few species were observed at both river valleys. Conspicuous species such as Beaver, Moose, and waterfowl were rarely observed. Species that are considered common in Labrador, such as Snowshoe Hare, Ruffed Grouse and Spruce Grouse were rarely encountered. Red Squirrel and Black Bear were the only common species. Table 13 lists the species incidentally observed by field crews and provides relative abundance and suitability for intensive study. The sections of the river valleys studied appeared to have low diversity and density of wildlife. Several factors may contribute to the few incidental sightings. The most plausible are:

1. Our study may have occurred at a low in the cycle of common prey species such as grouse, small mammals and Snowshoe Hare, affecting relative abundance and that of predators that depend upon them. The low small mammal trap success corroborates this theory. Grouse and hare were reported to be low in central Labrador at this time (F. Phillips, pers. comm.).
2. Much of the study area is open conifer or burned forest that may be poor habitat for many of the species we were considering.
3. Deep snow may periodically eliminate some species such as Moose.
4. Common game and fur bearing species (e.g. Beaver, Moose, Porcupine) are likely harvested at both study areas; but the extent and history of the harvest is not known.

Sound Measurements

The objective of measuring sound levels this year was to obtain baseline data on noise levels at the two river valleys. At the Mecatina treatment site, data for 212.5 hours spanning 20 days were collected. At Augustin, the sound meter malfunctioned, providing data for only 36.0 hours over 3 consecutive days.

The Mecatina site received a relatively high degree of over flight activity with 131 exceedence events over the 212.5 hours (events exceeding 75 dBA). On days with good weather, activity of 15 – 20 military over flights per day were observed. Days with poor, inclement weather were largely devoid of military over flight traffic. Low-level military jets observed included F-4, F-16, Tornado and Mirage fighters as well as propeller-driven C-160 Trans-All aircraft.

Aircraft activity was not directed or targeted toward the sound meter location, so flights paths triggering the sound meter varied. Flight activity was recorded in notebooks by the field crew whenever possible and used as a cross reference for the logged sound exceedence events. Further analysis to compare the number of events recorded by the sound meter, those logged as over flights by the field crew and those reported by DND in the 2001 digital flight track data may be useful for interpolation of sound models based on flight track data.

A detailed analysis of the noise data from the 2001 River Valley Project is necessary if future study in these areas is proposed. Raw sound data, an in-house breakdown/exploratory analysis of the sound data. A summary report of the inherent problems encountered in the field, noting some of the potential limitations of the data, including daily site-specific weather conditions and aircraft affrights has been submitted to a Canadian acoustic laboratory for initial exploration prior to pursuing detailed analysis.

Recommendations

Our study of selected wildlife and habitat characteristics at the Little Mecatina and St. Augustin river valleys has led us to make the following recommendations:

(1) The Institute should reconsider the cost/benefit of conducting intensive field research on the effects of noise on wildlife at these two sites. Although the Little Mecatina River is an attractive study area from the perspective of the history and number of over flights it receives, it may not be suitable as the site for large-scale ecosystem study. The St. Augustin River appeared to be a reasonable control site for the Little Mecatina River, however, habitat characteristics of the study sites for the two river valleys confounded interpretation of small mammal and bird data, and logistics of travel were difficult, time consuming and costly. With respect to study design and logistics at these sites:

i. Investigation of songbird and small mammal communities, coupled with incidental observations made during substantial field work, lead us to believe that the wildlife communities of these river valleys have poor diversity and abundance. Species of concern for study, such as Beaver, Snowshoe Hare, porcupine and grouse were rarely observed. Although some species may be numerous enough to permit detailed study (some songbird species, Red-backed Voles and Red Squirrels), they are ubiquitous in Labrador and could be better studied at more accessible sites.

ii. Habitat diversity is very low at the two sites. The coarse habitat classification maps provided in JWEL (2000) were not accurate enough for useful comparison when ground validated. Open conifer-lichen woodlands predominate and these areas have fairly low wildlife diversity and abundance. Limited closed canopy conifer forest occurred, and limited hardwood, burned forest or bog habitat were represented.

iii. The cost of traveling to these remote sites is high relative to the value of the data gathered. In several instances, field crews were trapped at study sites due to poor weather. In two other cases, the need to remove ill individuals by helicopter was also very costly. Given that the species recommended for further study are generally very common, these studies could be accomplished much more economically closer to Goose Bay or other more accessible sites, particularly at sites that can be more easily accessed (e.g. by vehicle and/or boat).

iv. Access to and mobility at the study areas was somewhat reasonable but, at times, outright difficult. The navigable stretch of river indicated in JWEL (2000) was not consistent throughout the study period. Rapids, current and water level fluctuations resulted in limited access to the study area by floatplane and restricted access to sampling stations by boat. For example, during one week in 2001, water levels were too low for aircraft to land at the St. Augustin River. At other times, high water levels and strong currents made access by floatplane infeasible. Field crews traveled 5-10 km by boat to reach study sites, which was time - consuming and unreliable, given water level fluctuations. Without companion roads or a lake as a travel corridor, river travel alone was not dependable, constraining and not conducive to efficient data collection. Considering the species with potential for future study, the availability of roads and/or a large lake in the study area will greatly decrease costs and increase both safety and data collection.

(2) The number of species that appear suitable for further, intensive study at these two river valleys is limited, but includes: five species of common songbirds (Gray Jay, Ruby-crowned Kinglet, Swainson's Thrush, Yellow-rumped Warbler and Slate-coloured Junco), Red Squirrel, Red-backed Vole and Black Bear.

i. The songbird species recommended were all detected at a minimum of 30% of the point count stations, making them somewhat readily observable. To this list, Magnolia Warbler, Northern Waterthrush, Fox Sparrow, and White-throated Sparrow might also be considered as they were observed at a minimum of 20% of the point count stations. Regardless, a consideration in choosing species for intensive field study should be to include a small number of species (3-5) from these nine species, which have different life history traits (see Table 7). Future study of density, nest success and productivity in similar habitats should be considered.

ii. The only small mammal species likely numerous enough to permit detailed field investigations were Red Squirrel and Red-backed Vole. Red Squirrels may be an ideal candidate for intensive study of the effect of noise on behaviour, activity and productivity, as they are relatively abundant, observable, large enough to be individually marked, nest in trees and are highly social and territorial.

iii. We have no quantitative data on Black Bear abundance at the two river valleys, but they did appear to be common, as they are elsewhere in Quebec-Labrador. Black Bear would be a suitable species to test hypotheses of the effect of low-level aircraft disturbance on space use, habitat displacement, activity and denning ecology. However, this would likely require much larger study areas than envisioned at the Little Mecatina and St. Augustin rivers. A Black Bear study would be better as part of an ecosystem study, such as the proposed Red Wine Mountains caribou project, rather than a treatment-based study design as envisioned at Little Mecatina and St. Augustin rivers.

(3) Given differences in habitat characteristics and natural differences in wildlife community composition among these two (or any) river valleys, we do not recommend that studies of a community composition or population abundance nature be pursued. Further study should focus on behavioral and reproductive success characteristics of individuals. It would be challenging to statistically separate the effects of jet training activity from those of subtle habitat and regional differences on wildlife communities and populations. Such results would not provide cause-effect relationships and the question of the effect of noise would remain ambiguous, despite significant research effort.

(4) If future studies are pursued in these areas, the songbird data should be further analyzed to examine other community-level indices between the river valleys, habitats, and sampling sites. Rarefraction and equitability should be measured and related to the habitat data through multivariate analyses such as detrended correspondence analysis. Further analyses might also focus on guilds and differences among riparian and interior sites.

(5) The Institute needs to develop a comprehensive sound monitoring protocol for the River Valley Ecosystem Project. Given the highly technical nature of acoustic sampling and data analyses, the growing number of cause and effect studies planned, and the acceptance that noise dosages are the preferred linkage variable, well-designed monitoring studies are necessary. This protocol may be project specific and have to be modified for additional studies (i.e. proposed Red Wine Mountains caribou project). Variables that need to be addressed for consultation include number of sound meters required, how they should be deployed, parameters measured, timing and recording schedules, topographical considerations, and effects of variable weather.

(6) There is potential for directed study of long term effects of exposure to low level training overflights in river valleys with relatively high numbers of over flights. Future collaboration with the Province of Quebec to examine specific questions should be pursued.

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Tables

Table 1. Differences in forest structure and ground cover variables (mean ± SE) between open conifer and closed canopy conifer forest plots surveyed for songbirds and small mammals in the St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Variable	St. Augustin River		Little Mecatina River		Effect [C]		
	Closed Conifer (*n* = 30)	Open Conifer (*n* = 62)	Closed Conifer (*n* = 38)	Open Conifer (*n* = 60)	River	Habitat	River X Habitat
Shrubs [A]	2771 ± 375	3252 ± 473	3607 ± 575	3963 ± 546	3.66 ‡	0.366	0.032
Saplings [A]	820 ± 96	378 ± 56	1072 ± 214	865 ± 223	6.54 *	12.369 **	4.31 *
Small Trees [A]	682 ± 111	285 ± 54	793 ± 105	432 ± 58	3.93 *	27.93 ***	0.10
Trees [A]	885 ± 84	452 ± 63	927 ± 80	179 ± 48	7.27 **	77.14 ***	11.18 **
Big Trees [A]	70 ± 20	15 ± 7	50 ± 11	5 ± 3	1.08	25.93 ***	0.39
Snags [A]	86 ± 18	25 ± 10	217 ± 32	18 ± 10	4.55 *	68.21 ***	13.00 **
Big Snags [A]	22 ± 7	1 ± 1	23 ± 7	2 ± 1	0.34	25.15 ***	0.24
Deciduous Trees (%)	11 ± 4	3 ± 1	6 ± 2	15 ± 6	0.83	>0.01	4.49 *
Bare Ground [B]	0.5 ± 0.2	3.0 ± 1.0	1.1 ± 0.6	0.9 ± 0.3	1.62	3.94 *	5.16 *
Coarse Woody Debris [B]	14.0 ± 1.7	5.7 ± 0.8	14.3 ± 1.7	6.0 ± 0.8	0.04	40.77 ***	>0.00
Leaf Litter [B]	9.9 ± 1.6	4.1 ± 0.8	7.1 ± 1.1	4.3 ± 0.7	1.67	15.91 ***	2.05

Variable	St. Augustin River		Little Mecatina River		Effect [C]		
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)	River	Habitat	River X Habitat
Lichen [B]	7.9 ± 2.8	48.1 ± 5.0	4.1 ± 2.2	48.5 ± 5.1	0.19	111.69 ***	0.28
Moss [B]	42.9 ± 4.0	16.9 ± 4.4	54.1 ± 3.6	17.9 ± 4.4	2.176	57.34 ***	1.55
Non-woody Vegetation [B]	12.2 ± 1.5	7.8 ± 1.0	10.7 ± 0.9	11.2 ± 2.0	0.44	1.81	3.02 *
Woody Vegetation [B]	12.4 ± 1.4	14.4 ± 1.3	8.8 ± 1.1	11.3 ± 1.7	6.01 *	2.65	0.04

[A] Forest structure variable: stems per ha.

