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# Effects of Manual, Mechanical, and Aerial Herbicide Conifer Release on Songbird Numbers In Regenerating Spruce Plantations In Northwestern Ontario

by

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A thesis is submitted in partial fulfilment
of the requirements for the degree of
Master of Science in Biology
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# Abstract

This study examined the effects of conifer release with herbicides [Vision®(glyphosate)], [Release®(triclopyr)], and proposed alternatives to herbicides with manual brush saws and mechanical brushsaws, on breeding songbird densities in regenerating spruce plantations in northwestern Ontario. Pre-treatment (1993) and post-treatment (1994) densities of songbirds were determined by territory mapping during June. In July and August of both years, birds were captured in mist nets and colour banded to document reproductive success and to determine whether resident birds continued to use these areas after treatment. Transects were walked during August and September of both years to identify species using the plantations.

Post-treatment data revealed no changes between years in breeding bird species richness in the plantations.

Overall mean songbird density decreased non-significantly from approximately 69 pairs per 10 ha in the pre-treatment year to approximately 63 pairs per 10 ha in the first post-treatment year.

Analysis of variance revealed significant decreases in mean density of Chestnut-sided Warblers (*Dendroica pensylvanica*) between the brushsaw and Silvana treatments and the controls in the post-treatment year. Paired t-tests showed that, for most of the common species, there were significant year to year

increases or decreases in mean densities in most areas where treatments were applied. Sparrow densities increased and the densities of foliage gleaning insectivores decreased.

Ten percent of the 826 birds banded in 1993 were recaptured in 1994, 80% of these were within 100m of the point of initial capture the previous year. Twenty individuals moved from treated areas into adjacent areas with more typical breeding habitat. More White-throated Sparrows *Zonotrichia albicollis* than warblers (*Dendroica* sp.) were observed utilizing the plantations during August and September in the post-treatment year compared to the pre-treatment year when there were no differences.

Clumps of untreated vegetation (skips) remaining within the brushsaw and Silvana treatments provided the only available nesting sites for Alder Flycatchers *Empidonax alnorum*, Chestnut-sided Warblers, and Mourning Warblers *Oporornis philadelphia*.

Conifer release treatments had non-significant impacts on the breeding densities of most songbird species. Evidence suggests, however, that treatment effects were masked by other confounding factors such as the presence of skips, male site tenacity, and too few degrees of freedom in the MANOVA analyses.

## Acknowledgements

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# 1. Introduction

Conifer release treatments are used by foresters to free desirable crop-trees from the competition of the vigorous, post-harvest regeneration of hardwood shrubs. Two methods commonly used to suppress competing vegetation are the application of selective herbicides and brushcutting (Walstad and Kuch 1987). These treatments are conducted in late summer when they have a maximum effect on the competing vegetation. Songbirds discontinue use of nests by this time and do not use the same nests in subsequent years. Therefore nest destruction by brushsaws or nestling exposure to potential predators through defoliation is not a concern. Many songbirds continue to use breeding territories through late summer however, thus the issue of direct toxic effects of herbicides needs to be addressed.

Herbicides registered for use in Canada are unlikely to cause a direct toxic effect at operational doses because of their low toxicity to vertebrates [e.g., acute toxicity of glyphosate to rats is less than table salt, $LD_{50}$ 4300mg/kg vs 3750mg/kg, respectively, (Freedman 1989)] and to birds specifically (Evans and Batty 1986). Herbicides are applied in forests infrequently, usually once per 80 year rotation (Walstad and Kuch 1987). The foliar residues of glyphosate and triclopyr are only briefly persistent (Newton and Dost 1984) and they do not bioaccumulate (Morrison and Meslow 1983; Norris 1975). Thompson *et al.* (1994) reported mean times to 50% dissipation were 2 days for all

glyphosate formulations, 1.5 days for triclopyr ester, and 4 days for triclopyr acid. Dissipation was essentially complete by 24 and 48 days post-application, respectively, when applied in late summer. Consequently, the potential for exposure to birds at this time is low. Given the potential for chronic exposure however, some herbicides do cause embryo mortality (Hoffman and Albers 1984). When they immersed duck eggs in aqueous emulsions of glyphosate, they concluded that glyphosate was not toxic, based on hatching rates, at operational concentrations. Batt *et al.* (1980) found the time from initiation of pipping to hatching and the rate of hatching was unaffected by the application of glyphosate at operational concentrations. Holmes *et al.* (1994) exposed Zebra Finches (*Poephila guttata*) to varying concentrations of triclopyr in their feed. They concluded that, at concentrations greater than the maximum expected environmental concentrations, there were no significant adverse effects, measured by changes in food consumption and daily activity patterns. Additionally, they concluded that forestry applications of triclopyr, at registered dosage rates, posed little risk of direct mortality to wild songbirds. This conclusion may be erroneous because no wild songbirds were tested.

Strong relationships exist between vegetation structure and avian communities through habitat selection. (Johnston & Odum 1956; MacArthur 1964; Morgan & Freedman 1986; Mills *et al.* 1991). It therefore follows that habitat manipulations, that seriously

alter existing vegetation composition and structure, would deleteriously affect the numbers of birds nesting in such areas. Studies reviewed by Lautenschlager (1993), suggest that conifer release treatments, such as brush cutting and herbicide application, have relatively minor effects (compared to timber harvesting) or only short-term (2 to 4 years) effects on the numbers of breeding songbirds. He found from previous studies that songbird numbers were seldom reduced during the growing season after treatment. Lautenschlager warned, however, that many of these studies lacked replication, appropriate controls and/or pretreatment data (Morrison & Meslow 1984b; Hardy & Desgranges 1990; Milton & Towers 1990). Morrison and Meslow (1984a & 1984b) reported no differences in the overall densities of breeding birds in Oregon following the application of herbicide sprays glyphosate and triclopyr, although the densities of some species increased while those of others decreased. Their findings indicated a shift in habitat use by some species. Freedman *et al.* (1988) reported no statistical differences in the numbers, species richness and diversity of breeding birds between herbicide sprayed and unsprayed plots in Nova Scotia.

Studies examining the impacts of shrub removal on breeding songbird numbers also indicated insignificant responses to habitat alteration (Knopf & Sedgwick 1987; Best 1979; Wiens *et al.* 1986). Wiens and Rotenberry (1985) recognized that there were no immediate response by birds to habitat alterations. They attributed this lack of response to time lags because of site

tenacity of breeding birds.

To evaluate the impact of one-time habitat alterations on birds, long-term studies with appropriate replicates and controls are required. This study presents the results of the first two years of such a long-term study.

## 2. Objectives

The objectives of this study were to document numbers of breeding songbirds (per 10 ha) in four regenerating spruce plantations before the application of conifer release treatments; to monitor numbers of breeding songbirds during the nesting season following treatments; to determine the relative effects of manual, mechanical, and aerial herbicide conifer release treatments on numbers of breeding songbirds and numbers of non-breeding songbirds using of the plantations during migration.
$H_0 1$ = There will be no difference in songbird numbers, determined by territory mapping and captures in mist-nets, on the plantations, between years or among treatments.
$H_0 2$ = There will be no difference in percent cover of common plant species on the plantations, between years or among treatments.

## 3. Study Area

The Fallingsnow study area, named after a nearby lake, is

located in Fraleigh Township, 60 km SW of Thunder Bay, Ontario (Fig. 1). It is in the Great Lakes-St. Lawrence forest region (Rowe 1972). Common tree species are white spruce *Picea glauca*, balsam fir *Abies balsamea*, trembling aspen *Populus tremuloides*, and paper birch *Betula papyrifera*. The coordinates of the four plantations are 48°8'-48°13'N and 89°49'-89°53'W with an altitude 380-550 m above sea level. The four plantations, also referred to as blocks in parts of this document (block 1 with an area of 39 ha; block 2, 28 ha; block 3, 46 ha; and block 4, 31 ha) were clear-cut in 1988, 1988, 1986 and 1987 respectively. Block 1 was planted with white spruce and black spruce in 1990. Blocks 2, 3, and 4 were planted with white spruce in 1990, 1987 and 1989 respectively. The blocks were selected to represent a range of site conditions typical of northwestern Ontario and commonly differed in aspect, slope, drainage, and soils (Simpson *et al* 1997). The replicate blocks in this study might be considered 'pseudoreplicates' because of these differences. At the landscape level, however, they are independant samples of typical clearcuts in this part of northwestern Ontario.

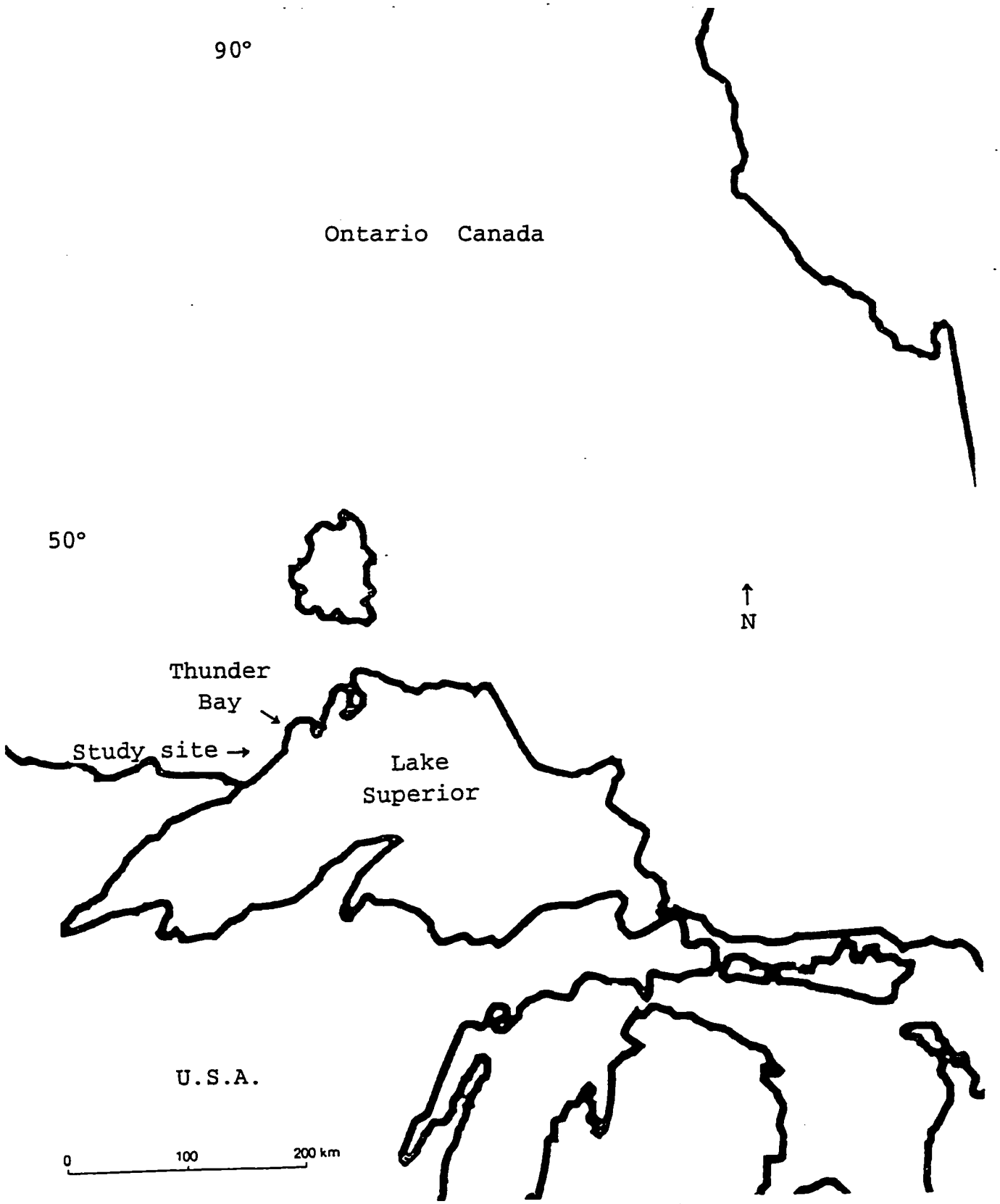
Trembling aspen and white birch saplings dominated the clearcuts at the time of treatment. Beaked hazel (*Corylus cornuta*), green alder (*Alnus viridis*), red raspberry (*Rubus idaeus*), mountain maple (*Acer spicatum*), and red-oiser dogwood (*Cornus stolonifera*) were common shrub species.

## 4. Methods

The 4 plantation blocks were each divided into 5 (4.4 to 12.5 ha) treatment plots and the following operational conifer release treatments applied to the plots in each block (Bell *et al.* 1995): (1)manual release with clearing saws (commonly called brushsaws) (2)mechanical release with the Silvana Selective/Ford Versatile tractor; (3)helicopter application of Release® (active ingredient [a.i.] triclopyr) herbicide; (4)helicopter application of Vision® (a.i., glyphosate) herbicide; and (5)control (no treatment). The herbicides Vision® (glyphosate at 1.5 kg /ha in 30 l/ha aqueous emulsion [a.e.] solution) and Release® (triclopyr at 1.9 kg /ha in 31 l/ha a.e. solution) were applied at the manufacturer's recommended rates by helicopter (Bell 206) on 16 August, 1993. The herbicides were applied under wind conditions below regulatory thresholds (2.2m $s^{-1}$) at spray height. Paper plate collectors distributed throughout the plots verified that the herbicides fell only where intended. The control plots were not treated. The size of each of the treatments is detailed in Table 1.

The manual brushsaw cutting was done between 12-22 October, 1993 using gasoline powered Stihl and Husquavarna brand brushsaws. The brush cutting with the Silvana Selective/Ford Versitile cleaning machine, started on 19 October, 1993 and was completed on 5 November, 1993. The Silvana Selective/Ford Versatile cleaning machine consists of a model 9030 Ford

Figure 1. Location in northwestern Ontario of the Fallingsnow study area.