[B] Ground cover variable: percent ground cover

[C] F-ratio values derived from a 2-way ANOVA ($F_{1, 92}$) of main treatment effects (River, Habitat) and their interaction (River X Habitat); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

Table 2. Percent of point count stations (n = 190) at which songbird species were detected within a 50 m radius in open conifer-lichen and closed canopy conifer forest at Little Mecatina River and St. Augustin River, Quebec-Labrador, 2001.

Species	Percent of Stations Present				Total Stations Present	
	St. Augustin River		Little Mecatina River			
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)	Number	Percent
Olive-sided Flycatcher *Contopus cooperi*	0	0	2.6	0	1	0.5
Yellow-bellied Flycatcher *Empidonax flaviventris*	3.3	1.6	10.5	11.7	13	6.8
Alder Flycatcher *Empidonax alnorum*	0	1.6	0	0	1	0.5
Blue-headed Vireo *Vireo solitarius*	3.3	6.5	5.3	1.7	8	4.2
Gray Jay *Perisoreus canadensis*	26.7	32.3	39.5	33.3	63	33.2
Boreal Chickadee *Poecile hudsonica*	50.0	14.5	10.5	1.7	29	15.2
Red-breasted Nuthatch *Sitta canadensis*	3.3	1.6	5.3	3.3	6	3.2
Winter Wren *Troglodytes troglodytes*	6.7	8.1	10.5	0	11	5.8
Golden-crowned Kinglet *Regulus strapa*	23.3	8.1	26.3	5.0	25	13.2
Ruby-crowned Kinglet *Regulus calendula*	13.3	38.7	68.4	43.3	80	42.1

Species	Percent of Stations Present				Total Stations Present	
	St. Augustin River		Little Mecatina River			
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)	Number	Percent
Swainson's Thrush *Catharus ustulatus*	63.3	32.3	57.9	30.0	79	41.6
Hermit Thrush *Catharus guttatus*	16.7	29.0	5.3	18.3	36	19.0
American Robin *Turdus migratorius*	0	1.6	0	3.3	3	1.6
Bohemian Waxwing *Bombycilla garrulus*	0	8.1	2.6	0	6	3.2
Cedar Waxwing *Bombycilla cedrorum*	6.7	6.5	5.3	0	8	4.2
Tennessee Warbler *Vermivora peregrina*	23.3	16.1	10.5	6.7	25	13.2
Yellow Warbler *Dendroica petechia*	10.0	6.5	7.9	5.0	13	6.8
Magnolia Warbler *Dendroica magnolia*	26.7	32.3	13.2	15.0	42	22.1
Yellow-rumped Warbler *Dendroica coronata*	43.3	17.7	42.1	35.0	61	32.1
Black-throated Green Warbler *Dendroica virens*	33.3	8.1	7.9	5.0	21	11.1
Blackburnian Warbler *Dendroica fusca*	0	1.6	0	0	1	0.5
Palm Warbler *Dendroica palmarum*	0	1.6	0	0	1	0.5

Species	Percent of Stations Present				Total Stations Present	
	St. Augustin River		Little Mecatina River			
	Closed Conifer (*n* = 30)	Open Conifer (*n* = 62)	Closed Conifer (*n* = 38)	Open Conifer (*n* = 60)	Number	Percent
Bay-breasted Warbler *Dendroica castanea*	10.0	0	5.3	0	5	2.6
Blackpoll Warbler *Dendroica striata*	3.3	9.7	0	16.7	17	9.0
Black-and-white Warbler *Mniotilta varia*	0	0	0	1.7	1	0.5
American Redstart *Setophaga ruticilla*	0	1.6	0	0	1	0.5
Ovenbird *Seiurus aurocapillus*	0	3.2	0	0	2	1.1
Northern Waterthrush *Seiurus noveboracensis*	23.3	29.0	50.0	16.7	54	28.4
Wilson's Warbler *Wilsonia pusilla*	3.3	0	0	1.7	2	1.1
Chipping Sparrow *Spizella passerina*	0	3.2	0	6.7	6	3.2
Fox Sparrow *Spizella iliaca*	10.0	14.5	31.6	30.0	42	22.1
Lincoln's Sparrow *Melospiza lincolnii*	0	0	0	1.7	1	0.5
White-throated Sparrow *Zonotrichia albicollis*	0	24.2	15.8	40.0	45	23.7
White-crowned Sparrow *Zonotrichia leucophrys*	6.7	3.2	10.5	13.3	16	8.4

Species	Percent of Stations Present				Total Stations Present	
	St. Augustin River		Little Mecatina River			
	Closed Conifer (*n* = 30)	Open Conifer (*n* = 62)	Closed Conifer (*n* = 38)	Open Conifer (*n* = 60)	Number	Percent
Slate-coloured Junco *Junco hyemalis*	46.7	48.4	34.2	53.3	89	46.8
Rusty Blackbird *Euphagus carolinus*	0	0	0	1.7	1	0.5
White-winged Crossbill *Loxia leucoptera*	3.3	4.8	0	0	4	2.1
Pine Siskin *Carduelis pinus*	10.0	3.2	5.3	3.3	9	4.7

Note:

Species not recorded within 50 m radius, but also observed as flyovers or at > 50 m included: spruce grouse (*Dendragapus canadensis*), ruffed grouse (*Bonasa umbellus*), spotted sandpiper (*Actitis hypoleucos*), common nighthawk (*Chordeiles minor*), common raven (*Corvus corax*), blue jay (*Cyanocitta cristata*), hairy woodpecker (*Picoides villosus*), black-backed woodpecker (*Picoides arcticus*), three-toed woodpecker (Picoides tridactylus), northern flicker (*Sphyrapicus varius*), tree swallow (*Tachycineta bicolor*), pine grosbeak (*Pinicola enucleator*), and Philadelphia vireo (*Vireo philadephicus*). All were recorded 1-4 times during 380 surveys.

Table 3. Abundance of songbirds per point count station (mean ± SE) detected within 50 m in open conifer–lichen and closed canopy conifer forest between St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Species [A]	St. Augustin River		Little Mecatina River		F-Ratio [B]	Effect [C]		
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)		River	Habitat	River X Habitat
Yellow-bellied Flycatcher *Empidonax flaviventris*	0.03 ± 0.03 A	0.02 ± 0.02 A	0.11 ± 0.05 A	0.12 ± 0.04 A	2.11	5.11*	>0.01	0.14
Gray Jay *Perisoreus canadensis*	0.30 ± 0.10 A	0.34 ± 0.07 A	0.40 ± 0.08 A	0.33 ± 0.06 A	0.32	0.65	>0.01	0.56
Boreal Chickadee *Poecile hudsonica*	0.57 ± 0.11 A	0.15 ± 0.05 B	0.13 ± 0.07 B	0.02 ± 0.02 B	15.27 ***	26.89 ***	21.43 ***	7.39 **
Winter Wren *Troglodytes troglodytes*	0.07 ± 0.05 A	0.10 ± 0.04 A	0.11 ± 0.05 A	0 A	1.93	0.44	1.31	2.91 ‡
Golden-crowned Kinglet *Regulus satrapa*	0.23 ± 0.08 A	0.08 ± 0.04 B	0.29 ± 0.08 A	0.05 ± 0.03 B	4.86 **	0.01	13.63 ***	0.49
Ruby-crowned Kinglet *Regulus calendula*	0.13 ± 0.06 A	0.45 ± 0.08 B	0.68 ± 0.08 C	0.53 ± 0.10 BC	6.76 ***	15.73 ***	0.20	10.21**
Swainson's Thrush *Catharus ustulatus*	0.83 ± 0.14 A	0.44 ± 0.09 BC	0.63 ± 0.10 AC	0.33 ± 0.07 B	5.315 **	1.12	15.38 ***	0.14
Hermit Thrush *Catharus guttatus*	0.20 ± 0.09 AB	0.34 ± 0.07 AB	0.05 ± 0.04 A	0.30 ± 0.09 AB	2.73 *	2.34	5.23 *	0.13
Tennessee Warbler *Vermivora peregrina*	0.27 ± 0.10 A	0.16 ± 0.05 A	0.11 ± 0.05 A	0.07 ± 0.03 A	2.08	5.147 *	1.425	0.206
Yellow Warbler *Dendroica petechia*	0.13 ± 0.08 A	0.07 ± 0.03 A	0.08 ± 0.04 A	0.05 ± 0.03 A	0.413	0.378	0.95	0.064
Magnolia Warbler *Dendroica magnolia*	0.27 ± 0.08 A	0.33 ± 0.06 A	0.13 ± 0.06 B	0.17 ± 0.05 B	2.40 *	5.64 *	0.41	0.06

Species [A]	St. Augustin River		Little Mecatina River		F-Ratio [B]	Effect [C]		
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)		River	Habitat	River X Habitat
Yellow-rumped Warbler *Dendroica coronata*	0.47 ± 0.10 A	0.19 ± 0.06 B	0.55 ± 0.12 A	0.38 ± 0.07 AB	3.53 *	1.92	6.23 *	1.02
Black-throated Green Warbler *Dendroica virens*	0.33 ± 0.09 A	0.08 ± 0.04 B	0.08 ± 0.04 B	0.05 ± 0.03 B	6.62 ***	9.69 **	9.46 **	5.97 *
Blackpoll Warbler *Dendroica striata*	0.03 ± 0.03 AB	0.10 ± 0.04 AB	0 A	0.17 ± 0.05 B	3.20 *	0.18	7.24 *	1.46
Northern Waterthrush *Seiurus novaboracensis*	0.27 ± 0.10 A	0.31 ± 0.06 A	0.58 ± 0.10 B	0.17 ± 0.05 A	5.06 *	1.24	5.13 *	8.87 **
Fox Sparrow *Passerella iliaca*	0.10 ± 0.06 A	0.15 ± 0.05 A	0.32 ± 0.08 B	0.33 ± 0.07 B	3.13 *	9.10 **	0.12	0.14
White-throated Sparrow *Zonotrichia albicollis*	0 A	0.34 ± 0.09 B	0.16 ± 0.06 A	0.47 ± 0.08 B	6.71 ***	4.89 *	15.94 ***	0.01
White-crowned Sparrow *Zonotrichia leucophrys*	0.07 ± 0.05 A	0.03 ± 0.02 A	0.11 ± 0.05 A	0.15 ± 0.05 A	1.55	2.84 ‡	>0.01	0.64
Slate-coloured Junco *Junco hyemalis*	0.57 ± 0.13 A	0.53 ± 0.08 A	0.34 ± 0.08 A	0.67 ± 0.10 A	1.57	0.24	2.16	2.20

[A] Species detected at 10 or more point count stations.

[B] 1-way ANOVA (F_3); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001. Means ± SE followed by the same letter do not differ significantly (P > 0.1) based on Tukey's HSD test.

[C] F-ratio values derived from a 2-way ANOVA ($F_{1,\ 186}$) of main treatment effects (River, Habitat) and their interaction (River X Habitat); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

Table 4. Effect of forest structural and ground cover characteristics on the presence and absence of the nine most common forest songbird

species detected in boreal forest river valleys, Quebec-Labrador, 2001.

	MANOVA [B]			Stations Present		Stations Absent		
Species [A]	Forest Structure	Ground Cover	Significant Habitat Variable(s) [C]	*n*	Mean ± SE	*n*	Mean ± SE	Statistic [D]
Gray Jay	0.541	1.182	none	29	-	67	-	-
Ruby-crowned Kinglet	0.783	0.563	Deciduous [E]	38	3.5 ± 0.9	58	11.6 ± 3.2	2.46 *
Swainson's Thrush	0.679	2.397 *	Trees [E]	38	717 ± 78	58	541± 57	-1.78 ‡
	-	-	Big Trees [E]	38	52 ± 14	58	24 ± 5	-1.78 ‡
	-	-	Snags [E]	38	110 ± 22	58	71 ± 15	-1.78 ‡
	-	-	Woody Debris [F]	38	12.1 ± 1.4	58	8.6 ± 0.8	-2.17 *
	-	-	Lichen [F]	38	16.8 ± 3.9	58	33.9 ± 3.9	3.08 **
	-	-	Woody Veg. [F]	38	13.8 ± 1.2	58	10.4 ± 0.9	-2.37 *
Magnolia Warbler	0.515	1.764 ‡	none	24	-	72	-	-
Yellow-rumped Warbler	1.180	2.201 *	Small Trees [E]	40	662 ± 82	56	466 ± 53	-2.70 **
	-	-	Trees [E]	40	738 ± 77	56	519 ± 56	-2.18 *

Species [A]	MANOVA [B] Forest Structure	Ground Cover	Significant Habitat Variable(s) [C]	Stations Present *n*	Mean ± SE	Stations Absent *n*	Mean ± SE	Statistic [D]
	-	-	Woody Debris [F]	40	12.1 ± 1.4	56	8.5 ± 0.8	-2.20 *
	-	-	Lichen [F]	40	19.0 ± 4.1	56	33.0 ± 3.9	2.46 *
	-	-	Non-Woody Veg [F]	40	12.8 ± 1.4	56	8.9 ± 0.7	-2.56 *
Northern Waterthrush	0.790	0.910	Snags [E]	27	120 ± 30	69	73 ± 13	-1.70 ‡
	-	-	Lichen [F]	27	19.4 ± 4.9	69	30.1 ± 3.6	1.76 ‡
Fox Sparrow	1.060	0.548	none	15	-	81	-	-
White-throated Sparrow	2.638 *	1.796 ‡	Small Trees [E]	16	326 ± 57	80	592 ± 54	2.49 *
	-	-	Trees [E]	16	298 ± 89	80	673 ± 51	3.52 **
	-	-	Big Trees [E]	16	13 ± 7	80	40 ± 8	2.22 *
	-	-	Snags [E]	16	53 ± 33	80	93 ± 14	2.24 *
	-	-	Big Snags [E]	16	3 ± 2	80	14 ± 3	2.89 *
	-	-	Woody Debris [F]	16	6.5 ± 1.5	80	10.7 ± 0.9	2.39 *

Species [A]	MANOVA [B] Forest Structure	Ground Cover	Significant Habitat Variable(s) [C]	Stations Present *n*	Mean ± SE	Stations Absent *n*	Mean ± SE	Statistic [D]
	-	-	Litter [F]	16	3.9 ± 0.5	80	6.8 ± 0.7	3.58 **
	-	-	Lichen [F]	16	42.9 ± 6.9	80	24.0 ± 3.1	-2.50 *
	-	-	Moss [F]	16	22.1 ± 6.2	80	35.1 ± 2.8	1.93 ‡
Slate-coloured Junco	0.720	0.404	Deciduous [E]	46	4.5 ± 2.4	53	11.6 ± 3.0	1.86 ‡

[A] Species detected =15% of point count stations.

[B] Multivariate Analysis of Variance (MANOVA). F-ratios ($F_{8,87}$) derived from Wilk's Lambda are reported; ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

[D] Univariate comparison – 2-sample *t*-test; ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

[E] Forest structure variables; stems per ha. Deciduous is the percent stems per ha that are deciduous trees.

[F] Ground cover composition variables; % ground cover.

Table 5. Density, species richness and diversity indices of songbirds (mean ± SE) detected at point count stations (*n* = 190) in open conifer–lichen and closed canopy conifer forest at St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Variable	St. Augustin River		Little Mecatina River		F-Ratio [A]	Effect [B]		
	Closed Conifer (*n* = 30)	Open Conifer (*n* = 62)	Closed Conifer (*n* = 38)	Open Conifer (*n* = 60)		River	Habitat	River X Habitat
Songbird Density	5.27 ± 0.46	4.61 ± 0.33	5.18 ± 0.36	4.62 ± 0.32	1.432	0.000	3.991 *	0.168
Species Richness	4.70 ± 0.37	4.18 ± 0.30	4.84 ± 0.34	4.05 ± 0.27	0.877	0.011	2.631	0.013
Species Diversity (*D'*)	0.72 ± 0.03	0.63 ± 0.04	0.73 ± 0.03	0.65 ± 0.03	2.008	0.241	5.520 *	0.021

[A] 1-way ANOVA (F_3); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001. Means ± SE followed by the same letter do not differ significantly (P > 0.1) based on Tukey's HSD test.

[B] F-ratio values derived from a 2-way ANOVA ($F_{1, 186}$) of main treatment effects (River, Habitat) and their interaction (River X Habitat); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

Table 6. Differences in songbird community indices (density, species richness and diversity) as correlated with habitat structure and ground cover variables between open conifer and closed canopy conifer forest plots (*n* = 96) in the St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Habitat Variable	Community Variable [A]			Habitat Variable	Community Variable [A]		
	Species Density	Species Richness	Species Diversity		Species Density	Species Richness	Species Diversity
Forest Structure				*Ground Composition*			
Shrubs	-0.319 *	-0.253 *	-0.136	Bare Ground	0.143	0.058	-0.023
Saplings	-0.042	-0.061	-0.049	Coarse Woody Debris	0.202 *	0.216 *	0.189 ‡
Small Trees	0.079	0.086	0.082	Leaf Litter	0.180 ‡	0.178 ‡	0.185 ‡
Trees	0.156	0.199 *	0.206 *	Lichen	-0.184 ‡	-0.225 *	-0.217 *
Big Trees	0.062	0.094	0.144	Moss	0.026	0.067	0.085
Snags	0.157	0.190 ‡	0.184 ‡	Non-woody Vegetation	0.108	0.162	0.176 ‡
Big Snags	0.034	0.090	0.116	Woody Vegetation	0.127	0.115	0.059
Deciduous Trees (%)	0.016	-0.038	-0.124				

[A] *r* values (95 df) from Pearson correlations; ‡ $0.05 < P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (Bonferroni-adjusted *P* values).

Table 7. Summary life-history strategies of the nine most commonly detected songbird species in river valleys, Quebec-Labrador, 2001.

Species [A]	Migration Status	Diet [B]	Nesting Guild	Foraging Guild
Gray Jay	Resident	Omnivorous	Tree	Glean
Ruby-crowned Kinglet	Mid-Distance	Berries	Tree	Hover
Swainson's Thrush	Long-Distance	Insects	Shrub	Ground
Magnolia Warbler	Long-Distance	Insects	Shrub	Glean
Yellow-rumped Warbler	Short-Distance	Insects	Tree	Glean
Northern Waterthrush	Long-Distance	Aquatic invertebrates	Ground	Ground
Fox Sparrow	Short-Distance	Seeds	Ground	Ground
White-throated Sparrow	Short Distance	Seeds	Shrub	Ground
Slate-coloured Junco	Resident	Seeds	Ground	Ground

[A] Adapted from Darveau *et al*. (1995) and Thompson *et al*. (1999).

[B] Primary component.

Table 8. Total small mammal captures and the percent of trapping grids (n = 96) at which species were captured in open conifer-lichen and closed canopy conifer forest at Little Mecatina River and St. Augustin River, Quebec-Labrador, 2001.

Species	Number of Individuals Captured				Total Grids Successful	
	St. Augustin River		Little Mecatina River			
	Closed Conifer (n = 30)	Open Conifer (n = 62)	Closed Conifer (n = 38)	Open Conifer (n = 60)	Number	Percent
Masked Shrew *Sorex cinereus*	5	13	7	6	21	21.9
Northern Flying Squirrel *Glaucomys sabrinus*	0	0	2	0	1	1.0
Deer Mouse *Peromyscus maniculatus*	0	1	0	0	1	1.0
Red-backed Vole *Clethrionymys gapperi*	45	20	48	10	45	46.9
Heather Vole *Phenacomys intermedius*	0	1	0	0	1	1.0
Meadow Vole *Microtus pennsylvanicus*	1	0	0	0	1	1.0
Meadow Jumping Mouse *Zapus hudsonius*	1	6	0	6	10	10.4
Woodland Jumping Mouse *Napaeozapus insignis*	6	5	0	0	6	6.3
Total Captures	58	46	57	22	58	60.4

Table 9. Abundance of small mammals (mean captures/100 trap nights ± SE) at trapping grids (n = 96) in open conifer–lichen and closed canopy conifer forest between St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Species	St. Augustin River		Little Mecatina River		F-Ratio [A]	Effect [B]		
	Closed Conifer (n = 24)	Open Conifer (n = 24)	Closed Conifer (n = 24)	Open Conifer (n = 24)		River	Habitat	River X Habitat
Masked Shrew *Sorex cinereus*	0.18 ± 0.08 A	0.48 ± 0.23 A	0.26 ± 0.13 A	0.21 ± 0.11	0.82	0.42	0.72	1.32
Deer Mouse *Peromyscus maniculatus*	0	0.04 ± 0.04	0	0				
Red-backed Vole *Clethrionymys gapperi*	1.62 ± 0.34 A	0.73 ± 0.20 AC	1.76 ± 0.44 AB	0.36 ± 0.15 C	5.06 *	0.16	14.32 **	0.71
Heather Vole *Phenacomys intermedius*	0	0.04 ± 0.04	0	0				
Meadow Vole *Microtus pennsylvanicus*	0.04 ± 0.04	0	0	0				
Meadow Jumping Mouse *Zapus hudsonius*	0.04 ± 0.04 A	0.23 ± 0.11 A	0 A	0.21 ± 0.09 A	2.38 ‡	0.12	6.99 *	0.03
Woodland Jumping Mouse *Napaeozapus insignis*	0.24 ± 0.24	0.18 ± 0.07	0	0				
Total Captures	2.12 ± 0.48 A	1.69 ± 0.43	2.09 ± 0.52 A	0.78 ± 0.22 A	2.13	1.20	4.12 *	1.06

[A] 1-way ANOVA (F_3); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001. Means ± SE followed by the same letter do not differ significantly (P > 0.1) based on Tukey's HSD test.

[B] F-ratio values derived from a 2-way ANOVA ($F_{1, 92}$) of main treatment effects (River, Habitat) and their interaction (River X Habitat); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

Table 10. Abundance, species richness and diversity indices of small mammals (mean ± SE) captured at trapping grids (n = 96) in open conifer–lichen and closed canopy conifer forest at St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Variable	St. Augustin River		Little Mecatina River			Effect [B]		
	Closed Conifer (n = 24)	Open Conifer (n = 24)	Closed Conifer (n = 24)	Open Conifer (n = 24)	F-Ratio [A]	River	Habitat	River X Habitat
Abundance	2.42 ± 0.53	1.92 ± 0.48	2.38 ± 0.59	0.92 ± 0.26	2.09	1.17	4.13 **	0.99
Species Richness	0.96 ± 0.21	1.21 ± 0.23	0.79 ± 0.17	0.63 ± 0.15	1.70	3.86 ‡	0.05	1.19
Species Diversity (*H'*)	0.14 ± 0.06	0.27 ± 0.08	0.10 ± 0.05	0.08 ± 0.05	1.81	3.30 ‡	0.74	1.38
Species Evenness (*J'*)	0.06 ± 0.02	0.11± 0.03	0.04 ± 0.02	0.04 ± 0.02	1.59	2.43	1.07	1.27

[A] 1-way ANOVA (F_3); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001. Means ± SE followed by the same letter do not differ significantly (P > 0.1) based on Tukey's HSD test.