Versatile bi-directional tractor, a model 290 CRANAB AB boom, and a Silvana Selective cutting head. Standard operational procedures (Walstad and Kuch 1987) were followed, thus some areas were left uncut either because they contained no crop trees or because operating the equipment on rough terrain could endanger workers.

Table 1. Area (ha) of treatments by block in Fraileigh township.

| Treatment | Control | Brushsaw | Release®[1] | Silvana | Vision®[2] |
|---|---|---|---|---|---|
| Block 1 | 8.2 | 6.5 | 5.9 | 8.9 | 9.1 |
| Block 2 | 5.0 | 4.4 | 5.8 | 5.0 | 8.0 |
| Block 3 | 7.4 | 12.5 | 7.2 | 9.8 | 9.5 |
| Block 4 | 4.2 | 4.4 | 9.8 | 7.5 | 5.2 |
| Total | 24.8 | 27.8 | 28.7 | 31.2 | 31.8 |

[1] Registered to DowElanco Canada Inc.

[2] Registered to Monsanto Canada Inc.

## 4.1. Procedure of Determining Vegetation Composition and Percent Cover

Vegetation data collected in late July, supplied by W. Bell of the Ontario Ministry of Natural Resources (Sault Ste. Marie) were used in the statistical analysis. Twenty-four randomly selected vegetation plots were located in each treatment (120 plots/block, 480 total in the 4 blocks). Each plot was 2.26 m in diameter (area of 4 $m^2$). Each plot was divided into four quadrants and percent cover recorded for the following vegetation groups: 'shrubs'; each species done separately with the exception of willow *Salix sp.* and service berry *Amelanchier sp.* which were lumped into genus only; all other species were lumped into horsetails, ferns, rushes, sedges, grasses, cattails, and forbs (dicot ground vegetation) (Appendices A and B).

## 4.2. Territory Mapping

I collected data on numbers and species of breeding birds in the plantations from late May through early July in 1993 (before treatment) and in 1994 (after treatment). I used the territory mapping method of Williams (1936), Koskimies & Väisänen (1991) and Ralph *et al.* (1993) to determine the number of birds of each species breeding on the plantations. This technique consisted of 10 replicate visits to each block and mapping the locations (to within 3 m) of all birds detected aurally and visually. Four

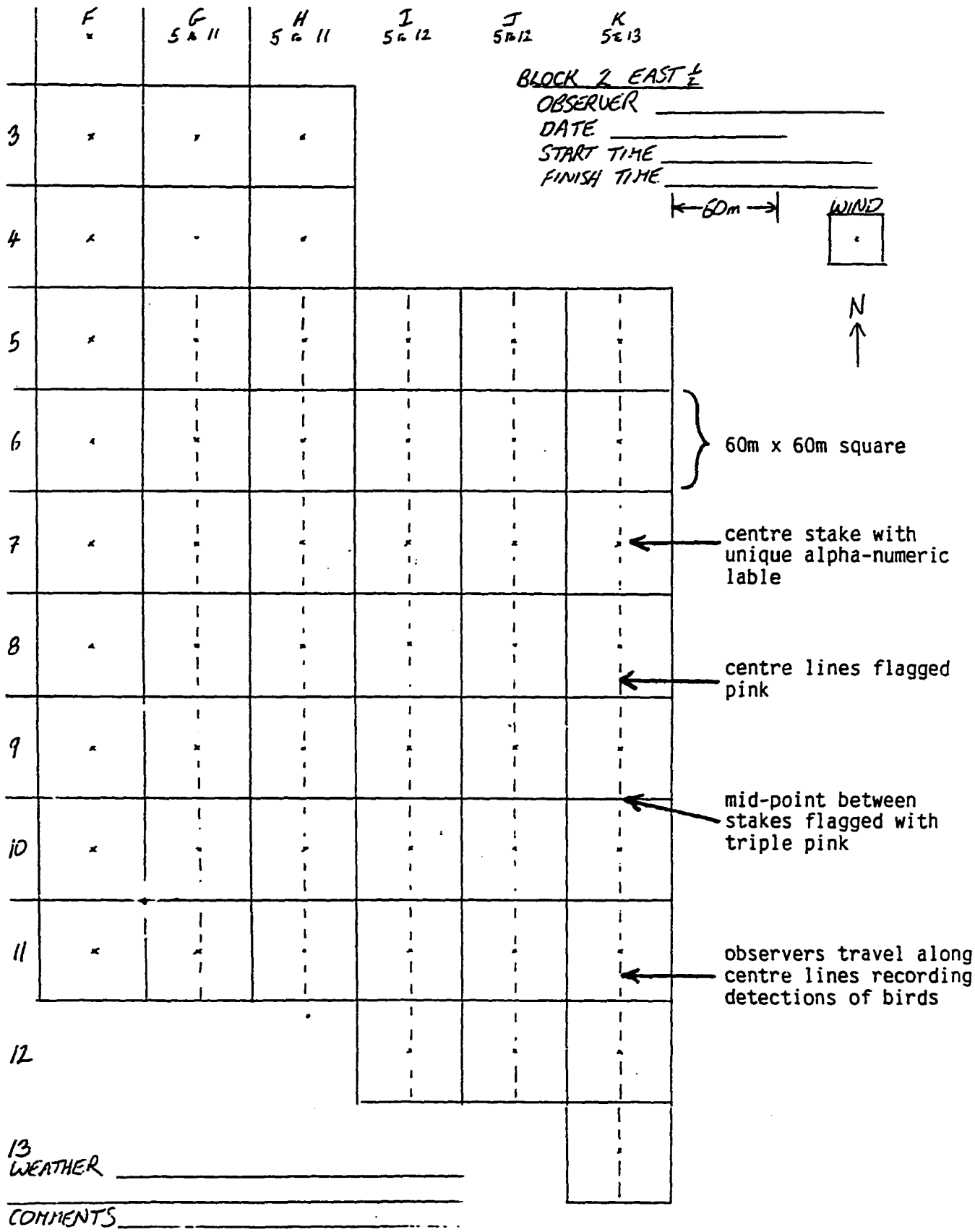
observers were responsible for monitoring half of two plantations. The visits took place in the morning (05:00-11:00). No visits were made when it was raining or when there were moderate to strong winds. Such conditions inhibited the singing of territorial birds.

Data were plotted on field maps of the blocks (fig. 2). The maps consisted of square grids with a scale of 3.8cm = 60m, corresponding to grids staked-out in the field. An alpha-numeric code was marked on each stake placed in the centre of each 60m x 60m square. Pink flagging tape was used to mark the centre lines of the squares and a triple combination of flags was used to mark the midpoints between the stakes in the centre (Fig 2).

Four observers walked slowly along the centre lines of the squares in separate halves of two blocks each morning. They kept track of their location by noting their position with respect to the flags and centre stakes. They spent approximately 4 min. in each square. Distinct symbols were used to identify each species, its' sex and activity (IBBC 1970; Appendix C). Individual birds were located (by sight and sound) as an observer moved along the centre lines. The locations of all birds detected were plotted on the field maps. Starting points for each replicate visit were rotated through the blocks to ensure that all parts of the blocks were visited at different times during the morning. Birds were thus recorded during species-specific peak activity periods.

Two observers, working in adjacent halves of the same block,

Figure 2. Sample field map of block 2 of the Fallingsnow study area.



compared notes at the completion of each morning observations to eliminate any duplicate detections in the area of overlap where the two halves abutted. This procedure reduced inter-observer variability in identification by verifying identifications and judgement of distances to singing birds between two observers. To identify and correct any discrepancies in species identification between observers, I switched blocks with each of the other observers on one occasion during the first week of data collection in both years.

Following each days' observations, data from the field maps, consisting of multi-species detections of birds, were transcribed to individual species maps on tracing paper. Detections from each visit were plotted with a different coloured fine-tip marker pen. After ten replicate visits an analysis of the individual species maps revealed clusters of detections, mostly of singing males in the same vicinity. These clusters indicated a single territory, assuming that territorial birds sing within or at the edge of their territories. Blocks were surveyed late May through early July of both years of the study (Appendix D).

One survey was done in the evening of 8 June in blocks 1 and 2 in 1993 to determine if species active only at this time were overlooked during the morning surveys.

## 4.3. Mist-netting

To determine breeding success and to obtain additional data

on bird species richness and numbers, I captured, in mist nets, birds that bred on and/or used the blocks in the latter part of the breeding season and during the post-breeding season (early July through mid-August). The nets were 32mm mesh, 4 pocket, 12m by 2m, suspended horizontally between two 3m sections of 4cm diameter steel electrical conduit pushed into the ground and/or supported with twine tied to vegetation. Vegetation was cleared from within about 1m of both sides of the nets and as close to the ground as possible before the nets were erected. The bottom of the nets were placed approximately 30cm above the remaining ground vegetation to avoid entanglement of birds in the lower pocket of the nets with vegetation. Net sites were chosen that were obscured by adjacent shrubbery to minimize their detection and avoidance by birds. Six to 20 nets were erected at sunrise and were taken down by about 11:00 when high temperatures and solar radiation endangered birds caught in nets. Netting was not done on rainy days because of the probability of hypothermia under such conditions. Nets were placed in different locations each day. The same net locations were used each year. Netting efforts were rotated among blocks on a regular basis although proportionately more days were spent netting in the larger blocks. Captured birds were identified, sexed by cloacal protuberance or brood patch, and aged by skull ossification (Pyle *et al.* 1987), banded with numbered leg bands, measured (wing chord only) and released with minimum delay. Coloured split-plastic rings were placed on the most numerous species to

facilitate the monitoring of their movements among plantations and their extended use of the plantations. These species were: Alder Flycatcher, Veery (*Catharus fuscescens*), Chestnut-sided Warbler, Mourning Warbler, American Goldfinch (*Carduelis tristis*), White-throated Sparrow, Lincoln's Sparrow (*Melospiza lincolnii*), and Song Sparrow (*Melospiza melodia*). Separate colours were assigned to each block as follows: block 1 - blue, block 2 - green, block 3 - red, block 4 - yellow. Banding activities were terminated when autumn migrant birds were captured (mid-August).

## 4.4. Transect Procedure

Birds using the blocks in the post-breeding season (August through September) were sampled using the same basic methodology as territory mapping except that time was not restricted to 4 minutes per square. This was done to determine if birds which bred on the plantations remained there after the breeding season and to determine if additional bird species utilized the plantations at this time. It was not possible to collect quantitative data when the singing activity of males ceased and the secretive behaviour of family groups made detections difficult. Thus an attempt was made only to list species of birds using the blocks and their relative abundances by keeping a tally of the number of individuals detected. Equal amounts of time were spent in each treatment of one block on each day of

sampling. Frequent use was made of 'spishing', mimicking alarm calls, to facilitate observation. Time was spent following individual birds to determine, with the aid of binoculars, if they had been banded.

## 4.5. Statistical Analyses

All statistical procedures were performed on SPSS/PC-6.1 software (Norusis 1992).

Multivariate analysis of variance (MANOVA) tested the null hypothesis of no difference in percent cover of common plant species among treatments.

One-way analysis of variance (TUKEY procedure) was used to determine where the significant differences in percent cover of common plant species among treatments occurred.

Stepwise discriminant analysis determined the extent to which vegetation differences reflected the treatments and to determine which vegetation components accounted for any variation in vegetation among treatments.

Multivariate analysis of variance (MANOVA) tested the null hypothesis of no difference in densities of bird species among treatments and blocks.

Oneway analysis of variance (TUKEY procedure) was used to determine where the differences in bird densities among treatments and blocks occurred.

Paired t-test were used to compare changes in mean bird

density between the pre- and post-treatment years.

Multivariate analysis of variance (MANOVA) tested the null hypothesis of no difference in numbers of captures of each species among treatments.

Linear regression analysis was used to compare species abundance using the territory mapping technique relative to the and mist-netting technique.

## 5. Results

### 5.1. Vegetation

Multiple analysis of variance indicated that the percent cover of aspen and birch saplings did not differ ($P<0.05$) among designated treatments in the pre-treatment year. In the post-treatment year the percent cover of aspen and birch was significantly ($P<0.05$) higher in the control plots than in all other treatments and aspen coverage was lower ($P<0.05$) in the Vision® plots than in the brushsaw and silvana plots (Table 2).

The percent cover of mountain maple, green alder, and beaked hazel shrubs did not differ ($P<0.05$) among treatments in the pre-treatment year. In the post-treatment year the percent cover of green alder was significantly ($P<0.05$) higher in the control plots than in all other treatments, mountain maple coverage was significantly ($P<0.05$) higher in the silvana treatment plots than in the Vision® plots, and beaked hazel coverage was significantly

Table 2. Mean cover percentages, 1993 and 1994, of abundant shrub-sized woody plants, and functional groups of ground vegetation with significant ($P<0.05$) differences among treatments.[1]

| Species/functional group | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| Tree saplings | | | | | | | | | | |
| Betula papyrifera | 0.9 | 1.2 | 1.8 | 2.4[a] | 1.5 | 0.4 | 1.0 | 0.9 | 1.3 | 0.0 |
| Picea mariana | 0.2 | 0.5 | 0.3 | 0.8 | 0.2 | 0.4 | 0.6[b] | 0.6 | 0.4 | 0.4 |
| Pinus banksiana | 0.2 | 0.3 | 0.5[c] | 0.9[d] | 0.1 | 0.2 | 0.0 | 0.0 | 0.1 | 0.2 |
| Populus tremuloides | 13.3 | 6.5 | 10.6 | 12.9[e] | 10.5 | 4.9 | 14.5 | 6.5 | 12.8 | 2.5[f] |
| Shrubs | | | | | | | | | | |
| Acer spicatum | 3.2 | 3.5 | 2.9 | 4.2 | 3.8 | 2.5 | 5.1 | 5.1[g] | 4.2 | 1.8 |
| Alnus viridis | 0.0 | 0.1 | 1.5 | 2.5[h] | 0.2 | 0.2 | 1.1 | 0.5 | 0.5 | 0.3 |
| Corylus cornuta | 5.1 | 4.7 | 5.3 | 7.6[i] | 5.1 | 3.0 | 7.7 | 5.5 | 7.8 | 1.8 |
| Diervilla lonicera | 2.2 | 2.8 | 2.7 | 4.7[j] | 1.8 | 3.4 | 4.9[k] | 5.6[l] | 4.5[m] | 1.3 |
| Rosa acicularis | 0.7 | 1.0 | 1.0 | 1.6[n] | 0.4 | 0.8 | 0.6 | 0.7 | 0.8 | 0.8 |

Table 2 (con't)

| Species/vegetation category | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| Others | | | | | | | | | | |
| Rubus idaeus | 10.2 | 16.1 | 8.8 | 14.0 | 11.1 | 7.8[o] | 7.8 | 16.2 | 10.4 | 10.8 |
| Carex sp. | 1.2 | 2.0 | 0.5 | 0.8 | 1.8[p] | 3.2 | 0.7 | 2.0 | 0.6 | 1.4 |
| Equisetum sp. | 0.1 | 0.3 | 0.2 | 0.7 | 1.1 | 1.9 | 0.4 | 1.0 | 0.7 | 0.7 |
| Grass | 6.0[q] | 10.3 | 3.8 | 7.9 | 3.1 | 15.9[r] | 2.4 | 5.6 | 3.6 | 6.7 |
| Herb | 42.2 | 53.9 | 41.6 | 55.8 | 34.2 | 39.2[s] | 38.3 | 56.0 | 36.5 | 55.1 |

[1] The complete species list is presented in Appendices A and B, data supplied by Wayne Bell; used with permission

[a] higher than all other treatments

[b] higher than Release®

[c] higher than Release® and silvana

[d] higher than silvana

[k] higher than brushsaw and Release®

[l] higher than brushsaw and Vision®

[m] higher than Release®

[n] higher than silvana

Table 2 (con't)

[e] higher than all other treatments

f lower than brushsaw and silvana

[g] higher than Vision®

[h] higher than all other treatments

[i] higher than Release® and Vision®

[j] higher than Vision®

[o] lower than brushsaw, control & silvana

[p] higher than control

[q] higher than silvana

[r] higher than control, silvana & Vision®

[s] lower than all other treatments

($P<0.05$) higher in the control plots than the Release® and Vision® plots. The percent cover of raspberry did not differ ($P<0.05$) among treatments in the pre-treatment year but was significantly lower in the Release® treatment plots than the brushsaw, control and silvana plots in the post-treatment year.

Grass coverage was higher ($P<0.05$) in the brushsaw plots prior to treatment but in the post-treatment year was significantly ($P<0.05$) higher in the Release® plots than in the control, silvana and Vision® plots.

The percent cover of herbaceous vegetation did not differ ($P<0.05$) among treatments in the pre-treatment year. In the post-treatment year herbaceous vegetation coverage was significantly ($P<0.05$) lower in the Release® plots than in all other treatments (Table 2).

Untreated patches and missed strips of vegetation occurred within the cutting and herbicide-treated plots respectively. Discriminant analysis further illustrated differences in vegetation among treatments in 1994. The first two functions of the discriminant analysis accounted for 79.17% of the variance in the data set. Function 1 separated the control from the herbicide spray plots on the basis of birch and aspen (Table 3). The control had the highest mean percent cover of birch and aspen and the herbicide spray plots had the lowest (Appendix B). Raspberry was also associated with Function 1, separating the brushsaw and Silvana treatments from the others on the basis of highest mean percent cover. Function 2 separated the two

herbicide spray plots from the other treatments on the basis of forbs, grasses, and thimbleberry (*Rubus parviflorus*) with the Release® treatment having the highest mean percent cover of grass and the lowest mean percent cover of forbs. The Vision® treatment had the lowest mean percent cover of thimbleberry and the Release® had the highest. The brushsaw and the Silvana showed very little separation. The all groups scatterplot illustrates the degree of separation (Fig. 3).

## 5.2. Birds

Seventy-three species of birds were recorded on the study area (Appendix E).

### 5.2.1. Territory Mapping

Twenty to 38 (block dependant) species of birds were detected during one or more territory mapping sessions in both years. The number of territories recorded are listed in appendices F through I.

Table 3. Standardized canonical discriminant function coefficients

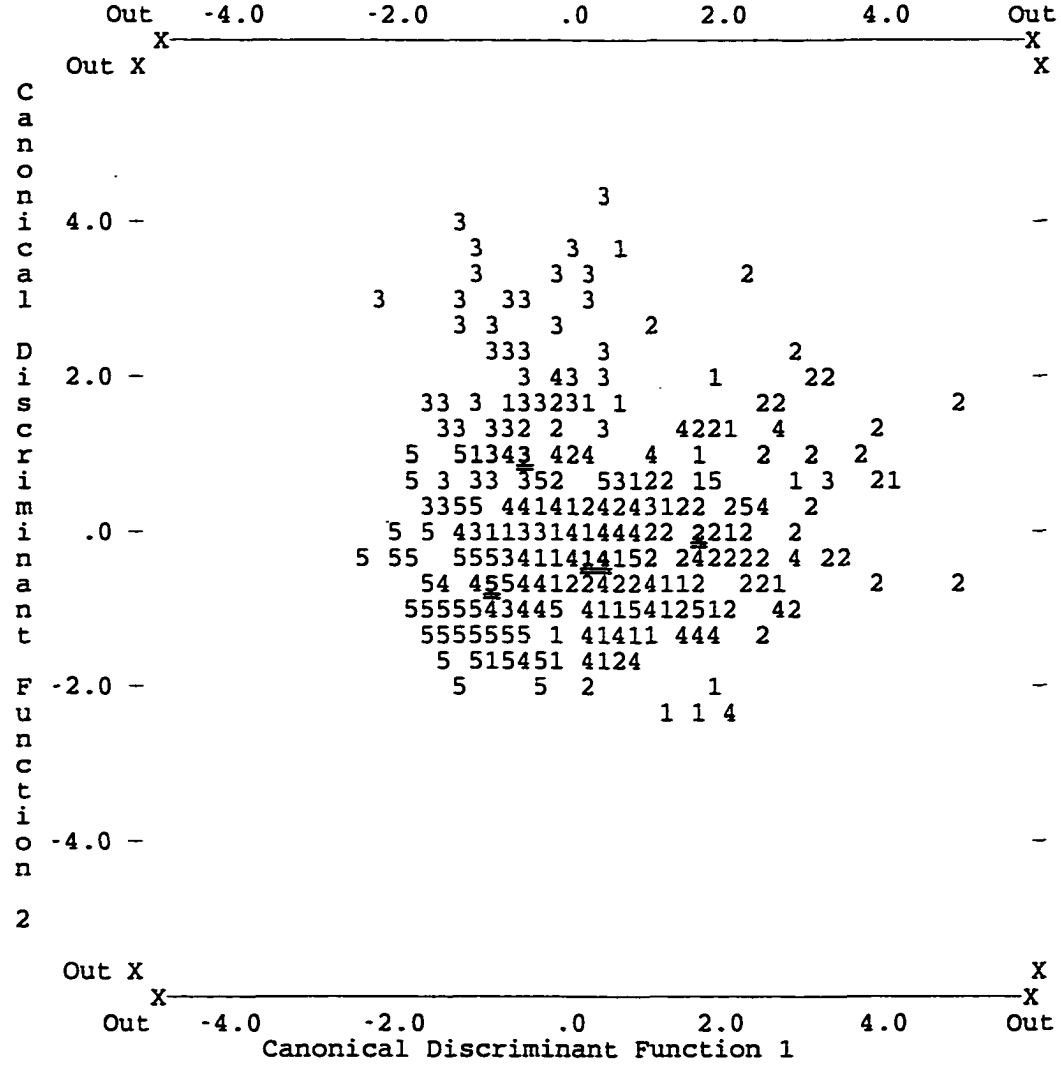
| Species | FUNC 1 | FUNC 2 | FUNC 3 | FUNC 4 |
|---|---|---|---|---|
| Abies balsamea | .12947 | -.07804 | .14358 | -.14758 |
| Acer spicatum | .23206 | .03198 | .28915 | -.14876 |
| Alnus viridis | .28563 | .07306 | -.25129 | -.09179 |
| Alnus incana | -.02535 | .13015 | .26920 | .04321 |
| Amelanchier sp. | .23470 | -.16109 | .16471 | -.08753 |
| Apocynum androsaemifolium | .26910 | -.10454 | .12030 | .14406 |
| Betula papyrifera | **.62720**[1] | .05119 | -.07456 | .12701 |
| Cornus alternifolia | -.01226 | -.01272 | .11739 | .26807 |
| Corylus cornuta | .33074 | .03743 | .16875 | -.03007 |
| Cornus stolonifera | .26589 | -.05559 | .31186 | .09823 |
| Diervilla lonicera | .05431 | .23366 | .21389 | -.49490 |
| Fern | .09373 | .13154 | .25843 | .19862 |
| Grass | .19326 | **.46065** | .15317 | .26174 |
| Herb | .31764 | **-.44801** | .12808 | .10011 |
| Equisetum sp. | -.06582 | .12229 | .08399 | -.27279 |
| Moss | .08025 | .28488 | .15486 | .23944 |
| Pinus banksiana | .35089 | .05612 | -.18977 | .07394 |
| Picea mariana | .21917 | .01006 | -.15115 | -.16819 |
| Populus balsamifera | .05014 | .13721 | -.16723 | -.17087 |
| Populus tremuloides | **.52900** | .17305 | -.30076 | .14354 |
| Prunus pensylvanica | .15535 | .01345 | -.06300 | .12334 |

Table 3 (con't)

| Species | FUNC 1 | FUNC 2 | FUNC 3 | FUNC 4 |
|---|---|---|---|---|
| Prunus virginiana | .01673 | -.10329 | .05918 | .44299 |
| Ribes glandulosum | .11527 | -.06612 | -.05330 | .29219 |
| Ribes hirtellum | -.10069 | .26538 | -.18674 | -.00001 |
| Ribes triste | .01057 | .12884 | -.15693 | .20110 |
| Rosa acicularis | .11652 | .10580 | -.16155 | -.03467 |
| Rubus idaeus | **.37804** | -.21939 | .46476 | .00437 |
| Rubus parviflorus | .28565 | **.52899** | .24954 | -.06769 |
| Eleocharis sp. | .30092 | .19123 | .04777 | .07823 |
| Sambucus pubens | .04701 | .15527 | -.12836 | .05308 |
| Carex sp. | -.09062 | .33235 | .30278 | -.00635 |
| Shepherdia canadensis | .04339 | -.01045 | .31069 | .29219 |
| Sorbus decora | .18529 | -.00725 | -.10178 | -.04976 |
| Vaccinium myrtilloides | .05530 | -.03372 | .21118 | .35649 |
| Virburnum rafinesquianum | .11089 | .02897 | .09171 | -.21051 |

[1] Species contributing significantly to the function

Figure 3. All-groups scatterplot of vegetation differences among treatments, in the post-treatment year, ordered by function 1 and 2 of the discriminant analysis.




All-groups scatterplot, **bold** indicates a group centroid

1=brushsaw 2=control 3=Release® 4=Silvana 5=Vision®

The territory mapping results were extrapolated to include the number of territories per 10 ha (Appendix J), to facilitate comparisons among treatments and with other studies. The evening survey carried out on blocks 1 and 2, in 1993, revealed no additional species relative to the number detected during the morning surveys. I found that the birds sang less frequently and for shorter periods of time in the evening compared to the morning. The evening surveys were discontinued because the same effort was required by observers to perform evening surveys as morning surveys but the data gathered was about half of that which could be gathered in the morning. Since the data were sparse and these surveys were not repeated, no data on evening surveys is presented here.

Densities of territories of American Goldfinches and Cedar Waxwings (*Bombycilla cedrorum*) were not determined because, although fairly common, they did not exhibit territorial behaviour until late in the season and tended to range widely across the plantations. In the pre-treatment year 11 species were detected in most treatment areas of all plantations. These species were therefore selected for statistical analyses; the Northern Flicker (*Colaptes auratus*), Alder Flycatcher, American Robin (*Turdus migratorius*), Veery, Red-eyed Vireo (*Vireo olivaceus*), Nashville Warbler (*Vermivora ruficapilla*), Chestnut-sided Warbler, Mourning Warbler, White-throated Sparrow, Lincoln's Sparrow, and Song Sparrow. The Chestnut-sided Warbler was the most abundant, with means of 23.4± and 14.6± pairs/10 ha during pre- and post-treatment years respectively (Tables 4 & 5).