[B] F-ratio values derived from a 2-way ANOVA ($F_{1, 92}$) of main treatment effects (River, Habitat) and their interaction (River X Habitat); ‡ 0.05 < P < 0.10; * P < 0.05; ** P < 0.01; *** P < 0.001.

Table 11. Differences in small mammal community indices (abundance, species richness and diversity) as correlated with habitat structure and ground cover variables between open conifer and closed canopy conifer forest plots in the St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Habitat Variable	Community Variable [A]			Habitat Variable	Community Variable [A]		
	Abundance	Species Richness	Species Diversity		Abundance	Species Richness	Species Diversity
Forest Structure				*Ground Composition*			
Shrubs	0.024	0.118	0.168	Bare Ground	-0.012	-0.052	-0.065
Saplings	0.136	-0.033	-0.060	Coarse Woody Debris	0.405 ***	0.228 **	0.188 ‡
Small Trees	0.075	-0.077	-0.128	Leaf Litter	0.264 ***	0.217 **	0.182 ‡
Trees	0.134	0.037	-0.001	Lichen	-0.311 **	-0.156	-0.033
Big Trees	0.348 ***	0.212 **	0.151	Moss	0.158	0.013	-0.073
Snags	0.357 ***	0.189 ‡	0.118	Non-woody Vegetation	0.070	0.057	-0.035
Big Snags	0.450 ***	0.210 **	0.126	Woody Vegetation	-0.018	0.135	0.118
Coniferous Trees (%)	-0.037	-0.068	-0.066				

[A] r values (95 df) from Pearson correlations; ‡ $0.05 < P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (Bonferroni-adjusted P values)

Table 12. Differences in forest structure and ground cover variables at trapping grid stations between total small mammal captures and Red-backed Vole captures (per 100 trap nights) in open conifer–lichen and closed canopy conifer forests, in the St. Augustin and Little Mecatina river valleys, Quebec-Labrador, 2001.

Habitat Variable	Small Mammal Captures		Habitat Variable	Small Mammal Captures	
	All Captures Combined	Red-backed Voles		All Captures Combined	Red-backed Voles
Forest Structure			*Ground Composition*		
Shrubs	0.030	-0.070	Bare Ground	-0.012	-0.009
Saplings	0.138	0.204 *	Coarse Woody Debris	0.406 ***	0.470 ***
Small Trees	0.076	0.167	Leaf Litter	0.271 **	0.157
Trees	0.131	0.268 **	Lichen	-0.310 **	-0.372 ***
Big Trees	0.341 ***	0.476 ***	Moss	0.155	0.279 **
Snags	0.352 ***	0.457 ***	Non-woody Vegetation	0.072	-0.007
Big Snags	0.443 ***	0.595 ***	Woody Vegetation	-0.016	-0.112
Coniferous Trees (%)	-0.050	0.115			

[A] r values (95 df) from Pearson correlations; ‡ $0.05 < P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (Bonferroni-adjusted P values)

Table 13. Estimated abundance rank and suitability for intensive field study of selected boreal forest mammals and birds at Little Mecatina River and St. Augustin River, based on incidental observations, Quebec-Labrador, 2001.

Species	Observed [A]	**Estimated** Abundance Rank [B]	**Estimated Suitability for Study**	**Comments**
Little Brown Bat *Myotis lucifugus*	Rarely	Rare	**Not suitable**	**Does not appear to be common, but may be more common than observed, given its limited observability.**
Red Squirrel *Tamiasciurus hudsonicus*	Regularly	Common	**May be suitable**	**Seen and/or heard fairly frequently. Not as abundant as expected, but there are likely enough individuals to permit suitable sample sizes in both river valleys.**
Northern Flying Squirrel *Glaucomys sabrinus*	Incidentally	Rare	Not suitable	**Two juveniles incidentally captured in snap traps, both from the same closed conifer sampling station. Nevertheless, likely a somewhat rare species in the study areas given the predominance of open conifer lichen. Capture probabilities are very low even in optimal habitats.**
Beaver *Castor canadensis*	Rarely	Rare	Not suitable	**Evidence of beaver trapping at both study areas. Very few beavers seen. Only a couple of beaver lodges seen on side streams. Likely that a suitable sample size for this species would not be attained.**
Porcupine *Erethizon dorsatum*	Rarely	Rare	Not suitable	**Appear to be very rare at both study areas. Those near the river in the winter may be harvested.**

Species	Observed [A]	Estimated Abundance Rank [B]	Estimated Suitability for Study	Comments
Snowshoe Hare *Lepus americanus*	Rarely	Regular?	Not suitable	**Crews reported surprisingly low observations of hare or their sign. Very few observed in transit to stations. May be at a cyclic low.**
Black Bear *Ursus americana*	Regularly	Common	May be suitable	**Animals were somewhat common at both river valleys. Bear trails are very common. However, numbers regularly using the river valleys, as opposed to transients, is unknown. May be suitable, but the number of animals in close proximity for study is not known, but likely low.**
Gray Wolf *Canis lupus*	No	V. Rare	Not suitable	**Not observed, heard, nor any sign. Few prey items. Likely that a few animals pass through the areas.**
Marten *Martes americana*	No	Rare	Not suitable	**No animals observed. The area is trapped. Predominately open conifer habitat and very low prey availability. Likely not many animals in the study areas.**
Moose *Alces alces*	Rarely	Regular?	Not suitable	**Very little sign observed, despite the study areas being okay moose habitat. The area may receive some hunting.**
Woodland Caribou *Rangifer tarandus*	No	V. Rare	Not suitable	**Not known caribou range. Some individuals may wander through on rare occasions.**

Species	Observed [A]	**Estimated** Abundance Rank [B]	**Estimated Suitability for Study**	**Comments**
Grouse *Bonasa umbellus* & *Dendragapus canadensis*	Rarely	Regular?	Not suitable	**Crews reported surprisingly low observations. Few observed in transit to stations. May be at a cyclic low.**
Raptors	Rarely	V. Rare	Not suitable	**Very rarely observed, primarily osprey.**
Waterfowl	Rarely	Rare	Not suitable	**Rarely observed. Not good waterfowl habitat.**
Tree Swallows *Tachycineta bicolor*	Rarely	Regular	Not suitable	**Some seen, but not common. No colonies found.**

[A] Observations include sightings, vocalizations heard, or sign seen (trail, scat, nest site, colony, etc.)

[B] An estimate based on a 4-point scale; very rare, rare, regular, common – in increasing order of abundance.

Figures

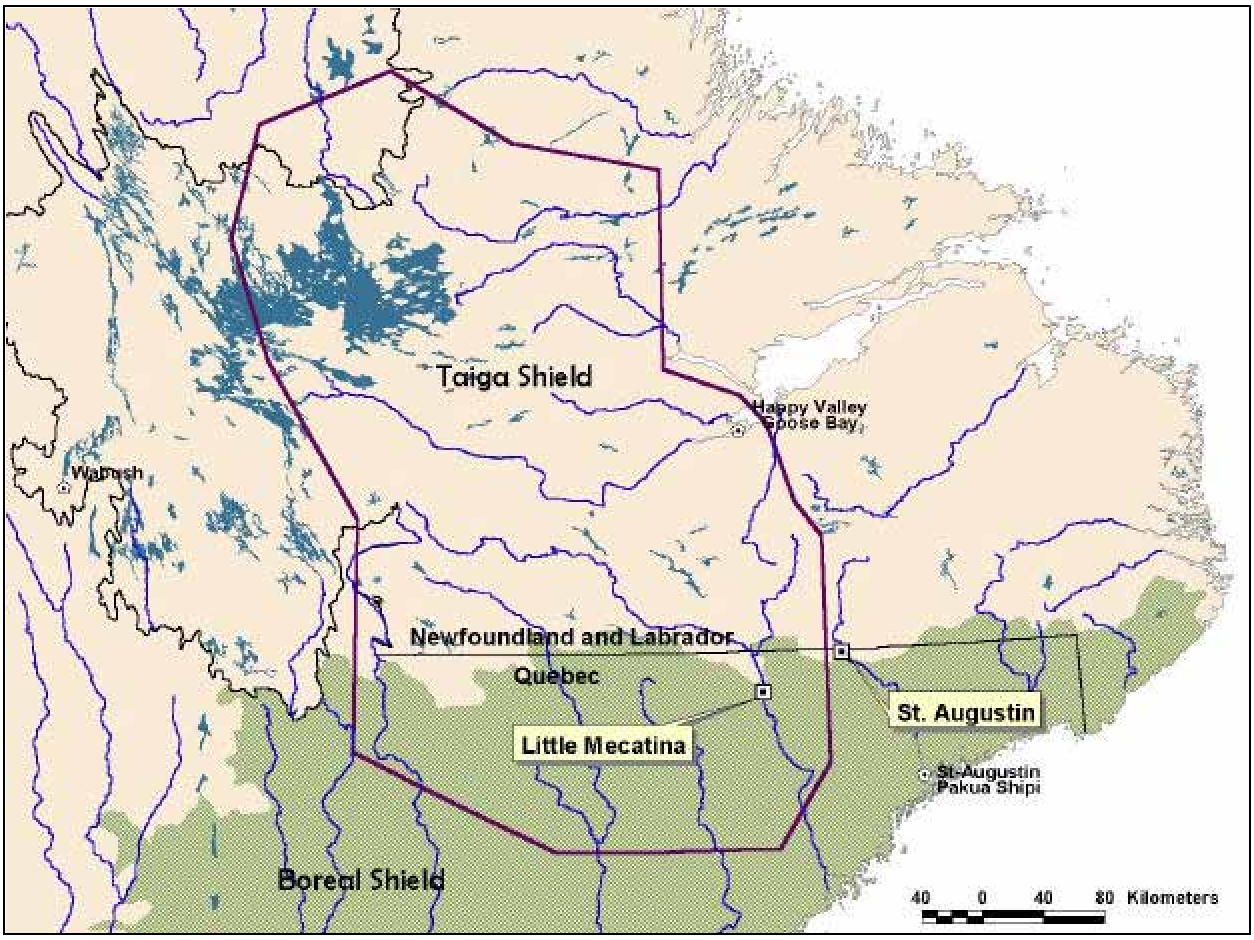

Figure 1. Location of the Little Mecatina River and St. Augustin River study areas, Quebec-Labrador.

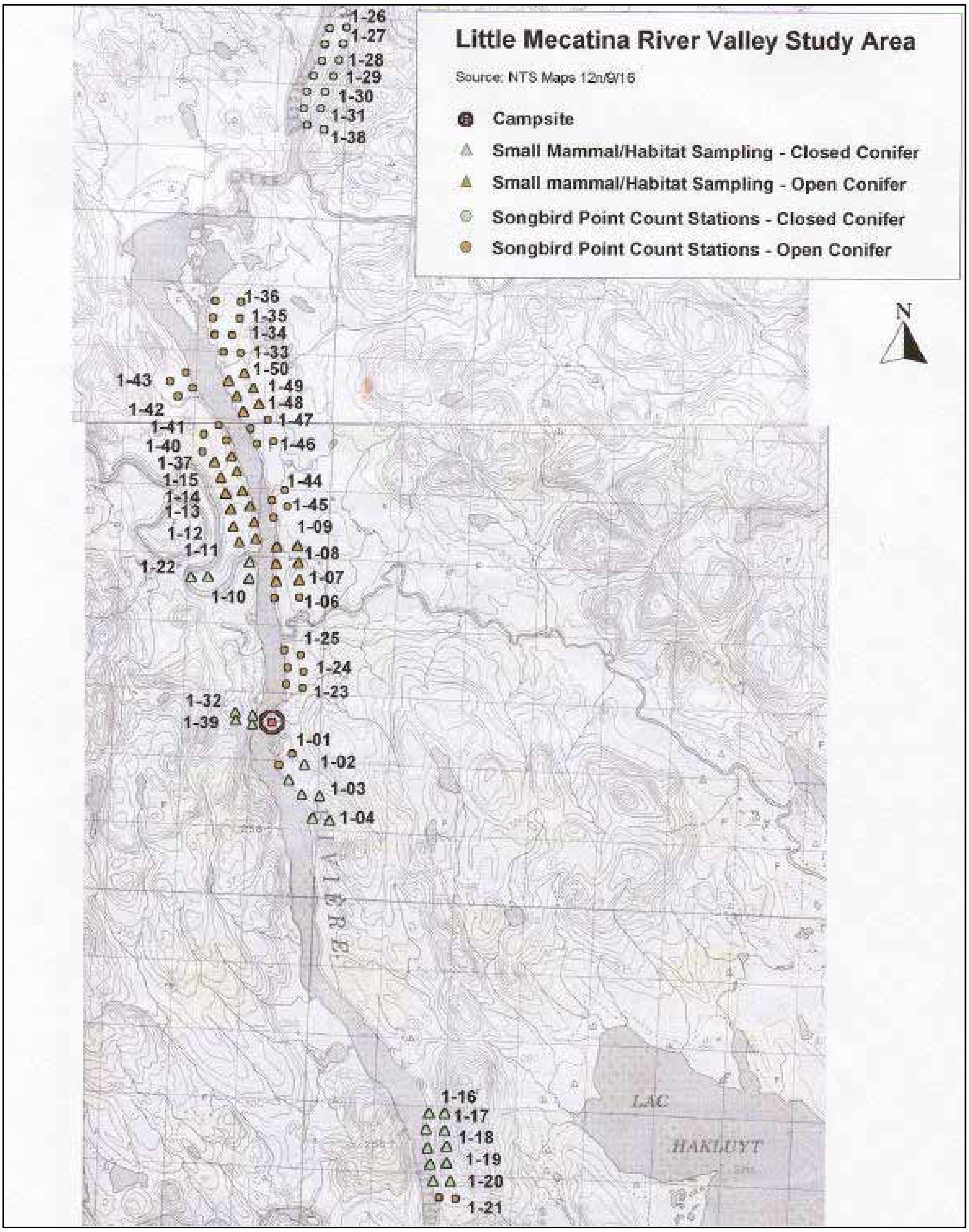

Figure 2. Spatial extent of sampling stations at the Little Mecatina River study area. Songbirds were surveyed at all stations (*n* = 98). Precise geographic coordinates of sampling stations are provided in Appendix A.

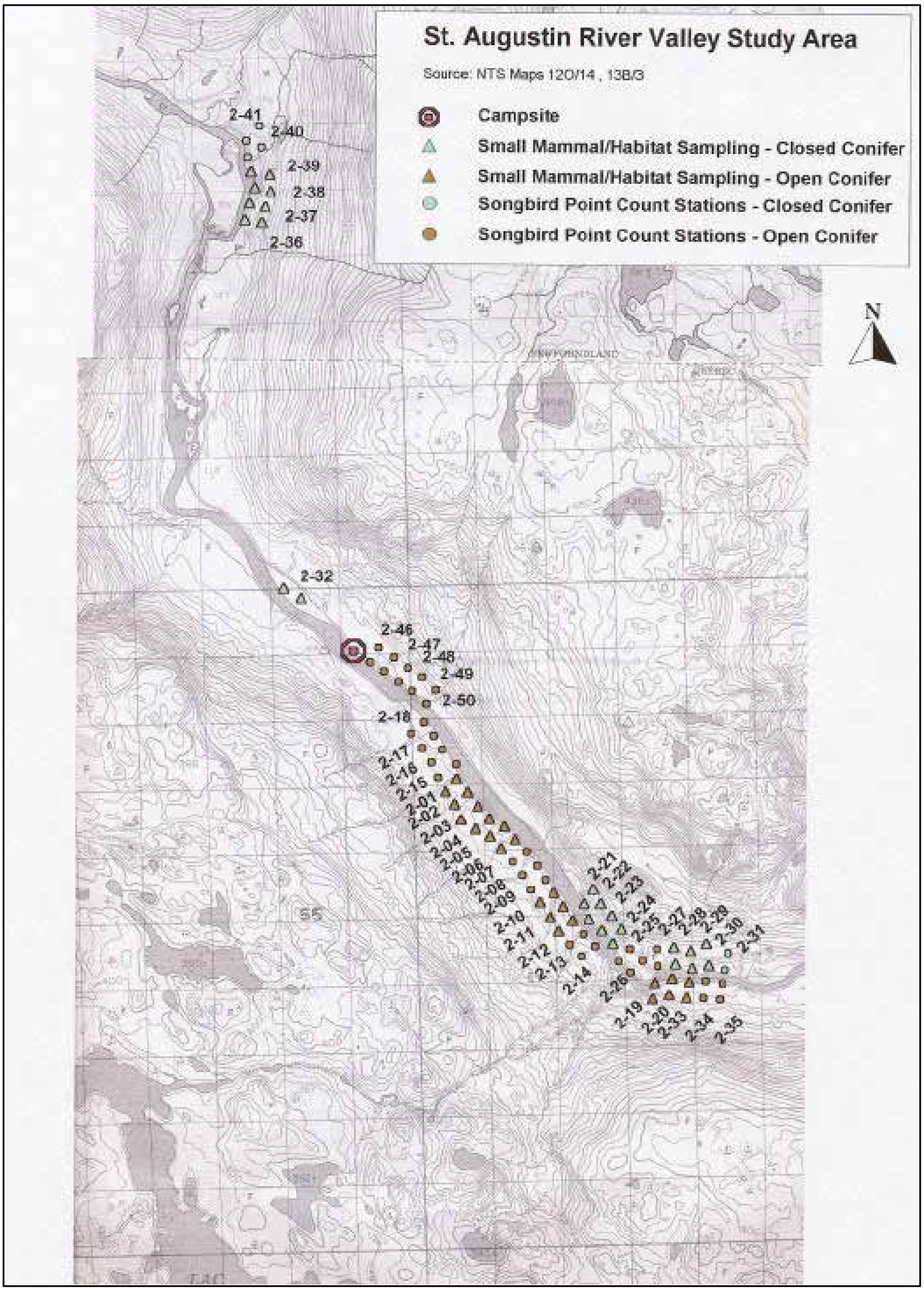

Figure 3. Spatial extent of sampling stations at the St. Augustin River study area. Songbirds were surveyed at all stations (n = 92). Precise geographic coordinates of sampling stations are provided in Appendix A.

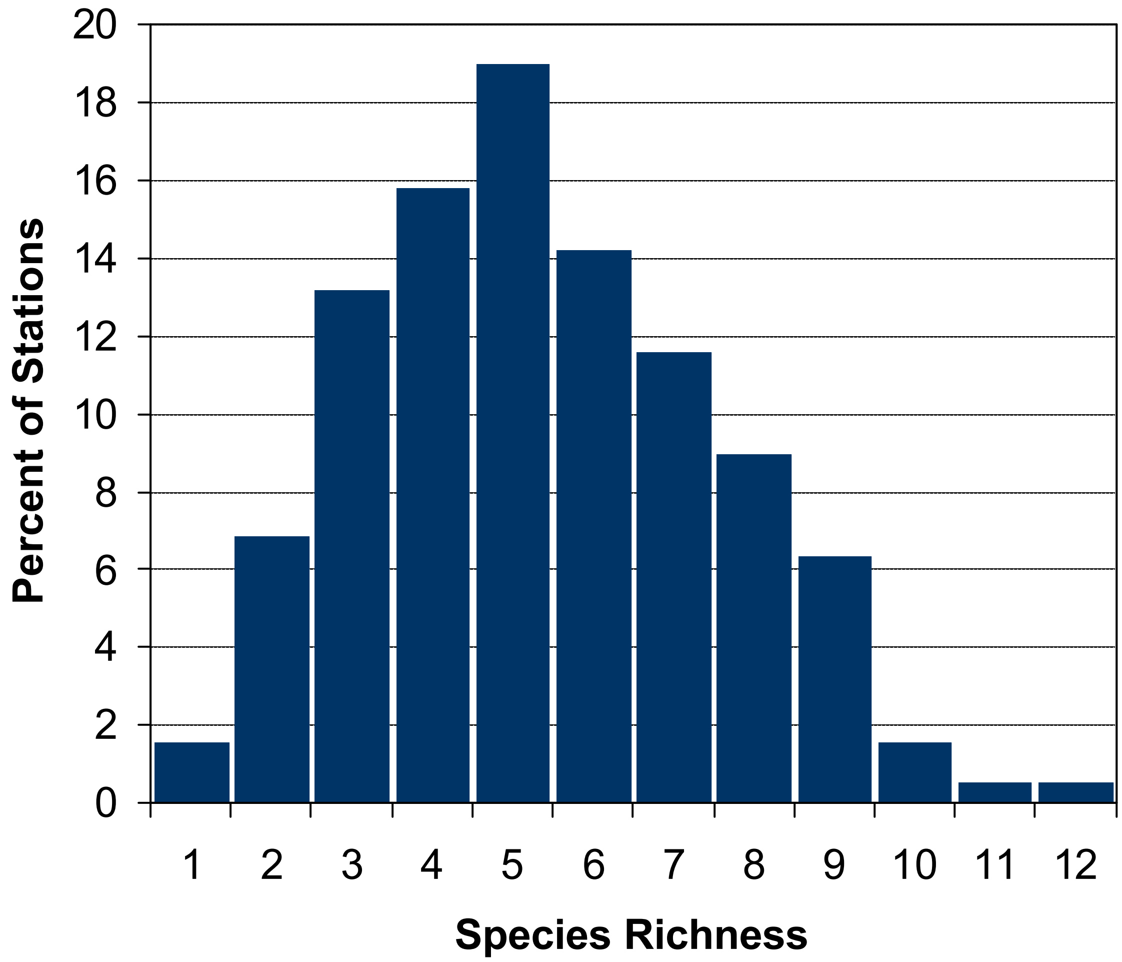

Figure 4. Histogram of songbird species richness at 190 point count stations in Quebec-Labrador.