Table 4. Number (mean ± SE) of territories/10 ha of common bird species pre-treatment (1993) (n=4 plots/treatment).

| | Control | | Brushsaw | | Silvana | | Release® | | Vision® | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Northern Flicker | 0.27 | 0.12 | 0.44 | 0.09 | 0.71 | 0.12 | 0.8 | 0.19 | 0.30 | 0.08 |
| Alder Flycatcher | 5.72 | 1.94 | 5.69 | 0.94 | 7.08 | 1.97 | 7.30 | 1.76 | 6.84 | 1.63 |
| American Robin | 0.75 | 0.32 | 0.94 | 0.20 | 0.97 | 0.68 | 0.56 | 0.20 | 0.62 | 0.40 |
| Veery | 1.73 | 0.89 | 3.34 | 1.32 | 3.83 | 1.18 | 1.80 | 0.40 | 2.96 | 1.10 |
| Red-eyed Vireo | 2.34 | 1.36 | 2.91 | 0.98 | 3.61 | 0.66 | 2.23 | 0.75 | 3.30 | 0.69 |
| Nashville Warbler | 2.06 | 0.43 | 3.10 | 1.48 | 1.36 | 0.63 | 1.93 | 0.26 | 1.91 | 0.65 |
| Chestnut-sided Warbler | 24.40 | 7.52 | 0.37 | 9.40 | 24.20 | 5.65 | 23.41 | 2.35 | 21.58 | 4.63 |
| Mourning Warbler | 9.89 | 1.05 | 0.44 | 1.56 | 7.27 | 1.83 | 12.08 | 1.02 | 8.58 | 1.26 |
| White-throated Sparrow | 4.98 | 1.91 | 5.47 | 0.65 | 4.52 | 1.08 | 5.88 | 1.55 | 4.67 | 0.98 |
| Lincoln's Sparrow | 2.32 | 0.89 | 1.96 | 0.39 | 1.17 | 0.28 | 1.77 | 0.65 | 2.37 | 0.19 |
| Song Sparrow | 8.76 | 2.06 | 8.17 | 2.65 | 5.40 | 1.49 | 7.48 | 1.86 | 8.77 | 1.47 |
| Total | 63.27 | | 66.76 | | 60.17 | | 43.81 | | 61.99 | |

Table 5. Number (mean ± SE) of territories/10 ha of common bird species post-treatment (1994) (n=4 plots/treatment).

| | Control | | Brushsaw | | Silvana | | Release® | | Vision® | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Northern Flicker | 0.71 | 0.29 | 0.40 | 0.14 | 0.62 | 0.22 | 0.60 | 0.25 | 0.56 | 0.15 |
| Alder Flycatcher | 8.53 | 3.59 | 3.29 | 1.23 | 3.08 | 1.04 | 7.19 | 1.16 | 6.44 | 1.68 |
| American Robin | 0.58 | 0.30 | 0.79 | 0.29 | 0.58 | 0.33 | 0.90 | 0.57 | 1.12 | 0.68 |
| Veery | 3.51 | 1.67 | 1.30 | 0.63 | 1.81 | 0.80 | 2.02 | 1.03 | 3.66 | 1.76 |
| Red-eyed Vireo | 3.36 | 1.37 | 1.35 | 0.87 | 1.48 | 0.52 | 0.91 | 0.55 | 1.76 | 0.85 |
| Nashville Warbler | 2.97 | 1.43 | 1.74 | 1.03 | 1.05 | 0.38 | 3.96 | 0.76 | 2.84 | 0.60 |
| Chestnut-Sided Warbler | 24.70 | 2.42 | 8.23 | 3.04 | 9.21 | 2.95 | 0.97 | 2.94 | 13.75 | 2.55 |
| Mourning Warbler | 8.08 | 0.76 | 8.53 | 4.27 | 7.50 | 0.67 | 8.49 | 2.59 | 4.78 | 1.16 |
| White-throated Sparrow | 5.78 | 1.93 | 6.28 | 1.46 | 4.18 | 0.91 | 0.86 | 1.60 | 7.42 | 2.05 |
| Lincoln's Sparrow | 1.94 | 0.92 | 4.17 | 0.74 | 3.20 | 0.63 | 3.63 | 1.13 | 4.14 | 0.64 |
| Song Sparrow | 6.53 | 2.55 | 2.89 | 0.55 | 1.07 | 1.73 | 8.23 | 1.68 | 8.29 | 0.79 |
| Total | 54.82 | | 60.43 | | 49.03 | | 65.31 | | 63.89 | |

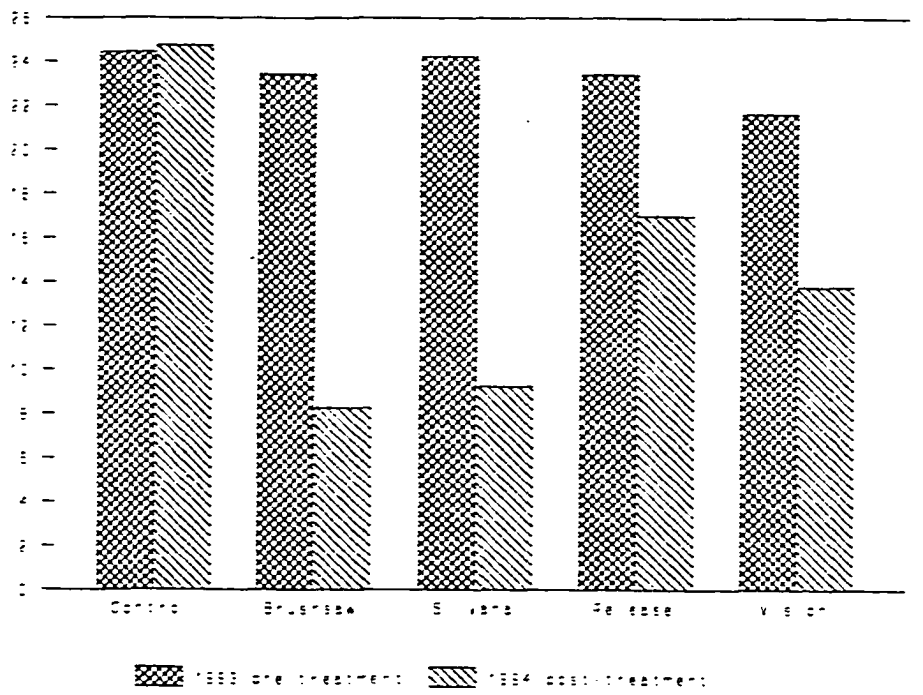
In the pre-treatment year the densities of Northern Flicker differed ($P<0.05$) among treatments (Table 4). The densities of territorial males of all other species examined did not differ among treatments. In the post-treatment year, Chestnut-sided Warbler densities differed ($P<0.05$) among treatments (Table 5). Tukey analysis indicated differences ($P<0.05$) between the controls and the brushsaw and Silvana treatments (Fig. 4).

In the pre-treatment year, densities of Alder Flycatcher, Chestnut-sided Warbler, Lincoln's Sparrow, Veery, and White-throated Sparrow were lower ($P<0.05$) on plantation 4, a drier, more open site. In the post-treatment the densities of Alder Flycatcher, Chestnut-sided Warbler, and Veery were lower ($P<0.05$) on plantation 4. No colour banded birds from other plantations were observed.

Between year differences in mean densities were indicated by paired-t tests. Significant ($P<0.05$) decreases in mean densities of Alder Flycatcher, Chestnut-sided Warbler, Red-eyed Vireo, and Veery were noted on the brush removal (brushsaw and Silvana) plots. On the spray plots (Release® and Vision®) the densities of Chestnut-sided Warbler and Mourning Warbler declined ($P<0.05$); the latter also declining in the controls. Significant ($P<0.05$) increases in the numbers of White-throated Sparrow were noted on the controls and the Release® plots. Song Sparrow numbers increased on the Silvana plots and Lincoln's Sparrow increased on the Silvana and Vision® plots ($P<0.05$).

In the post-treatment year, all territories of Chestnut-

Figure 4. Differences in Chestnut-sided Warbler density among treatments and between years.



sided Warblers, Alder Flycatchers, and Mourning Warblers in the brushsaw treatment of block 1 were restricted to the edges of the treatment plot where clumps of uncut shrubs (skips) remained. There were no territories mapped in the centre of this treatment plot where all shrubs were cut. These birds were not restricted to the edges of the plot in the pre-treatment year (Appendix K). On block 2 Chestnut-sided Warbler and Alder Flycatcher territories were similarly associated with skips in the brushsaw and silvana plots (Appendix K). Skips were scattered throughout the brushsaw plot of block 3 which were within the territories of Chestnut-sided Warblers and Alder Flycatchers.

5.2.2. Mist-netting

In July and August of 1993 and 1994, 826 and 1020 birds, 38 and 44 species, were captured respectively (Appendices L & M). Banding was terminated when large numbers of non-resident (migrant) birds were being captured. In the pre-treatment year the numbers of female Mourning Warblers captured were significantly ($P<0.05$) higher in the Release® treatment than in all other treatments. No other common species differed among treatments (Appendix L) in the pre-treatment year. In the post-treatment year captures of female Chestnut-sided Warblers were significantly ($P<0.05$) higher in the control than the brushsaw treatment. Captures of male Chestnut-sided Warblers were significantly ($P<0.05$) lower in the brushsaw and silvana

treatments than in all other treatments. Lincoln's Sparrow males were captured in significantly ($P<0.05$) higher numbers in the Release® than in the Vision® treatment (Appendix M).

One hundred and eighty-three hatching year birds were captured in the pre-treatment year and 262 in the following year (Fig. 5). In the post-treatment year significantly ($P<0.05$) more hatching year Song Sparrows were captured in the brushsaw treatment than in the Vision® treatment.

Linear regression analysis (Table 6) of the number of territories determined from territory mapping and the number of males captured, indicates a high degree of correlation between these two sets of data for both years.

Eighty-one of the 826 birds that were banded in 1993 were recaptured in 1994 yielding a recapture rate of 9.8%. If only the 1993 banding totals of the species recaptured are considered then the pool from which these 81 recaptures is drawn becomes 658 and the recapture rate is 12.3% (Table 7). Applying the average annual survival rates for genera to which most of these species belong, ≈50% (Mönkkönen,1992), yields a recapture rate of 24.6% of those individuals surviving from 1993. This suggests that an average of ≈25% of the birds on the blocks are being recaptured and further extrapolation leads one to conclude that about 25% of all birds on the blocks were captured. This is a fairly large sample of the total population and thus one would expect that the sexes were similarly sampled.

In the pre-treatment year 396 males and 253 females were

Figure 5. Hatching year birds captured in 1993 and 1994.

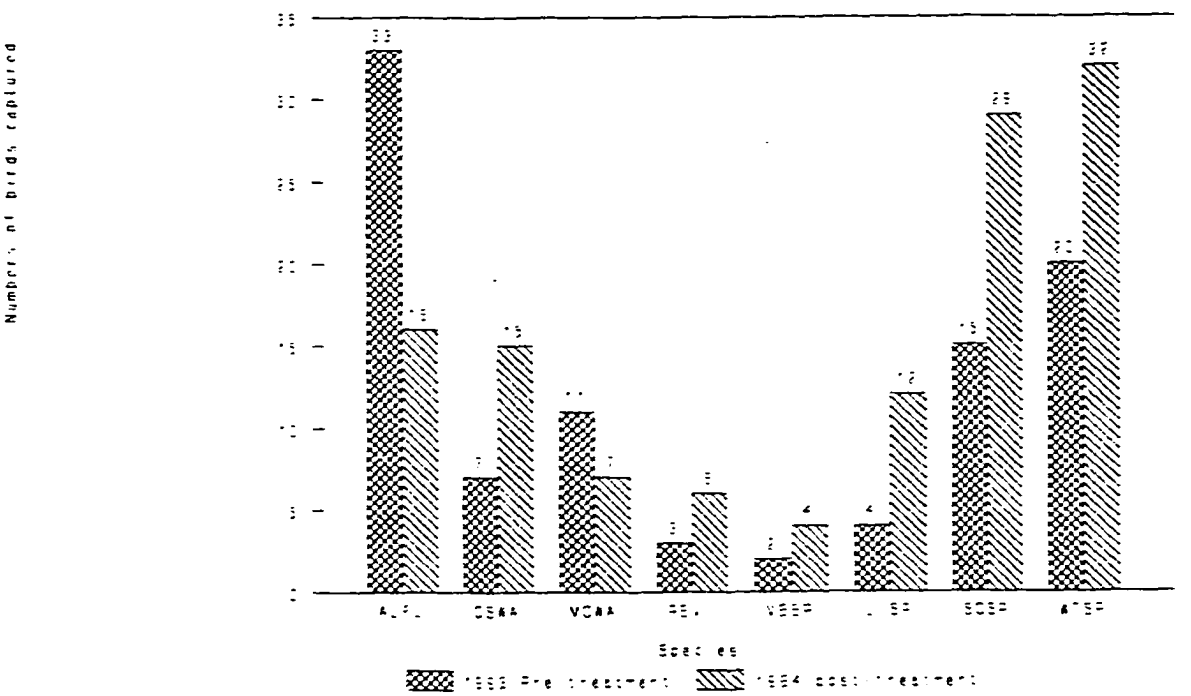


Table 6. Correlation coefficients from the regression analysis of banded males vs. territories mapped.

| | 1993 | 1994 |
|---|---|---|
| block 1 | .78[1] | .74 |
| block 2 | .75 | .80 |
| block 3 | .91 | .80 |
| block 4 | .88 | .71 |
| all blocks combined | .90 | .83 |

[1] ($r^2$ values given; 1993 N=20, 18 d.f., P <.0001; 1994 N=20, 18 d.f., P <.0001)

Table 7. Numbers of birds banded in 1993 and recaptured in 1994.

| spp. | Banded (1993) | Recaptured (1994) | % Recaptured |
|---|---|---|---|
| ALFL | 142 | 9 | 6.34 |
| AMGO | 20 | 2 | 10.00 |
| AMRO | 3 | 2 | 66.60 |
| COYE | 5 | 3 | 60.00 |
| CSWA | 136 | 21 | 15.44 |
| LISP | 29 | 1 | 3.45 |
| MOWA | 75 | 4 | 5.33 |
| PHVI | 9 | 1 | 11.11 |
| REVI | 54 | 5 | 9.26 |
| SOSP | 62 | 6 | 9.68 |
| VEER | 22 | 3 | 13.64 |
| WTSP | 92 | 23 | 25.00 |
| YBFL | 9 | 1 | 11.11 |
| Totals | 658[1] | 81 | 12.31% (average) |

[1] Totals of the above 13 species includes hatching year birds.

captured. In the post-treatment year 473 males and 206 females were captured. There was a significant difference in the sex ratios between years (1.56 males/female in 1993 and 2.39 males/female in 1994) ($\chi^2_{.1}$ = 2.70554, df=1). Table 8 shows that the surplus males were warblers and flycatchers, not sparrows.