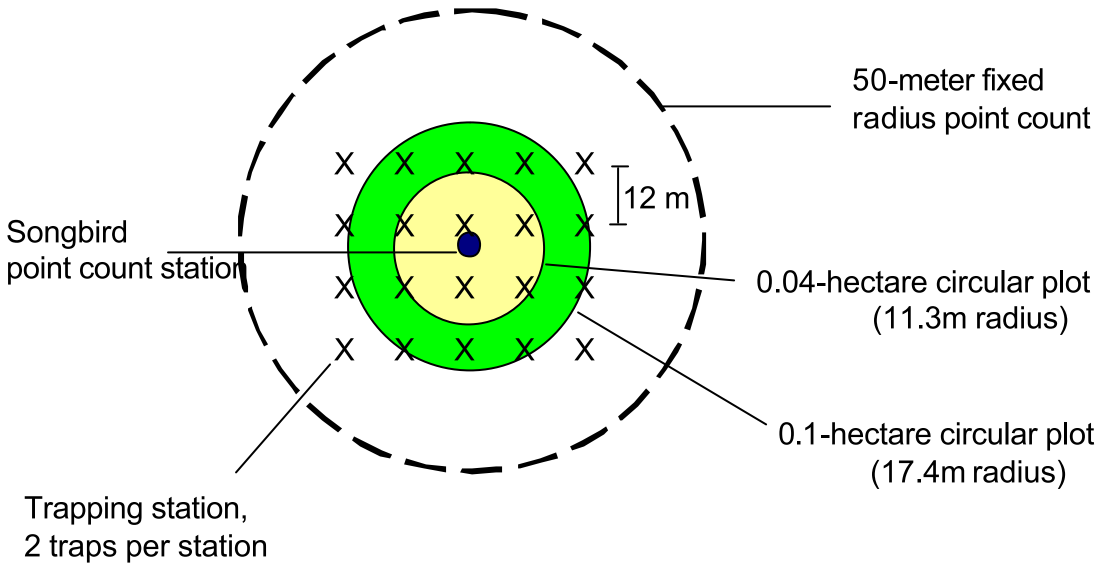

Figure 5. Depiction of the sampling areas of point count stations used for small mammal trapping and vegetation sampling (*n* = 96) at the Little Mecatina River and St. Augustin River study areas, Quebec-Labrador.

Appendix A

Geographic coordinates and wildlife and habitat characteristics sampled at 196 sampling sites in the Little Mecatina and St. Augustin river valleys in Quebec-Labrador, 2001.

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
Little Mecatina River									
1-01A	Open Conifer	Riparian	51.7050	-60.1142	699398	5731948	Yes		
1-01B	Open Conifer	Interior	51.7065	-60.1114	699583	5732123	Yes		
1-02A	Closed Conifer	Riparian	51.7028	-60.1121	699552	5731717	Yes	Yes	Yes
1-02B	Closed Conifer	Interior	51.7049	-60.1088	699770	5731959	Yes	Yes	Yes
1-03A	Closed Conifer	Riparian	51.7009	-60.1094	699751	5731510	Yes	Yes	Yes
1-03B	Closed Conifer	Interior	51.7008	-60.1057	700004	5731504	Yes	Yes	Yes
1-04A	Closed Conifer	Riparian	51.6978	-60.1071	699920	5731168	Yes	Yes	Yes
1-04B	Closed Conifer	Interior	51.6975	-60.1036	700161	5731142	Yes	Yes	Yes
1-06A	Open Conifer	Riparian	51.7271	-60.1151	699238	5734403	Yes		
1-06B	Open Conifer	Interior	51.7272	-60.1099	699596	5734428	Yes		
1-07A	Open Conifer	Riparian	51.7292	-60.1147	699254	5734645	Yes	Yes	Yes
1-07B	Open Conifer	Interior	51.7294	-60.1099	699586	5734678	Yes	Yes	Yes

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-08A	Open Conifer	Riparian	51.7315	-60.1148	699243	5734901	Yes	Yes	Yes
1-08B	Open Conifer	Interior	51.7316	-60.1101	699565	5734926	Yes	Yes	Yes
1-09A	Open Conifer	Riparian	51.7338	-60.1146	699245	5735150	Yes	Yes	Yes
1-09B	Open Conifer	Interior	51.7339	-60.1102	699547	5735177	Yes	Yes	Yes
1-10A	Closed Conifer	Riparian	51.7318	-60.1203	698860	5734910	Yes	Yes	Yes
1-10B	Closed Conifer	Interior	51.7295	-60.1204	698862	5734663	Yes	Yes	Yes
1-11A	Open Conifer	Riparian	51.7348	-60.1190	698939	5735253	Yes	Yes	Yes
1-11B	Open Conifer	Interior	51.7344	-60.1224	698700	5735196	Yes	Yes	Yes
1-12A	Open Conifer	Riparian	51.7370	-60.1193	698905	5735500	Yes	Yes	Yes
1-12B	Open Conifer	Interior	51.7364	-60.1237	698602	5735418	Yes	Yes	Yes
1-13A	Open Conifer	Riparian	51.7391	-60.1202	698831	5735730	Yes	Yes	Yes
1-13B	Open Conifer	Interior	51.7387	-60.1242	698557	5735669	Yes	Yes	Yes
1-14A	Open Conifer	Riparian	51.7411	-60.1217	698720	5735950	Yes	Yes	Yes
1-14B	Open Conifer	Interior	51.7408	-60.1253	698475	5735905	Yes	Yes	Yes
1-15A	Open Conifer	Riparian	51.7438	-60.1229	698628	5736238	Yes	Yes	Yes
1-15B	Open Conifer	Interior	51.7429	-60.1263	698398	5736136	Yes	Yes	Yes
1-16A	Closed Conifer	Riparian	51.6587	-60.0827	701778	5726889	Yes	Yes	Yes

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-16B	Closed Conifer	Interior	51.6587	-60.0794	702006	5726900	Yes	Yes	Yes
1-17A	Closed Conifer	Riparian	51.6565	-60.0834	701743	5726645	Yes	Yes	Yes
1-17B	Closed Conifer	Interior	51.6564	-60.0794	702018	5726641	Yes	Yes	Yes
1-18A	Closed Conifer	Riparian	51.6540	-60.0830	701778	5726371	Yes	Yes	Yes
1-18B	Closed Conifer	Interior	51.6543	-60.0790	702053	5726409	Yes	Yes	Yes
1-19A	Closed Conifer	Riparian	51.6519	-60.0825	701822	5726134	Yes	Yes	Yes
1-19B	Closed Conifer	Interior	51.6521	-60.0790	702063	5726162	Yes	Yes	Yes
1-20A	Closed Conifer	Riparian	51.6497	-60.0819	701877	5725890	Yes	Yes	Yes
1-20B	Closed Conifer	Interior	51.6496	-60.0782	702131	5725895	Yes	Yes	Yes
1-21A	Open Conifer	Riparian	51.6476	-60.0806	701972	5725658	Yes		
1-21B	Open Conifer	Interior	51.6475	-60.0771	702215	5725658	Yes		
1-22A	Closed Conifer	Riparian	51.7297	-60.1326	698019	5734648	Yes	Yes	Yes
1-22B	Closed Conifer	Interior	51.7297	-60.1290	698268	5734662	Yes	Yes	Yes
1-23A	Open Conifer	Riparian	51.7157	-60.1126	699460	5733146	Yes		
1-23B	Open Conifer	Interior	51.7152	-60.1092	699702	5733101	Yes		
1-24A	Open Conifer	Riparian	51.7179	-60.1123	699471	5733389	Yes		
1-24B	Open Conifer	Interior	51.7174	-60.1090	699702	5733344	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-25A	Open Conifer	Riparian	51.7203	-60.1130	699412	5733651	Yes		
1-25B	Open Conifer	Interior	51.7196	-60.1096	699650	5733587	Yes		
1-26A	Closed Conifer	Riparian	51.8027	-60.1035	699707	5742846	Yes		
1-26B	Closed Conifer	Interior	51.8028	-60.0999	699953	5742869	Yes		
1-27A	Closed Conifer	Riparian	51.8006	-60.1046	699642	5742608	Yes		
1-27B	Closed Conifer	Interior	51.8007	-60.1007	699907	5742629	Yes		
1-28A	Closed Conifer	Riparian	51.7984	-60.1051	699615	5742361	Yes		
1-28B	Closed Conifer	Interior	51.7985	-60.1015	699859	5742387	Yes		
1-29A	Closed Conifer	Riparian	51.7964	-60.1070	699495	5742138	Yes		
1-29B	Closed Conifer	Interior	51.7964	-60.1028	699785	5742143	Yes		
1-30A	Closed Conifer	Riparian	51.7943	-60.1084	699408	5741898	Yes		
1-30B	Closed Conifer	Interior	51.7943	-60.1045	699672	5741911	Yes		
1-31A	Closed Conifer	Riparian	51.7921	-60.1089	699377	5741648	Yes		
1-31B	Closed Conifer	Interior	51.7921	-60.1053	699630	5741662	Yes		
1-32A	Closed Conifer	Riparian	51.7114	-60.1197	698988	5732649	Yes	Yes	Yes
1-32B	Closed Conifer	Interior	51.7118	-60.1234	698735	5732687	Yes	Yes	Yes
1-33A	Open Conifer	Riparian	51.7597	-60.1257	698361	5738004	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-33B	Open Conifer	Interior	51.7596	-60.1221	698612	5738000	Yes		
1-34A	Open Conifer	Riparian	51.7620	-60.1276	698222	5738251	Yes		
1-34B	Open Conifer	Interior	51.7619	-60.1240	698472	5738254	Yes		
1-35A	Open Conifer	Riparian	51.7642	-60.1279	698191	5738497	Yes		
1-35B	Open Conifer	Interior	51.7641	-60.1223	698579	5738504	Yes		
1-36A	Open Conifer	Riparian	51.7665	-60.1275	698208	5738752	Yes		
1-36B	Open Conifer	Interior	51.7664	-60.1220	698588	5738755	Yes		
1-37A	Open Conifer	Riparian	51.7458	-60.1241	698536	5736458	Yes	Yes	Yes
1-37B	Open Conifer	Interior	51.7450	-60.1276	698296	5736366	Yes	Yes	Yes
1-38A	Closed Conifer	Riparian	51.7899	-60.1083	699434	5741405	Yes		
1-38B	Closed Conifer	Interior	51.7893	-60.1047	699683	5741350	Yes		
1-39A	Closed Conifer	Riparian	51.7102	-60.1198	698988	5732518	Yes	Yes	Yes
1-39B	Closed Conifer	Riparian	51.7108	-60.1233	698747	5732572	Yes	Yes	Yes
1-40A	Open Conifer	Riparian	51.7480	-60.1251	698454	5736699	Yes		
1-40B	Open Conifer	Interior	51.7464	-60.1302	698115	5736516	Yes		
1-41A	Open Conifer	Riparian	51.7500	-60.1268	698329	5736916	Yes		
1-41B	Open Conifer	Interior	51.7488	-60.1299	698120	5736776	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-42A	Open Conifer	Riparian	51.7550	-60.1322	697933	5737457	Yes		
1-42B	Open Conifer	Interior	51.7538	-60.1353	697726	5737319	Yes		
1-43A	Open Conifer	Riparian	51.7570	-60.1336	697829	5737681	Yes		
1-43B	Open Conifer	Interior	51.7558	-60.1369	697605	5737540	Yes		
1-44A	Open Conifer	Riparian	51.7400	-60.1156	699151	5735843	Yes		
1-44B	Open Conifer	Interior	51.7414	-60.1129	699329	5736004	Yes		
1-45A	Open Conifer	Riparian	51.7378	-60.1152	699187	5735592	Yes		
1-45B	Open Conifer	Interior	51.7393	-60.1124	699374	5735766	Yes		
1-46A	Open Conifer	Riparian	51.7475	-60.1187	698901	5736667	Yes		
1-46B	Open Conifer	Interior	51.7478	-60.1152	699139	5736713	Yes		
1-47A	Open Conifer	Riparian	51.7496	-60.1201	698797	5736894	Yes		
1-47B	Open Conifer	Interior	51.7508	-60.1165	699038	5737034	Yes		
1-48A	Open Conifer	Riparian	51.7517	-60.1216	698684	5737120	Yes	Yes	Yes
1-48B	Open Conifer	Interior	51.7527	-60.1183	698905	5737242	Yes	Yes	Yes
1-49A	Open Conifer	Riparian	51.7537	-60.1229	698581	5737347	Yes	Yes	Yes
1-49B	Open Conifer	Interior	51.7548	-60.1195	698814	5737475	Yes	Yes	Yes
1-50A	Open Conifer	Riparian	51.7558	-60.1246	698455	5737572	Yes	Yes	Yes

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
1-50B	Open Conifer	Interior	51.7567	-60.1213	698679	5737683	Yes	Yes	Yes

St. Augustin River

Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-01A	Open Conifer	Riparian	51.9435	-59.3184	340648	5757080	Yes	Yes	Yes
2-01B	Open Conifer	Interior	51.9418	-59.3207	340480	5756890	Yes	Yes	Yes
2-02A	Open Conifer	Riparian	51.9417	-59.3162	340791	5756868	Yes	Yes	Yes
2-02B	Open Conifer	Interior	51.9401	-59.3187	340611	5756693	Yes	Yes	Yes
2-03A	Open Conifer	Riparian	51.9398	-59.3139	340944	5756659	Yes	Yes	Yes
2-03B	Open Conifer	Interior	51.9380	-59.3174	340693	5756459	Yes	Yes	Yes
2-04A	Open Conifer	Riparian	51.9381	-59.3114	341108	5756464	Yes	Yes	Yes
2-04B	Open Conifer	Interior	51.9368	-59.3144	340898	5756319	Yes	Yes	Yes
2-05A	Open Conifer	Riparian	51.9371	-59.3082	341323	5756342	Yes	Yes	Yes
2-05B	Open Conifer	Interior	51.9358	-59.3112	341114	5756201	Yes	Yes	Yes
2-06A	Open Conifer	Riparian	51.9354	-59.3059	341479	5756144	Yes	Yes	Yes
2-06B	Open Conifer	Interior	51.9341	-59.3089	341266	5756010	Yes	Yes	Yes
2-07A	Open Conifer	Riparian	51.9338	-59.3034	341644	5755963	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-07B	Open Conifer	Interior	51.9325	-59.3063	341435	5755826	Yes		
2-08A	Open Conifer	Riparian	51.9320	-59.3011	341791	5755756	Yes		
2-08B	Open Conifer	Interior	51.9307	-59.3042	341572	5755621	Yes		
2-09A	Open Conifer	Riparian	51.9300	-59.2994	341902	5755536	Yes		
2-09B	Open Conifer	Interior	51.9287	-59.3025	341688	5755398	Yes		
2-10A	Open Conifer	Riparian	51.9282	-59.2975	342029	5755327	Yes	Yes	Yes
2-10B	Open Conifer	Interior	51.9269	-59.3004	341820	5755187	Yes	Yes	Yes
2-11A	Open Conifer	Riparian	51.9263	-59.2955	342159	5755115	Yes	Yes	Yes
2-11B	Open Conifer	Interior	51.9249	-59.2982	341964	5754960	Yes	Yes	Yes
2-12A	Open Conifer	Riparian	51.9244	-59.2935	342289	5754898	Yes	Yes	Yes
2-12B	Open Conifer	Riparian	51.9230	-59.2964	342087	5754746	Yes	Yes	Yes
2-13A	Open Conifer	Riparian	51.9227	-59.2911	342446	5754701	Yes		
2-13B	Open Conifer	Interior	51.9213	-59.2940	342243	5754554	Yes		
2-14A	Open Conifer	Riparian	51.9211	-59.2886	342617	5754521	Yes		
2-14B	Open Conifer	Interior	51.9197	-59.2915	342412	5754371	Yes		
2-15A	Open Conifer	Riparian	51.9456	-59.3184	340650	5757313	Yes		
2-15B	Open Conifer	Interior	51.9438	-59.3223	340376	5757121	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-16A	Open Conifer	Riparian	51.9476	-59.3214	340452	5757537	Yes		
2-16B	Open Conifer	Interior	51.9459	-59.3238	340281	5757350	Yes		
2-17A	Open Conifer	Riparian	51.9495	-59.3234	340326	5757753	Yes		
2-17B	Open Conifer	Interior	51.9478	-59.3258	340153	5757571	Yes		
2-18A	Open Conifer	Riparian	51.9513	-59.3254	340193	5757958	Yes		
2-18B	Open Conifer	Interior	51.9497	-59.3281	339998	5757791	Yes		
2-19A	Open Conifer	Riparian	51.9161	-59.2757	343481	5753934	Yes	Yes	Yes
2-19B	Open Conifer	Interior	51.9139	-59.2762	343440	5753689	Yes	Yes	Yes
2-20A	Open Conifer	Riparian	51.9166	-59.2720	343741	5753987	Yes	Yes	Yes
2-20B	Open Conifer	Interior	51.9144	-59.2726	343688	5753738	Yes	Yes	Yes
2-21A	Closed Conifer	Riparian	51.9268	-59.2910	342468	5755154	Yes	Yes	Yes
2-21B	Closed Conifer	Interior	51.9287	-59.2890	342613	5755370	Yes	Yes	Yes
2-22A	Closed Conifer	Riparian	51.9246	-59.2900	342531	5754915	Yes	Yes	Yes
2-22B	Closed Conifer	Interior	51.9267	-59.2874	342714	5755145	Yes	Yes	Yes
2-23A	Closed Conifer	Riparian	51.9231	-59.2871	342721	5754737	Yes	Yes	Yes
2-23B	Closed Conifer	Interior	51.9251	-59.2851	342869	5754956	Yes	Yes	Yes
2-24A	Closed Conifer	Riparian	51.9214	-59.2848	342874	5754540	Yes	Yes	Yes

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-24B	Closed Conifer	Interior	51.9233	-59.2830	343006	5754754	Yes	Yes	Yes
2-25A	Open Conifer	Riparian	51.9191	-59.2836	342952	5754287	Yes		
2-25B	Open Conifer	Interior	51.9208	-59.2811	343128	5754468	Yes		
2-26A	Open Conifer	Riparian	51.9176	-59.2809	343131	5754114	Yes		
2-26B	Open Conifer	Interior	51.9192	-59.2785	343304	5754289	Yes		
2-27A	Open Conifer	Riparian	51.9185	-59.2751	343530	5754196	Yes		
2-27B	Open Conifer	Interior	51.9208	-59.2753	343526	5754453	Yes		
2-28A	Closed Conifer	Riparian	51.9187	-59.2713	343793	5754210	Yes	Yes	Yes
2-28B	Closed Conifer	Interior	51.9209	-59.2717	343773	5754458	Yes	Yes	Yes
2-29A	Closed Conifer	Riparian	51.9181	-59.2678	344036	5754137	Yes	Yes	Yes
2-29B	Closed Conifer	Interior	51.9204	-59.2681	344020	5754402	Yes	Yes	Yes
2-30A	Closed Conifer	Riparian	51.9184	-59.2642	344280	5754172	Yes	Yes	Yes
2-30B	Closed Conifer	Interior	51.9214	-59.2648	344252	5754505	Yes	Yes	Yes
2-31A	Closed Conifer	Riparian	51.9180	-59.2607	344519	5754111	Yes		
2-31B	Closed Conifer	Interior	51.9203	-59.2601	344569	5754368	Yes		
2-32A	Closed Conifer	Riparian	51.9691	-59.3556	338180	5760004	Yes	Yes	Yes
2-32B	Closed Conifer	Interior	51.9678	-59.3518	338334	5759652	Yes	Yes	Yes

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-33A	Open Conifer	Riparian	51.9163	-59.2684	343985	5753939	Yes	Yes	Yes
2-33B	Open Conifer	Interior	51.9140	-59.2690	343939	5753693	Yes	Yes	Yes
2-34A	Open Conifer	Riparian	51.9165	-59.2649	344231	5753957	Yes		
2-34B	Open Conifer	Interior	51.9142	-59.2653	344192	5753700	Yes		
2-35A	Open Conifer	Riparian	51.9161	-59.2612	344479	5753910	Yes		
2-35B	Open Conifer	Interior	51.9140	-59.2618	344432	5753669	Yes		
2-36A	Closed Conifer	Riparian	52.0191	-59.3644	337756	5765581	Yes	Yes	Yes
2-36B	Closed Conifer	Interior	52.0187	-59.3609	337996	5765530	Yes	Yes	Yes
2-37A	Closed Conifer	Riparian	52.0213	-59.3635	337828	5765824	Yes	Yes	Yes
2-37B	Closed Conifer	Interior	52.0208	-59.3602	338053	5765765	Yes	Yes	Yes
2-38A	Closed Conifer	Riparian	52.0234	-59.3624	337911	5766059	Yes	Yes	Yes
2-38B	Closed Conifer	Interior	52.0230	-59.3590	338140	5766002	Yes	Yes	Yes
2-39A	Closed Conifer	Riparian	52.0255	-59.3633	337856	5766298	Yes	Yes	Yes
2-39B	Closed Conifer	Interior	52.0252	-59.3593	338129	5766250	Yes	Yes	Yes
2-40A	Closed Conifer	Riparian	52.0277	-59.3640	337813	5766540	Yes		
2-40B	Closed Conifer	Interior	52.0290	-59.3611	338019	5766681	Yes		
2-41A	Closed Conifer	Riparian	52.0299	-59.3643	337802	5766787	Yes		

Sampling Site			Geographic Coordinates [A]				Sampled Characteristics		
Point	Habitat	Site	Latitude	Longitude	UTM - E	UTM - N	Birds	Mammals	Habitat
2-41B	Closed Conifer	Interior	52.0319	-59.3617	337992	5767002	Yes		
2-46A	Open Conifer	Riparian	51.9594	-59.3370	339424	5758886	Yes		
2-46B	Open Conifer	Interior	51.9613	-59.3352	339556	5759096	Yes		
2-47A	Open Conifer	Riparian	51.9581	-59.3339	339629	5758738	Yes		
2-47B	Open Conifer	Interior	51.9600	-59.3319	339777	5758942	Yes		
2-48A	Open Conifer	Riparian	51.9568	-59.3309	339833	5758581	Yes		
2-48B	Open Conifer	Interior	51.9587	-59.3289	339975	5758785	Yes		
2-49A	Open Conifer	Riparian	51.9555	-59.3280	340031	5758429	Yes		
2-49B	Open Conifer	Interior	51.9574	-59.3259	340182	5758642	Yes		
2-50A	Open Conifer	Riparian	51.9538	-59.3249	340232	5758238	Yes		
2-50B	Open Conifer	Interior	51.9557	-59.3230	340375	5758442	Yes		

[A] Geographic coordinates expressed as Latitude/Longitude (Decimal Degrees) and Universal Transverse Mercator. In both cases datum is NAD 1927 (East Canada). Note Little Mecatina River study area is located in UTM Zone 20, whereas St. Augustin River study area is in UTM Zone 21.