5.2.3. Transects

There were no significant differences in numbers of individuals or species detected among blocks or designated treatments in the pre-treatment year. In the post-treatment year there were no significant differences in numbers of birds or species detected among blocks but the numbers species and individuals were significantly ($\underline{P}$<0.05) different among treatments (Appendices N-S). For numbers of species, differences were between the Silvana treatment (fewest species) and the control and Release® treatments ($\underline{P}$<0.05). The total numbers observed differed between the Silvana treatment (lowest numbers) and both spray plots ($\underline{P}$<0.05).

Table 8. Ratio of males to females captured in 1993 and 1994.

| Species | 1993 | 1994 |
|---|---|---|
| Alder Flycatcher | .59 | 1.62 |
| Chestnut-sided Warbler | 2.21 | 4.79 |
| Song Sparrow | 2.07 | 1.85 |
| White-throated Sparrow | 2.09 | 2.08 |

# 6. Discussion

## 6.1. Territory Mapping

With the exception of Slagsvold (1977), no one has attempted to examine the effects of more than one conifer-release alternative (herbicide treatment vs. reference of control) on breeding songbird numbers. The net reduction in number of bird territories in my study was negligible (8.69%), contrasting with Slagsvold's (1977) report of 30% reductions in bird numbers. My results counter the suggestion by Probst *et al.* (1992) that species dependant upon shrubs would be eliminated in stands where such vegetation is removed by herbicides or other means. No major shifts in species composition of the bird communities using the treated plots were noted between the pre- and post-treatment years. Freedman *et al.* (1988) reported similar findings in Nova Scotia.

Greatest reductions in Chestnut-sided Warblers were on the brush-cutting (brushsaw and Silvana) treatments. Morrison and Meslow (1984), reported a similar response by Wilson's Warbler (*Wilsonia pusilla*), a species also associated with deciduous tree cover. Greenberg (1979) found that the Chestnut-sided Warbler was more highly stereotyped in its foraging repertoire than were other *Dendroica* species. Collins (1981,1983) noted different requirements for song perches and nest sites among eastern warblers. Changes in these structures would affect the use of an

altered habitat by a bird with a specific narrow niche. The percent cover of aspen, birch, alder and hazel did not change significantly between years in the controls but was significantly reduced in the other treatments and reductions in Chestnut-sided Warbler densities paralleled these treatment-induced vegetation changes. It is likely that lack of foraging plasticity resulted in the reductions.

Chestnut-sided Warblers are dependant upon dense shrubs for nest placement and typically eat insects gleaned from deciduous foliage. A reduction in numbers of these birds was expected where the shrubs had been removed (brushsaw and Silvana treatments). I intuitively anticipated a similar response from the birds to the defoliation which occurred in the herbicide treated plots but the territory mapping data did not indicate significant reductions there. MacKinnon and Freedman (1993) concluded that there are relatively small and short-term effects of the silvicultural use of glyphosate on the prominent bird species of regenerating clearcuts in Nova Scotia. Wiens and Rotenberry (1985) suggested that time lags in the responses of breeding migrant songbirds to changes made to their breeding habitat in their absence confound any effort made to measure those responses. They interpreted the time lags in responses to shrubsteppe habitat alteration as a consequence of site tenacity or philopatry; adult birds that had previously bred successfully in an area often return to breed in subsequent years. Knopf and Sedgwick (1987) support speculations from Wiens and Rotenberry's

(1985) studies of shrubsteppe bird populations, that site tenacity may play a stronger role in determining annual densities of breeding birds than previously thought. Although sapling and shrub foliage was much reduced (≈50-200%) in the herbicide spray plots the physical structure of the defoliated stems remained. Beaver (1976) reported insignificant shifts of abundance of breeding songbirds in herbicide-treated brushfields, suggesting that there was little change in species abundance and composition due to the birds responding to essential elements of habitat structure which remained unchanged i.e. distribution and density of stems. The densities and numbers of captures of Chestnut-sided Warblers in the Release® and Vision® treatments were most similar to the control treatments, suggesting that the structure of the remaining stems in these treatments provided some clues to the birds on the suitability of such areas. Hildén (1965) describes proximate factors that underlie habitat selection, when present in adequate abundance, elicit a settling response by birds to use a certain location. In the case of herbicide treated areas, the birds may be responding to the proximate factors of density and distribution of stems.

The densities of warblers in the herbicide plots may be poor indicators of habitat quality. Van Horn (1983) first questioned the assumption that habitat quality for a species is positively correlated with the density of the species. Vickery *et al.* (1992) lend support to Van Horne's thesis and suggest that additional 'demographic' factors should be considered. Probst

and Hayes (1987) demonstrated that a lower proportion of male Kirtland Warblers (*Dendroica kirtlandii*) in marginal habitat are mated. The overall sex ratios changed significantly between years in my study, suggesting that there was a greater surplus of males in the post-treatment year. If the excess males were holding territories and had failed to attract mates but were censused as breeding males then the impact of the treatments may have been even greater than what was measured. Used alone, the technique of territory mapping may not be an appropriate means to measure the responses of breeding songbirds to habitat alteration. Unpaired males have been observed to sing as much or more than paired individuals (Nice 1964, Krebs 1992, Nolan 1978, Morton 1992). MacKinnon and Freedman (1993) suggest that in the first post spray year there were few declines in abundance of breeding birds. They suggest that the census technique used (territory mapping) does not include a measure of breeding success; the densities of males defending territories did not change (site fidelity) but perhaps reproductive success did change. They further alluded to the phenomena of 'migrant deception'; birds returning to claim territories on previously high-quality habitat failing to perceive habitat changes in defoliated sites. More direct measures of breeding success, such as nest monitoring or constant-effort mist nets and banding (Ralph *et al.* 1993) may provide additional insight into the responses of songbirds to habitat alterations. My finding that the proportion of female flycatchers and warblers in the

population declined suggests that potential breeding success may have been impacted but was masked by the methodology of counting singing males. The male to female sex ratio reflects the status of the health of the breeding habitat. A male skewed population resulting from females choosing mates elsewhere reflects poor quality habitat.

Treatment effects on songbirds have been lessened by the presence of untreated patches (skips) of vegetation. These skips contained the only active nest sites for some species of birds (Alder Flycatchers, Chestnut-sided Warblers, and Mourning Warblers) which would likely have been absent from the treatments if the skips had not been present. Morrison and Meslow (1984a) suggested that small patches of untreated vegetation scattered throughout the herbicide treated areas were sufficient to maintain an avian community similar in species composition to that on untreated sites. The presence of untreated patches of vegetation in most treatments helped maintain the diversity of the avian community in this study.

Although the other species examined in this study were determined to not have statistically significantly different responses to the various treatments this may be an artifact of the statistical procedure MANOVA due to the small territory mapping sample sizes. Despite considerable effort involved in territory mapping, after 10 replicate visits all the data gathered for each species is pooled to arrive at one density estimate per species per treatment, thereby reducing the number

of degrees of freedom. Changes in breeding densities as measured by paired t-test between years may more accurately portray what is occurring biologically. In the controls only one species had a significant difference in breeding densities between years. Mourning Warbler densities decreased, and this may be due to successional changes (increasing canopy closure) rendering this habitat less suitable. Five species of insectivorous birds (Alder Flycatcher, Chestnut-sided Warbler, Mourning Warbler, Red-eyed Vireo, and Veery) demonstrated reduced breeding densities between years in all areas where a treatment was applied. These species are characteristically arboreal, requiring second growth deciduous shrubs for nest placement and as substrate for the insects upon which they forage, so it is not surprising that they were more abundant in the controls where there is the greatest density and diversity of shrubs. They typically eat insects gleaned from deciduous foliage (Chestnut-sided Warbler and Red-eyed Vireo), catch insects on the wing (Alder Flycatcher) or forage beneath shrubs (Mourning Warbler) and closed canopy (Veery).

Three species of sparrows tended to increase in numbers following treatment. White-throated Sparrow numbers increased more in the herbicide spray plots than in the shrub removal plots whereas Song Sparrows displayed the opposite trend. The increase in Lincoln's Sparrow numbers was greatest in the Release® treatments. The abundant grasses in the Release® treatment provided the moist meadows which the Lincoln's Sparrow, a species

which builds its nest of grass on the ground, requires. This increase in numbers of sparrows is consistent with the habitat preference of these birds for more open areas. These opportunistic birds typically eat seeds, fruit and some insects. The proliferation of seed and fruit bearing herbaceous vegetation in the treatments would provide an abundant food source. The scattered shrubs and small conifers in abundant openings provided required nesting habitat.

## 6.2. Transects

More sparrows and fewer warblers were observed in the late summer of the post-treatment year than in the pre-treatment year on the effective treatments. The Silvana treatments had the least number of birds observed foraging, while the Release® and Vision® had the most. The brushsaw and the control treatments had the most species and the Silvana had the least. Bell (1994) demonstrated that the Silvana Selective Brushcutter caused considerably more damage to the remaining stems of the shrubs being removed than the manual brushcutting technique. This damage resulted in greater fungus infection and consequently greater dieback and less resprouting. Thus the Silvana treatments had less hardwood shrub foliage left intact as foraging substrate for the birds.

## 6.3. Mist-netting and Banding

In the post-treatment year, the relative abundance of species captured shifted; fewer flycatchers, warblers, vireos, and Veerys were captured; sparrow captures increased. Prior to treatment, the numbers of both Chestnut-sided Warblers and Alder Flycatchers captured exceed the numbers of White-throated Sparrows captured. Following treatment the number of captures of White-throated Sparrows was greater than the sum of captures of the other two species (Appendix M).

The mist-netting methodology used in this study involved sampling each net location only once during the post-breeding season. While this provided much useful information on the proportions of species present, it did not yield rigorous data on reproductive success due to small numbers captured. Figure 6, comparing hatching year birds captured in the two years, does however suggest that sparrow reproductive success increased and flycatcher reproductive success decreased.

The increase in numbers of hatching year Chestnut-sided Warblers captured in the post-treatment year is probably due to stochastic events. Brawn and Robinson (1996) pointed out that the lack of data on dispersal is a major gap in understanding the population dynamics of Neotropical migrants. Little is known of the post-fledging dispersal of birds such as the Chestnut-sided Warbler. My banding data revealed a decline in the numbers of these birds captured in the post-fledging period and observations

indicated a shift in habitat use from the regenerating clearcut to the canopy of the adjacent mature aspen forests. Thus, unless one is capturing birds continuously in one location, the post-fledging dispersal is likely to be missed, and I believe that probably happened in this study. A reverse habitat shift was detected for the interior forest species, Least Flycatcher (*Empidonax minimus*) and Ovenbird (*Seiurus aurocapillus*). Neither of these species were detected in the clearcut during June (the nesting period) but were captured in the post-fledging period (July/August). When evaluating the impact of a treatment on breeding songbirds, this new information cautions us to examine not only the birds breeding on the site but also the birds breeding in adjacent habitats.

If one regards the mist netted birds as a random sample of the territorial birds then the banding data supports the conclusions drawn from mapping at least with regards to the proportions of the species present.

In the post-treatment year mist-nets were erected daily throughout the month of May. Song Sparrows, Lincoln's Sparrows and White-throated Sparrows were present on all blocks when netting began early in May. Many individuals which were banded the previous year were recaptured in nets erected in the same locations as the previous year. Most of these birds held territories in the same vicinity throughout the breeding season. The warblers and flycatchers appeared later in the month and most initial recaptures were also made in the same locations in which

the birds were caught the previous year, irrespective of the treatment. However, most of the warblers which were first captured in the brushsaw and Silvana treatments were later captured (or observed) in locations removed from the original capture and recapture points. These observations reinforce the supposition that site fidelity is an important factor affecting the birds' responses to the treatments. In the case of the sparrows, site fidelity resulted in birds returning to establish territories in the same locations as the previous year. The warblers which returned to past territories from which the shrubs had been removed shifted their territories to adjacent locations which had shrubs intact. No such shifts were noted from the herbicide spray treatments. Thus it appears that while site fidelity is a strong force causing birds to return to previous breeding locations, this force can be moderated by extremes of habitat alteration as in the case of the Chestnut-sided Warblers. Since the numbers of sparrows increased it is presumed that the treatment induced vegetation changes were found to be favourable to these birds.

Of the 650 known sex, breeding adults banded prior to treatment, 81 were recaptured in the post-treatment year. Using frequency analysis ( $\chi^2_{.005} = 7.88$, df=1, P=.01) there was a significantly higher proportion of males recaptured. The noticeable differences in degrees of site fidelity between the sexes in this study may be the result of the interaction of two factors, the sudden changes in habitat structure to which the

males are not responding (Best 1979; Wiens 1985; Knopf & Sedgewick 1987) and female choice of mates being influenced by territory quality (Searcy 1979). The males are continuing to occupy sub-optimal habitats (O'Connor 1985) and the quality females are moving on to select mates holding territories in better quality habitats.

## 7. Conclusions

The Chestnut-sided Warbler was the only species to demonstrate statistically detectably different responses to the treatments as measured by analysis of variance. Declines in the numbers of this species were greater where brush cutting techniques (brushsaw & Silvana) were used, than where the herbicide spray (Release® & Vision®) were applied.

Other species (Alder Flycatcher, Mourning Warbler, Red-eyed Vireo & Veery) having similar habitat requirements appeared to respond similarly, although their responses to the different treatments were not statistically detectable.

A second group of species (Lincoln's Sparrow, Song Sparrow & White-throated Sparrow) having alternate habitat requirements appeared to respond positively to the treatments but the responses were not statistically different among treatments.

Year to year changes in the abundance of some bird species were statistically detectable using paired t-tests in some treatments, and this is attributable to changes in the vegetation

brought about by the treatments.

The presence of 'skips', areas missed by the treatments, ameliorated the impact of the treatments on some species of birds. Such skips could be incorporated into vegetation management plans to maintain bird biodiversity.

The methodology of territory mapping may not be an appropriate means to measure the response of songbirds to habitat alteration. Male site fidelity results in a disproportionate number of males returning to establish territories and female choice of mates may result in some of these males failing to secure a mate. Since the methodology does not differentiate between mated and unmated males it may artificially inflate the perceived breeding population. To truly measure the response of breeding songbirds to habitat alterations, demographic methods such as nest monitoring or constant-effort mist nets and banding, should be employed to supplement census data.

Post-breeding surveys revealed that the Silvana treated areas were the least used by birds.

Potential impacts of different treatments on songbird abundance should be evaluated from local through global scales. Chestnut-sided Warblers for instance are locally abundant but are ranked as a species of concern (Thompson *et al.* 1992) due to significant declines in the mid-west in the last two decades.

## 8. Literature Cited

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Appendix A Cover percentages (mean and standard error) of vegetation plots in 1993

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Tree saplings | | | | | | | | | | |
| Pinus strobus | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.02 | 0 | 0 |
| Pinus banksiana | 0.20 | 0.09 | 0.49 | 0.22 | 0.05 | 0.05 | 0 | 0 | 0.07 | 0.06 |
| Abies balsamea | 0.39 | 0.22 | 0.28 | 0.13 | 0.43 | 0.31 | 0.70 | 0.38 | 0.45 | 0.22 |
| Picea mariana | 0.23 | 0.07 | 0.33 | 0.08 | 0.20 | 0.07 | 0.55 | 0.10 | 0.43 | 0.10 |
| Picea glauca | 1.49 | 0.21 | 1.40 | 0.18 | 1.18 | 0.18 | 1.26 | 0.19 | 1.30 | 0.20 |
| Populus tremuloides | 13.28 | 1.71 | 10.58 | 1.33 | 10.53 | 1.38 | 14.45 | 1.64 | 12.75 | 1.57 |
| Populus balsamifera | 0.18 | 0.16 | 0.35 | 0.22 | 0.98 | 0.39 | 0.58 | 0.30 | 0.46 | 0.28 |
| Betula papyrifera | 0.93 | 0.35 | 1.81 | 0.44 | 1.54 | 0.38 | 0.99 | 0.39 | 1.30 | 0.47 |
| Tall shrubs | | | | | | | | | | |
| Acer spicatum | 3.23 | 0.68 | 2.85 | 0.61 | 3.75 | 0.82 | 5.11 | 0.98 | 4.19 | 0.90 |
| Alnus incana | 0.59 | 0.35 | 0.10 | 0.10 | 1.48 | 0.94 | 0.72 | 0.45 | 0.88 | 0.57 |
| Alnus viridis | 0 | 0 | 1.53 | 0.54 | 0.20 | 0.12 | 1.13 | 0.69 | 0.52 | 0.29 |

Appendix A (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Sorbus decora | 0.07 | 0.06 | 0.17 | 0.12 | 0.13 | 0.08 | 0 | 0 | 0 | 0 |
| Prunus virginiana | 0.30 | 0.17 | 0.15 | 0.11 | 0.1 | 0.07 | 0 | 0 | 0.19 | 0.08 |
| Prunus pensylvanica | 0.22 | 0.10 | 0.43 | 0.24 | 0.75 | 0.28 | 0.07 | 0.06 | 0.36 | 0.17 |
| Medium shrubs | | | | | | | | | | |
| Sambucus pubens | 0 | 0 | 0.07 | 0.05 | 0.23 | 0.10 | 0.02 | 0.02 | 0.07 | 0.06 |
| Cornus stolonifera | 2.07 | 0.59 | 1.66 | 0.76 | 2.10 | 0.74 | 1.89 | 0.68 | 2.12 | 0.64 |
| Cornus alternifolia | 0.02 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corylus cornuta | 5.05 | 1.02 | 5.30 | 1.16 | 5.11 | 1.48 | 7.68 | 1.69 | 7.84 | 1.78 |
| Low shrubs | | | | | | | | | | |
| Diervilla lonicera | 2.16 | 0.45 | 2.65 | 0.44 | 1.78 | 0.45 | 4.91 | 0.79 | 4.46 | 0.77 |
| Lonicera hirsuta | 0.04 | 0.03 | 0.19 | 0.09 | 0.09 | 0.06 | 0.04 | 0.03 | 0.53 | 0.33 |
| Lonicera canadensis | 0.14 | 0.07 | 0.07 | 0.05 | 0.11 | 0.06 | 0.05 | 0.05 | 0.07 | 0.06 |
| Rubus idaeus | 10.17 | 1.36 | 8.81 | 1.32 | 11.05 | 1.09 | 7.82 | 1.27 | 10.40 | 1.32 |

Appendix A (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Rubus parviflorus | 5.28 | 0.87 | 8.56 | 1.27 | 7.54 | 1.35 | 5.89 | 0.95 | 7.66 | 1.09 |
| Rosa acicularis | 0.67 | 0.17 | 0.95 | 0.22 | 0.40 | 0.14 | 0.56 | 0.13 | 0.82 | 0.31 |
| Ribes oxyacanthoides | 0 | 0 | 0 | 0 | 0.05 | 0.05 | 0 | 0 | 0 | 0 |
| Ribes hirtellum | 0 | 0 | 0 | 0 | 0.16 | 0.09 | 0 | 0 | 0.04 | 0.03 |
| Ribes glandulosum | 0.24 | 0.10 | 0.17 | 0.09 | 0.12 | 0.08 | 0.12 | 0.08 | 0.07 | 0.06 |
| Ribes triste | 0.26 | 0.10 | 0.37 | 0.14 | 0.46 | 0.23 | 0.15 | 0.11 | 0.21 | 0.10 |
| Vaccinium angustifolium | 0.07 | 0.06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Graminoids | | | | | | | | | | |
| Horsetails | 0.07 | 0.06 | 0.18 | 0.08 | 1.05 | 0.43 | 0.37 | 0.15 | 0.71 | 0.53 |
| Rushes | 0.51 | 0.19 | 0.89 | 0.44 | 0.87 | 0.30 | 0.44 | 0.20 | 0.59 | 0.30 |
| Sedges | 1.17 | 0.22 | 0.50 | 0.12 | 1.84 | 0.70 | 0.74 | 0.14 | 0.61 | 0.13 |
| Grasses | 5.98 | 0.99 | 3.81 | 1.00 | 3.13 | 0.72 | 2.39 | 0.57 | 3.58 | 0.84 |
| Cattails | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.04 | 0.03 |

Appendix A (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Forbs | | | | | | | | | | |
| Ferns | 5.30 | 1.25 | 2.71 | 0.55 | 3.07 | 0.77 | 5.60 | 1.42 | 6.48 | 1.30 |
| Herbs | 42.19 | 2.44 | 41.60 | 2.12 | 34.23 | 2.47 | 38.25 | 2.32 | 36.48 | 2.23 |

Appendix B Cover percentages (mean and standard error) of vegetation plots in 1994

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Tree saplings | | | | | | | | | | |
| Pinus banksiana | 0.28 | 0.16 | 0.93 | 0.40 | 0.18 | 0.16 | 0 | 0 | 0.16 | 0.12 |
| Abies balsamea | 0.44 | 0.27 | 0.67 | 0.23 | 0.48 | 0.28 | 1.20 | 0.54 | 0.69 | 0.24 |
| Picea mariana | 0.46 | 0.12 | 0.83 | 0.15 | 0.36 | 0.11 | 0.57 | 0.13 | 0.44 | 0.11 |
| Picea glauca | 1.68 | 0.21 | 1.45 | 0.23 | 1.86 | 0.24 | 1.77 | 0.24 | 2.40 | 0.41 |
| Thuja occidentalis | 0 | 0 | 0.02 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 |
| Populus tremuloides | 6.46 | 0.91 | 12.92 | 1.54 | 4.94 | 0.59 | 6.45 | 0.63 | 2.51 | 0.82 |
| Populus balsamifera | 0.21 | 0.13 | 0.52 | 0.33 | 0.98 | 0.55 | 0.43 | 0.16 | 0.18 | 0.12 |
| Acer rubrum | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.05 | 0 | 0 |
| Betula papyrifera | 1.23 | 0.26 | 2.42 | 0.50 | 0.40 | 0.13 | 0.94 | 0.25 | 0.02 | 0.02 |
| Tall shrubs | | | | | | | | | | |
| Salix sp. | 2.24 | 0.55 | 2.28 | 0.62 | 2.49 | 1.03 | 1.21 | 0.44 | 1.53 | 0.46 |
| Acer spicatum | 3.49 | 0.74 | 4.21 | 0.77 | 2.46 | 0.60 | 5.06 | 1.02 | 1.82 | 0.48 |

Appendix B (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Alnus incana | 0.57 | 0.28 | 0.21 | 0.16 | 0.73 | 0.41 | 0.48 | 0.26 | 0.02 | 0.02 |
| Alnus viridis | 0.05 | 0.05 | 2.52 | 0.92 | 0.16 | 0.16 | 0.48 | 0.20 | 0.34 | 0.32 |
| Amelanchier sp. | 0.51 | 0.18 | 0.59 | 0.19 | 0.02 | 0.02 | 0.69 | 0.23 | 0.05 | 0.05 |
| Sorbus decora | 0.07 | 0.06 | 0.39 | 0.27 | 0.05 | 0.05 | 0.07 | 0.06 | 0 | 0 |
| Sorbus americana | 0.05 | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prunus virginiana | 0.49 | 0.20 | 0.21 | 0.13 | 0.16 | 0.09 | 0.07 | 0.06 | 0.26 | 0.13 |
| Prunus pensylvanica | 0.30 | 0.10 | 0.44 | 0.23 | 0.15 | 0.08 | 0.13 | 0.08 | 0.05 | 0.05 |
| Medium shrubs | | | | | | | | | | |
| Cornus stolonifera | 3.02 | 0.85 | 2.28 | 0.90 | 0.59 | 0.30 | 2.52 | 0.82 | 1.26 | 0.49 |
| Cornus alternifolia | 0.02 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corylus cornuta | 4.72 | 0.71 | 7.57 | 1.60 | 2.97 | 1.11 | 5.50 | 0.96 | 1.75 | 0.99 |
| Shepherdia canadensis | 0.16 | 0.12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Virburnum rafinesquianum | 0.05 | 0.05 | 0.36 | 0.24 | 0 | 0 | 0.53 | 0.38 | 0.11 | 0.08 |

Appendix B (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Sambucus pubens | 0.05 | 0.05 | 0.12 | 0.08 | 0.15 | 0.08 | 0.02 | 0.02 | 0.04 | 0.03 |
| Low shrubs | | | | | | | | | | |
| Diervilla lonicera | 2.77 | 0.48 | 4.65 | 0.88 | 3.43 | 0.76 | 5.64 | 0.76 | 1.34 | 0.33 |
| Lonicera hirsuta | 0.09 | 0.06 | 0.28 | 0.14 | 0.15 | 0.08 | 0.38 | 0.23 | 0.12 | 0.06 |
| Lonicera canadensis | 0.19 | 0.08 | 0.07 | 0.06 | 0.23 | 0.10 | 0.13 | 0.11 | 0.18 | 0.09 |
| Rubus idaeus | 16.11 | 1.78 | 13.99 | 1.75 | 7.78 | 0.98 | 16.19 | 1.88 | 10.81 | 1.33 |
| Rubus parviflorus | 8.41 | 1.10 | 10.44 | 1.27 | 12.50 | 1.82 | 10.32 | 1.37 | 3.29 | 0.77 |
| Rosa acicularis | 1.01 | 0.20 | 1.59 | 0.30 | 0.78 | 0.22 | 0.70 | 0.18 | 0.77 | 0.21 |
| Ribes hirtellum | 0 | 0 | 0.05 | 0.05 | 0.1 | 0.07 | 0 | 0 | 0 | 0 |
| Ribes glandulosum | 0.42 | 0.16 | 0.30 | 0.12 | 0.21 | 0.13 | 0.11 | 0.07 | 0.20 | 0.16 |
| Ribes oxyacanthoides | 0.02 | 0.02 | 0 | 0 | 0.02 | 0.02 | 0.05 | 0.05 | 0 | 0 |
| Ribes triste | 0.52 | 0.19 | 0.72 | 0.25 | 0.65 | 0.23 | 0.32 | 0.17 | 0.15 | 0.08 |
| Vaccinium angustifolium | 0.04 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