Appendix B

Breeding Bird Point Count Data Sheet

SITE: Mecatina River **PLOT:** 1-99-A **HABITAT:** Open Conifer **DATE:** 26 June 2005

OBSERVOR(S): F. Flintstone **LAT.:** 51^{0}41.4563 **LONG.:** 61^{0}82.9831 **VISIT:** 2

Point	Time	Species	≤ 50 m		> 50 m		Fly-Overs	
			0-3 min	3-5 min	0-3 min	3-5 min	0-3 min	3-5 min
1	05:08	AMRO	IIII 4		I 1			
		TTWO				II 2		
		OSFL		III 3				
2	05:22	AMRO	II 2					
		RTHA						I 1
		GRAJ	II 2		III 3			
		CORA					I 1	
3	05:38	RUBL	I 1					
		PIGR	I 1					
		AMRO			III 3			
		WWCR						IIII 4
		BBAW		II 2				

Sample

Modified from: Ralph et al. (1995).

Appendix C

Small Mammal Trapping Data Sheet

SITE: Mecatina River **TRAPPING GRID:** 1-99-A **HABITAT:** Open Conifer

OBSERVOR(S): F. Flintstone, B. Rubble **TRAP DAY:** 3 **DATE:** 6 May 2005

Station	Trap	Species	Sex	Age	Mass	Notes
1-03-01	1	Meadow Vole	M	J	15.2	
	2	0	0	0	0	
1-03-02	1	Deer Mouse	F	A	21.4	
	2	0				Trap set off
1-03-03	1	0				
	2	0				
1-03-04	1	Bog Lemming	M	A	32.2	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
1-0[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
1-03-06	1	0				
	2	Bog Lemming	M	A	17.8	
1-03-07	1	0				Trap set off – hair collected
	2	0				
1-03-08	1	Meadow Vole	F	J	14.3	
	2	0				
1-03-09	1	0				
	2	Deer Mouse	F	A	13.4	Partially eaten
1-03-10	1	0				
	2	0				Trap set off

Appendix D

Example of LD 824 SLM Translated File

824 System Settings
Translated: 13-Nov-2001 15:55:09

File Translated: C:\Program Files\Larson Davis\824 Utility\25Aug10l.slmdl
Model Number: 824
Serial Number: A1061
Firmware Rev: 3.520
Software Version: 3.050
Name: IEMR
Descr1: Goose Bay, Labrador A0P 1E0
Descr2: (709) 896-3266
Setup: RVE_Log.log
Setup Descr: River Valley Ecosystem Project
Location: St. Augustine River
Note 1: St. Augustine River Noise Data
Note 2: Control Data

Calibration
Calibrator S/N: 2670
Calibrator Level: 114.0dB
Auto. Calibration: No
Calibration Time: 23:59

Transducer: Condensor
Noise Floor: 8.00 dB
Rand. Inc Correction: Disabled

Linear Eng. Units: Disabled

Power Monitor
Power Off Mode:Auto Off
Auto Off Time:8 minutes
Backlight:Off
LCD Contrast:66

Controls
Logic Input Mode:None
Logic Output:Off

Modem Settings
Modem control: Disabled
Dial out mode: <none>
Telephone Number: <none>
Monitor Number: 0
Modem Init String: X4 E0 Q0 V0 T M1 S0=5 &D

Logging Sound Level Meter Settings
Translated: 16-Nov-2001 08:45:49

File Translated: C:\Program Files\Larson Davis\824 Utility\25Aug10l.slmdl
Model Number: 824
Serial Number: A1061
Firmware Rev: 3.520
Software Version: 3.050
Name: IEMR
Descr1: Goose Bay, Labrador A0P 1E0
Descr2: (709) 896-3266
Setup: RVE_Log.log
Setup Descr: River Valley Ecosystem Project
Location: St. Augustine River

Note 1: St. Augustine River Noise Data
Note 2: Control Data

Sound Level Meter
- Detector: Fast
- Weighting: A
- Peak-1 Weighting: Flat
- Range: Normal
- AC Output Control: AC-1 DC
- Current Threshold: 80 dB
- Current Exchange Rate: 3 dB
- Overall Threshold: 80 dB
- Overall Exchange Rate: 3 dB

Time Weighted Average
- Criterion Time: 8 hours
- Current Criterion Level: 90 dB
- Overall Criterion Level: 90 dB

Ln Start Level: 30 dB

Ln Percentiles
- L 1.00
- L 5.00
- L 50.00
- L 90.00
- L 95.00
- L 99.00

Triggering
- SPL Exceedance Level 1: 75.0 dB
- SPL Exceedance Level 2: 95 dB
- Peak-1 Exceedance Level: 120 dB
- Peak-2 Exceedance Level: 120 dB
- Exceedance Hysteresis: 3 dB

Time History
- Time History: Enabled
- Time History Period: 60
- Time History Units: 1.0 seconds
- Store Other Level: Advanced
- Resolution: 0.1 dB

Intervals
- Intervals: Enabled
- Interval Time Sync: Yes
- Interval Save Ln: Yes
- Interval Save Ln Table: Yes
- Interval Auto Stop: No
- Interval Period: 00:30:00
- Interval Threshold: 80 dB
- Interval Exchange Rate: 3 dB

- Daily History: Yes
- Daily Save Ln: Yes
- Daily Save Ln Table: Yes
- Daily Auto. Calibration: No

Define Report
- Print Data Report: Yes
- Print SPL Histogram: Yes
- Print Peak-1 Histogram: No
- Print Peak-2 Histogram: No
- Print Time History: Yes
- Interval Report: Short

Timer
- Timer Mode: 1/Day

Start Date: 25-Aug-2001
Stop Date: 27-Aug-2001
Start Time 1: 10:00
Start Time 2: 00:00
Stop Time 1: 22:00
Stop Time 2: 00:00

Logging Sound Level Meter Summary
Translated: 16-Nov-2001 08:47:16

File Translated: C:\Program Files\Larson Davis\824 Utility\25Aug10l.slmdl
Model Number: 824
Serial Number: A1061
Firmware Rev: 3.520
Software Version: 3.050
Name: IEMR
Descr1: Goose Bay, Labrador A0P 1E0
Descr2: (709) 896-3266
Setup: RVE_Log.log
Setup Descr: River Valley Ecosystem Project
Location: St. Augustine River
Note 1: St. Augustine River Noise Data
Note 2: Control Data

Overall Measurement			Current Measurement		
Start Time:		25-Aug-2001 10:00:00	Start Time		25-Aug-2001 10:00:00
Elapsed Time:		36:00:00.0	Elapsed Time		36:00:00.0
TWA-3:		18.4	TWA-3:		18.4
SEL:		69.5	SEL:		69.5
Dose:		0.00	Dose:		0.00
Proj. Dose:		0.00	Proj. Dose:		0.00
Threshold:		80 dB	Threshold:		80 dB
Criterion:		90 dB	Criterion:		90 dB
Exchange Rate:		3 dB	Exchange Rate:		3 dB
Min:	19.1	25-Aug-2001 18:58:39	Min:	19.1	25-Aug-2001 18:58:39
Max:	76.4	25-Aug-2001 10:00:18	Max:	76.4	25-Aug-2001 10:00:18
Peak-1:	104.5	25-Aug-2001 15:52:38	Peak-1:	104.5	25-Aug-2001 15:52:38
Peak-2:	99.3	25-Aug-2001 10:00:18	Peak-2:	99.3	25-Aug-2001 10:00:18

Ln Start Level: 30 dB
L (1.00) 55.2
L (5.00) 50.7
L (50.00) 30.0
L (90.00) 30.0
L (95.00) 30.0
L (99.00) 30.0
LDN: 43.4
CNEL: 43.5
Overall Leq: 43.4

Detector: Fast
Weighting: A
SPL Exceedance Level 1: 75.00 Exceeded: 1 times
SPL Exceedance Level 2: 95 Exceeded: 0 times
Peak-1 Exceedance Level: 120 Exceeded: 0 times
Peak-2 Exceedance Level: 120 Exceeded: 0 times
Hysteresis: 3
Overloaded: 0
Pause Count: 0 Pause Time: 00:00:00.0

Calibrated: 15-Aug-2001 09:14:32 Offset: -44.8 dB
Checked: 18-Aug-2001 19:39:52 Level: 114.0 dB
Calibrator: 2670
Level: 114.0
Cal Record Count: 0

Interval Records: Enabled Number Interval Records: 75
Time History: Enabled Number History Records: 2166

824 Memory: 2097152
Free Memory: 1977645 Percent Free: 94.30%
Battery Level: 11.5V Source: EXT

Overall Any Data
Start Time: 25-Aug-2001 10:00:00
Elapsed Time: 36:00:00.0

	A Weight	C Weight	Flat
TWA-3:	18.4 dBA	56.3 dBC	66.1 dBF
SEL:	69.5 dBA	107.4 dBC	117.2 dBF
Peak:	99.3 dBA	99.9 dBC	104.5 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 15:52:38	25-Aug-2001 15:52:38
Lmax (slow):	69.4 dBA	86.1 dBC	91.5 dBF
	26-Aug-2001 13:33:21	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (slow):	19.3 dBA	22.6 dBC	24.6 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:54:16	25-Aug-2001 19:32:57
Lmax (fast):	76.4 dBA	91.1 dBC	96.4 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (fast):	19.1 dBA	21.5 dBC	23.4 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:53:41	25-Aug-2001 19:32:57
Lmax (impulse):	81.4 dBA	93.9 dBC	99.7 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (impulse):	18.8 dBA	22.1 dBC	24.6 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:53:38	25-Aug-2001 19:32:19

Current Any Data
Start Time: 25-Aug-2001 10:00:00
Elapsed Time: 36:00:00.0

	A Weight	C Weight	Flat
TWA-3:	18.4 dBA	56.3 dBC	66.1 dBF
SEL:	69.5 dBA	107.4 dBC	117.2 dBF
Peak:	99.3 dBA	99.9 dBC	104.5 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 15:52:38	25-Aug-2001 15:52:38
Lmax (slow):	69.4 dBA	86.1 dBC	91.5 dBF
	26-Aug-2001 13:33:21	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (slow):	19.3 dBA	22.6 dBC	24.6 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:54:16	25-Aug-2001 19:32:57
Lmax (fast):	76.4 dBA	91.1 dBC	96.4 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (fast):	19.1 dBA	21.5 dBC	23.4 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:53:41	25-Aug-2001 19:32:57
Lmax (impulse):	81.4 dBA	93.9 dBC	99.7 dBF
	25-Aug-2001 10:00:18	25-Aug-2001 12:01:45	25-Aug-2001 15:52:38
Lmin (impulse):	18.8 dBA	22.1 dBC	24.6 dBF
	25-Aug-2001 18:58:39	25-Aug-2001 18:53:38	25-Aug-2001 19:32:19