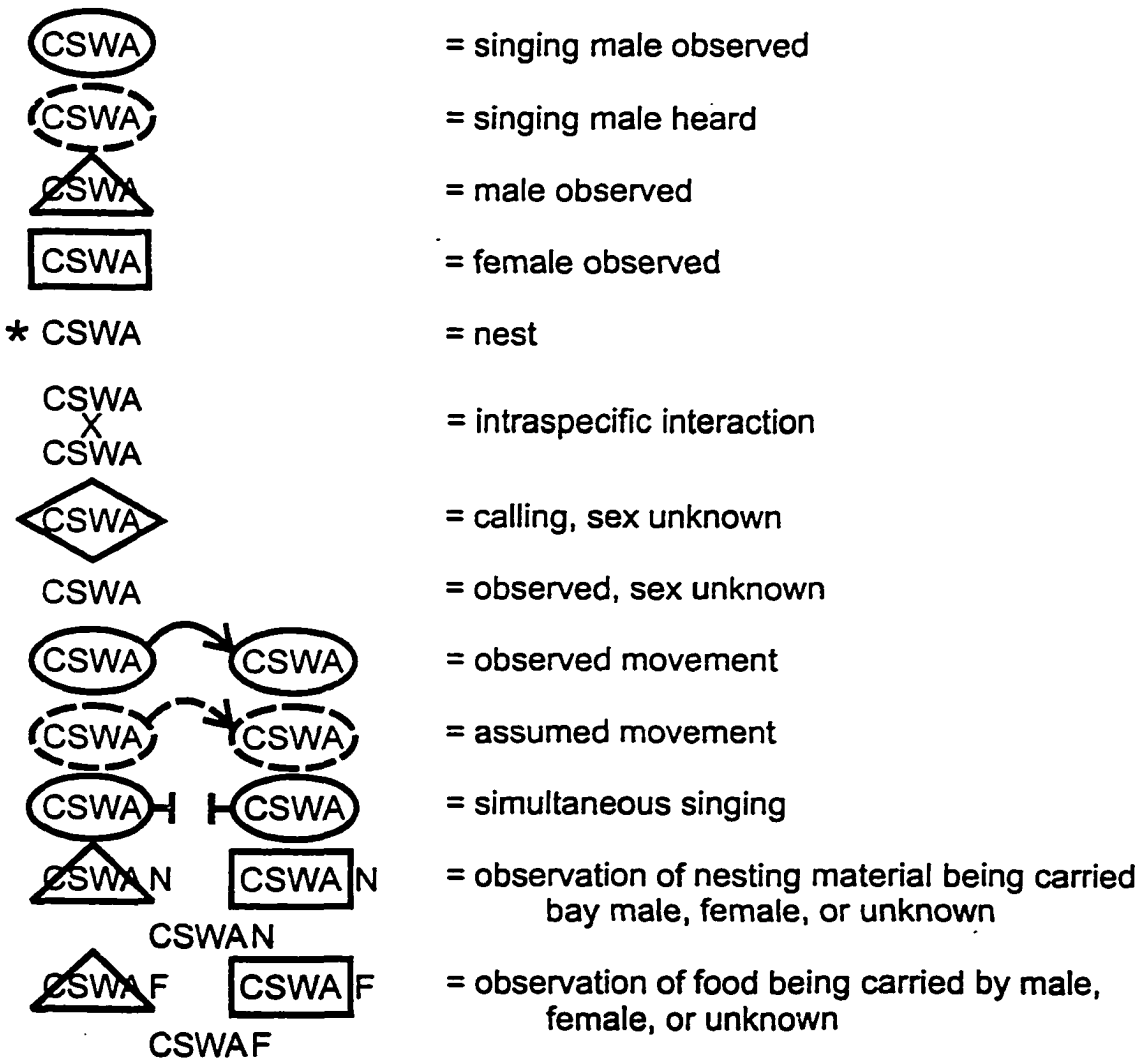
Appendix B (con't)

| Vegetation category/ Species | Treatments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brushsaw | | Control | | Release® | | Silvana | | Vision® | |
| | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| Graminoids | | | | | | | | | | |
| Horsetails | 0.33 | 0.22 | 0.68 | 0.29 | 1.86 | 0.70 | 0.96 | 0.36 | 0.69 | 0.38 |
| Rushes | 1.10 | 0.31 | 1.69 | 0.81 | 2.52 | 0.67 | 0.80 | 0.32 | 0.22 | 0.13 |
| Sedges | 1.96 | 0.28 | 0.83 | 0.16 | 3.15 | 0.60 | 2.02 | 0.36 | 1.44 | 0.24 |
| Grasses | 10.31 | 1.37 | 7.88 | 1.48 | 15.89 | 2.18 | 5.59 | 0.97 | 6.72 | 0.73 |
| Cattails | 0.10 | 0.10 | 0.05 | 0.05 | 0.18 | 0.09 | 0.05 | 0.05 | 0.02 | 0.02 |
| Forbs | | | | | | | | | | |
| Ferns | 8.51 | 1.59 | 6.24 | 1.22 | 7.80 | 1.56 | 7.85 | 1.46 | 4.81 | 1.12 |
| Herbs | 53.91 | 1.98 | 55.78 | 2.19 | 39.22 | 2.06 | 55.96 | 1.93 | 55.05 | 2.24 |

# Appendix C Territory mapping symbols

Species name abbreviation conventions

CSWA = Chestnut-sided Warbler
CHSP = Chipping Sparrow
OVEN = Ovenbird
DEJU = Dark-eyed Junco



Appendix D Territory mapping dates, 1993 and 1994

| Visit | Block 1 | | Block 2 | | Block 3 | | Block 4 | |
|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| 1 | May 31 | May 31 | May 31 | May 31 | June 2 | June 1 | June 2 | June 2 |
| 2 | June 4 | June 2 | June 4 | June 2 | June 5 | June 3 | June 5 | June 3 |
| 3 | June 6 | June 6 | June 6 | June 6 | June 9 | June 7 | June 9 | June 7 |
| 4 | June 10 | June 9 | June 10 | June 9 | June 11 | June 10 | June 11 | June 10 |
| 5 | June 12 | June 13 | June 12 | June 13 | June 14 | June 16 | June 14 | June 16 |
| 6 | June 17 | June 18 | June 17 | June 18 | June 18 | June 20 | June 18 | June 20 |
| 7 | June 19 | June 21 | June 19 | June 21 | June 20 | June 22 | June 20 | June 22 |
| 8 | June 22 | June 23 | June 22 | June 23 | June 23 | June 24 | June 23 | June 24 |
| 9 | June 24 | June 27 | June 24 | June 27 | June 25 | June 29 | June 25 | June 29 |
| 10 | June 28 | June 30 | June 28 | June 30 | June 29 | July 1 | June 29 | July 1 |
| 11* | June 15 | | June 15 | | | | | |

* - evening visit

Appendix E - Alphabetical list (by species abbreviation) of all bird species recorded on the study area in 1993 and 1994

| Abbreviation | Common Name | Scientific Name | 1993 | 1994 |
|---|---|---|---|---|
| ALFL | Alder flycatcher | *Empidonax alnorum* | ✓ | ✓ |
| AMGO | American Goldfinch | *Carduelis tristis* | ✓ | ✓ |
| AMKE | American Kestrel | *Falco sparverius* | ✓ | ✓ |
| AMRE | American Redstart | *Setophaga ruticilla* | ✓ | ✓ |
| AMRO | American Robin | *Turdus migratorius* | ✓ | ✓ |
| AMWO | American Woodcock | *Scolopax minor* | | ✓ |
| BAOW | Barred Owl | *Strix varia* | | ✓ |
| BBCU | Black-billed Cuckoo | *Coccyzus erythropthalmus* | ✓ | |
| BBWA | Bay-breasted Warbler | *Dendroica castanea* | ✓ | ✓ |
| BCCH | Black-capped Chickadee | *Parus atricapillus* | ✓ | ✓ |
| BLJA | Blue Jay | *Cyanocitta cristata* | ✓ | ✓ |
| BOCH | Boreal Chickadee | *Parus hudsonicus* | | ✓ |
| BRCR | Brown Creeper | *Certhia americana* | ✓ | |
| BTBW | Black-throated Blue Warbler | *Dendroica caerulescens* | | ✓ |
| BTGW | Black-throated Green Warbler | *Dendroica virens* | ✓ | ✓ |
| BWHA | Broad-winged Hawk | *Buteo platypterus* | ✓ | ✓ |

Appendix E (con't)

| Abbreviation | Common Name | Scientific Name | 1993 | 1994 |
|---|---|---|---|---|
| BWWA | Black and White Warbler | *Mniotilta varia* | ✓ | ✓ |
| CAWA | Canada Warbler | *Wilsonia canadensis* | ✓ | ✓ |
| CEDW | Cedar Waxwing | *Bombycilla cedrorum* | ✓ | ✓ |
| CHSP | Chipping Sparrow | *Spizella passerina* | ✓ | ✓ |
| CMWA | Cape May Warbler | *Dendroica tigrina* | ✓ | ✓ |
| CONI | Common Nighthawk | *Chordeiles minor* | ✓ | ✓ |
| COSN | Common Snipe | *Gallinago gallinago* | ✓ | ✓ |
| COWA | Connecticut Warbler | *Oporornis agilis* | | ✓ |
| COYE | Common Yellowthroat | *Geothlypis trichas* | ✓ | ✓ |
| CSWA | Chestnut-sided Warbler | *Dendroica pensylvanica* | ✓ | ✓ |
| DEJU | Dark-eyed Junco | *Junco hyemalis* | ✓ | ✓ |
| DOWO | Downey Woodpecker | *Picoides pubescens* | ✓ | ✓ |
| EAKI | Eastern Kingbird | *Tyrannus tyrannus* | ✓ | ✓ |
| EVGR | Evening Grosbeak | *Coccothraustes vespertinus* | ✓ | ✓ |
| EWPE | Eastern Wood-pewee | *Contopus virens* | ✓ | ✓ |
| FOSP | Fox Sparrow | *Passerella iliaca* | ✓ | |
| GCKI | Golden-crowned Kinglet | *Regulus satrapa* | ✓ | ✓ |

Appendix E (con't)

| Abbreviation | Common Name | Scientific Name | 1993 | 1994 |
|---|---|---|---|---|
| GRCA | Gray Catbird | *Dumetella carolinensis* | ✓ | ✓ |
| GRJA | Gray Jay | *Perisoreus canadensis* | ✓ | ✓ |
| HAWO | Hairy Woodpecker | *Picoides villosus* | ✓ | ✓ |
| HETH | Hermit Thrush | *Catharus guttatus* | ✓ | ✓ |
| INBU | Indigo Bunting | *Passerina cyanea* | ✓ | ✓ |
| LEFL | Least Flycatcher | *Empidonax minimus* | ✓ | ✓ |
| LISP | Lincoln's Sparrow | *Melospiza lincolnii* | ✓ | ✓ |
| MADU | Mallard Duck | *Anas platyrhynchos* | ✓ | ✓ |
| MAWA | Magnolia Warbler | *Dendroica magnolia* | ✓ | ✓ |
| MOWA | Mourning Warbler | *Oporornis philadelphia* | ✓ | ✓ |
| NAWA | Nashville Warbler | *Vermivora ruficapilla* | ✓ | ✓ |
| NOFL | Northern Flicker | *Colaptes auratus* | ✓ | ✓ |
| NOWA | Northern Waterthrush | *Seiurus noveboracensis* | | ✓ |
| NPWA | Northern Parula Warbler | *Parula americana* | ✓ | |
| OCWA | Orange-crowned Warbler | *Vermivora celata* | ✓ | |
| OSFL | Olive-sided Flycatcher | *Contopus borealis* | ✓ | ✓ |
| OVEN | Ovenbird | *Seiurus aurocapillus* | ✓ | ✓ |

Appendix E (con't)

| Abbreviation | Common Name | Scientific Name | 1993 | 1994 |
|---|---|---|---|---|
| PAWA | Palm Warbler | *Dendroica palmarum* | ✓ | ✓ |
| PHVI | Philadelphia Vireo | *Vireo philadelphicus* | ✓ | ✓ |
| PISI | Pine Siskin | *Carduelis pinus* | ✓ | ✓ |
| PIWA | Pine Warbler | *Dendroica pinus* | | ✓ |
| PUFI | Purple Finch | *Carpodacus purpureus* | ✓ | ✓ |
| RCKI | Ruby-crowned Kinglet | *Regulus calendula* | ✓ | ✓ |
| REVI | Red-eyed Vireo | *Vireo olivaceus* | ✓ | ✓ |
| RBGR | Rose-breasted Grosbeak | *Pheucticus ludovicianus* | ✓ | ✓ |
| RTHU | Ruby-throated Hummingbird | *Archilochus colubris* | ✓ | ✓ |
| RUBB | Rusty Blackbird | *Euphagus carolinus* | ✓ | |
| RUGR | Ruffed Grouse | *Bonasa umbellus* | ✓ | ✓ |
| SASP | Savannah Sparrow | *Passerculus sandwichensis* | ✓ | ✓ |
| SCTA | Scarlet Tanager | *Piranga olivacea* | ✓ | ✓ |
| SOSP | Song Sparrow | *Melospiza melodia* | ✓ | ✓ |
| SOVI | Solitary Vireo | *Vireo solitarius* | ✓ | ✓ |
| SSHA | Sharp-shinned Hawk | *Accipiter striatus* | ✓ | ✓ |
| SWTH | Swainson's Thrush | *Catharus ustulatus* | ✓ | ✓ |

Appendix E (con't)

| Abbreviation | Common Name | Scientific Name | 1993 | 1994 |
|---|---|---|---|---|
| TEWA | Tennessee Warbler | *Vermivora peregrina* | ✓ | ✓ |
| VEER | Veery | *Catharus fuscescens* | ✓ | ✓ |
| WIWR | Winter Wren | *Troglodytes troglodytes* | ✓ | ✓ |
| WTSP | White-throated Sparrow | *Zonotrichia albicollis* | ✓ | ✓ |
| YBFL | Yellow-bellied Flycatcher | *Empidonax flaviventris* | ✓ | ✓ |
| YBSA | Yellow-belied Sapsucker | *Sphyrapicus varius* | ✓ | ✓ |
| YEWA | Yellow Warbler | *Dendroica petechia* | ✓ | ✓ |
| YRWA | Yellow-rumped Warbler | *Dendroica coronata* | ✓ | ✓ |

Appendix F. Number of bird territories on block 1.

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| ALFL[1] | 6.0 | 2.1 | 6.4 | 14.4 | 7.2 | 6.2 | 5.6 | 3.0 | 8.7 | 7.0 | 33.9 | 32.7 |
| AMGO | | | I | I | I | I | I | V | I | I | | |
| AMKE | I | | I | I | I | | I | I | I | I | | |
| AMRE | 0.1 | 1.0 | | | V | | | 1.0 | | | 0.1 | 2.0 |
| AMRO | 0.5 | 0.5 | V | 0.2 | 0.5 | 0.1 | V | | V | | 1.0 | 0.8 |
| BWWA | 0.8 | 0.6 | 1.4 | 1.3 | | | 1.0 | 0.6 | | | 3.2 | 2.5 |
| BCCH | 0.5 | | | | | | V | | V | | 0.5 | |
| BLJA | V | V | V | V | V | V | V | V | V | V | | |
| CAWA | V | | | | V | | | | | | | |
| CEDW | | V | I | I | I | I | V | V | I | I | | |
| CHSP | 1.0 | 0.9 | V | | | | | | V | V | 1.0 | 0.9 |
| CONI | | | | | | V | | | | | | |
| COYE | 0.4 | | | | | | | 0.6 | | 0.4 | 0.4 | 1.0 |
| CSWA | 16.7 | 5.4 | 16.0 | 19.0 | 14.6 | 10.4 | 17.4 | 9.7 | 17.0 | 17.3 | 81.7 | 61.8 |

Appendix F (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| DOWO | V | | | | | | | | | | | |
| HAWO | V | | | | | | | | | | | |
| HETH | | | | | | | | | | V | | |
| INBU | | | 0.2 | V | V | | | | 0.3 | V | 0.5 | |
| LEFL | V | | | | | | | | | | | |
| LISP | 1.0 | 2.3 | 3.9 | 3.6 | 2.1 | 3.5 | 0.9 | 2.6 | 2.6 | 4.8 | 10.5 | 16.8 |
| MAWA | V | | | | | | V | V | V | | | |
| MOWA | 8.9 | 2.5 | 10.6 | 7.6 | 7.1 | 1.0 | 4.4 | 6.4 | 8.5 | 3.1 | 39.5 | 20.6 |
| NAWA | 4.6 | 2.6 | 1.1 | 5.0 | 1.3 | 3.4 | 2.3 | 1.6 | 2.7 | 2.8 | 12.0 | 15.4 |
| NOFL | 0.3 | 0.5 | 0.2 | 0.5 | 0.3 | 0.1 | 0.4 | 0.6 | 0.5 | 0.6 | 1.7 | 2.3 |
| PISI | | | | | V | | | | | | | |
| PUFI | | V | | | | | | | | | | |
| RBGR | | 0.2 | | | | 0.2 | V | 0.2 | V | 0.8 | | 1.4 |
| REVI | 0.1 | V | V | 2.0 | 0.1 | V | 3.4 | 1.4 | 2.4 | 3.6 | 6.0 | 7.0 |

Appendix F (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| RTHU | | V | | | | | | | | | | |
| RUGR | | | | | | | V | | V | 0.9 | 0.9 | |
| SOSP | 10.2 | 8.0 | 8.8 | 8.7 | 7.3 | 5.1 | 3.8 | 5.5 | 10.0 | 8.5 | 40.1 | 35.8 |
| TEWA | | | | | V | | | 1.5 | | | | 1.5 |
| VEER | 1.6 | 0.3 | 1.1 | 2.0 | 0.6 | V | 2.4 | 0.9 | 2.6 | 3.4 | 8.3 | 6.6 |
| WTSP | 4.2 | 2.9 | 7.5 | 9.2 | 2.9 | 8.7 | 4.6 | 2.4 | 5.1 | 6.8 | 24.3 | 30.0 |
| YBFL | 0.1 | 0.1 | | | | | | | | | 0.1 | 0.1 |
| YBSA | | V | | | | | | | | | | |
| Total | | | | | | | | | | | 265.7 | 239.2 |

Note: some species of birds, either not behaving territorially throughout the census period or having an undetermined fraction of their territory within the block are indicated with I; indeterminate. Birds not meeting the minimum number of replicate

Appendix F (con't)

encounters (3) to have territories assigned to them or clearly just visiting the block are indicated with V; visitor in Appendices F through I.

[1] See Appendix E for list of abbreviations, common and scientific names of birds.

Appendix G Number of bird territories on block 2.

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| ALFL | 2.5 | 2.9 | 4.5 | 4.3 | 2.6 | 3.6 | 4.5 | 1.1 | 6.1 | 4.0 | 20.2 | 15.9 |
| AMGO | V | I | I | 1.0 | I | I | V | | I | I | | 1.0 |
| AMKE | | I | | | I | I | | I | 0.1 | I | 0.1 | |
| AMRE | V | 0.7 | | | V | | V | V | V | | | 0.7 |
| AMRO | 0.25 | | 0.75 | | | | 0.75 | | 0.25 | | 2.0 | |
| BCCH | | | | | | | | | 0.1 | | 0.1 | |
| BLJA | V | V | V | V | V | V | V | V | V | V | | |
| BWWA | 0.8 | V | 0.1 | | 1.0 | | | | 0.1 | 1.9 | 2.0 | 1.9 |
| CAWA | V | 0.9 | | | | 0.5 | | | 0.4 | 2.2 | 0.4 | 3.6 |
| CEDW | V | | | | | | V | | V | | | |
| CHSP | V | | V | | V | V | | | 0.5 | V | 0.5 | |
| COYE | V | | | | | | V | | | | | |
| CSWA | 20.5 | 6.4 | 17.8 | 14.0 | 22.2 | 14.5 | 19.3 | 2.2 | 27.3 | 15.7 | 106.4 | 52.8 |
| DOWO | V | | | | | V | | | 0.4 | V | 0.4 | |

Appendix G (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| EAKI | V | | | | | | | | | | | |
| INBU | 0.5 | 1.1 | 1.0 | 1.3 | 1.0 | | | 0.2 | 0.5 | V | 3.0 | 2.6 |
| LEFL | 0.1 | | | | 0.3 | | | | 0.8 | 0.8 | 1.2 | 0.8 |
| LISP | 1.0 | 1.1 | 1.0 | 1.0 | 1.0 | 0.3 | 1.0 | 1.7 | 2.0 | 3.5 | 6.0 | 7.6 |
| MADU | | | 1.0 | | | | | V | | | 1.0 | |
| MAWA | 0.9 | | 0.2 | 1.0 | 0.1 | 0.3 | | | 0.8 | 1.0 | 2.0 | 2.3 |
| MOWA | 5.4 | 9.4 | 4.1 | 3.2 | 7.3 | 8.1 | 5.9 | 4.0 | 8.8 | 6.6 | 31.5 | 31.3 |
| NAWA | 1.0 | 1.3 | 0.7 | V | 0.7 | 2.7 | 0.3 | | 1.9 | 1.4 | 4.6 | 5.4 |
| NOFL | 0.3 | 0.1 | 0.3 | 0.4 | 0.3 | 0.1 | 0.5 | 0.4 | 0.2 | V | 1.6 | 1.0 |
| PISI | | | | | V | | | | V | | | |
| PUFI | 0.2 | V | | | V | | | | 0.8 | | 1.0 | |
| RBGR | 0.3 | 0.75 | 0.1 | | | | | | | | 0.4 | 0.75 |
| REVI | 2.0 | 1.6 | 0.5 | | 1.5 | V | 1.0 | | 1.5 | 0.8 | 6.5 | 2.4 |
| RTHU | 1.2 | | 0.3 | | 0.9 | | | | 0.6 | V | 3.0 | |

Appendix G (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| RUGR | 0.3 | | | | | | | | | | 0.3 | |
| SASP | | | | | | | V | | | | | |
| SOSP | 1.6 | 5.6 | 5.7 | 2.5 | 2.0 | 2.8 | 4.9 | 6.2 | 7.0 | 6.8 | 21.2 | 22.9 |
| SSHA | | | | | | I | | | I | I | | |
| YEWA | | | | | | V | | | | | | |
| VEER | 2.3 | 1.0 | 2.1 | 1.8 | 1.5 | 1.0 | 1.9 | V | 3.0 | 2.0 | 10.8 | 5.8 |
| WTSP | 2.9 | 4.7 | 3.3 | 1.2 | 5.9 | 6.3 | 3.1 | 1.6 | 4.7 | 10.4 | 19.9 | 24.2 |
| Total | | | | | | | | | | | 246.1 | 182.95 |

Appendix H. Number of bird territories on block 3.

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| ALFL | 9.8 | 3.3 | 4.3 | 5.9 | 5.5 | 5.1 | 11.0 | 5.7 | 7.7 | 10.0 | 38.3 | 30.0 |
| AMGO | I | I | I | I | I | I | I | V | I | I | | |
| AMKE | I | | | | | | | | | | | |
| AMRE | 0.2 | 1.8 | 0.7 | 0.6 | 1.8 | 2.5 | 1.7 | 1.8 | 2.0 | 1.0 | 6.4 | 13.1 |
| AMRO | 1.9 | 1.3 | 0.4 | 1.0 | 0.4 | 1.8 | 1.8 | 1.1 | 1.7 | 2.6 | 6.2 | 7.8 |
| AMWO | | | | | | 0.5 | | | | | | 0.5 |
| BBCU | V | | | | | | V | | | | | |
| BCCH | 0.1 | | | | 0.3 | | | | | | 0.4 | |
| BLJA | V | V | V | V | V | V | V | V | V | V | | |
| BWWA | V | | 0.1 | | 0.5 | 1.0 | 0.1 | | | | 0.7 | 1.0 |
| CAWA | | | V | | | V | | | | | | |
| CEDW | | V | V | I | | I | I | V | I | V | | |
| CHSP | 0.8 | 1.3 | | | 1.0 | 0.6 | V | | | V | 1.8 | 2.0 |
| CONI | 0.5 | 0.3 | 1.0 | 1.0 | | | | | 0.5 | 0.7 | 2.0 | 2.0 |

Appendix H (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| COSN | 1.2 | 1.3 | | 0.3 | 1.8 | 1.4 | 1.0 | | 0.9 | 1.0 | 4.9 | 4.0 |
| COYE | 4.6 | 1.2 | 2.3 | 2.7 | 1.9 | 1.9 | 3.2 | 2.8 | 6.5 | 2.2 | 18.5 | 10.8 |
| CSWA | 26.0 | 12.7 | 18.6 | 21.5 | 13.6 | 8.2 | 26.7 | 16.5 | 20.8 | 15.5 | 105.7 | 74.4 |
| DOWO | V | | | | | | | V | | | | |
| EAKI | | | | | | | | V | | | | |
| GRJA | | | V | | | | | | | | | |
| HAWO | | | V | | V | | | V | | | | |
| INBU | 0.2 | | 0.2 | | 0.6 | | | | | | 1.0 | |
| LEFL | 0.2 | 0.5 | 0.2 | | 0.5 | 2.9 | | | | | 0.9 | 3.4 |
| LISP | 3.6 | 5.9 | 1.5 | 1.0 | 1.0 | 3.1 | 1.0 | 1.7 | 1.9 | 4.1 | 9.0 | 15.8 |
| MAWA | | 0.1 | 0.1 | | 0.5 | 0.9 | | | V | | 0.6 | 1.0 |
| MOWA | 11.3 | 6.1 | 7.1 | 7.0 | 6.8 | 5.7 | 3.6 | 5.7 | 4.8 | 3.8 | 33.6 | 28.3 |
| NAWA | 3.8 | V | 2.3 | 3.4 | 1.7 | 1.7 | 2.2 | 1.2 | 2.2 | 2.0 | 12.2 | 8.3 |
| NOFL | 0.5 | 0.2 | V | V | 0.6 | 0.8 | 0.6 | 0.9 | 0.2 | 0.9 | 1.9 | 2.8 |

Appendix H (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| PHVI | 0.3 | | | | 1.3 | | 1.0 | | | | 2.6 | |
| PISI | V | | V | | V | | | | V | | | |
| PUFI | 0.3 | 0.2 | | 0.1 | 0.3 | 0.9 | | | | | 0.6 | 1.2 |
| RBGR | 1.2 | 0.9 | | 0.1 | 0.9 | | 1.4 | | 0.3 | V | 3.8 | 1.0 |
| REVI | 5.0 | 2.2 | 1.6 | 4.6 | 1.7 | 1.6 | 5.1 | 2.3 | 4.8 | 2.0 | 18.2 | 12.7 |
| RTHU | V | | V | | | | | | | | | |
| RUGR | | | | | | | 1.0 | | V | 1.0 | 1.0 | 1.0 |
| SASP | 0.3 | V | | | | | | | 0.7 | | 1.0 | |
| SCTA | | | | | | | 0.2 | | 0.8 | | 1.0 | |
| SOSP | 9.6 | 15.1 | 7.6 | 7.8 | 5.8 | 8.1 | 2.9 | 11.3 | 10.3 | 8.9 | 36.2 | 51.2 |
| TEWA | V | 0.4 | | | | V | | | | V | | 0.4 |
| VEER | 7.1 | 3.1 | 1.0 | 5.9 | 1.7 | 3.5 | 7.0 | 3.5 | 5.0 | 8.0 | 21.8 | 24.0 |
| WTSP | 4.8 | 6.0 | 2.9 | 4.2 | 2.0 | 4.8 | 5.3 | 4.0 | 5.2 | 3.1 | 20.2 | 22.1 |
| Total | | | | | | | | | | | 350.5 | 318.8 |

Appendix I. Number of bird territories on block 4.

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| ALFL | | 0.3 | 0.1 | | 4.8 | 4.9 | 1.5 | 0.7 | 1.1 | 1.4 | 8.0 | 7.3 |
| AMGO | V | V | V | I | I | I | I | I | I | I | | |
| AMRE | | V | | V | 1.0 | 1.0 | | | | | 1.0 | 1.0 |
| AMRO | 0.4 | 0.6 | 0.4 | 0.3 | 0.8 | 0.9 | 0.4 | 0.9 | 0.2 | 0.9 | 2.2 | 3.6 |
| BAOW | | | | | | V | | | | | | |
| BLJA | V | V | | V | V | V | V | | | V | | |
| BTBW | | | | | | V | | | | | | |
| BWWA | V | 0.1 | | V | V | | V | | | V | | 0.1 |
| CAWA | | | | | V | | | | | | | |
| CEDW | V | V | V | I | V | V | I | | I | I | | |
| CHSP | 0.6 | 0.3 | 1.5 | 1.8 | 1.9 | 3.7 | V | 1.3 | 0.6 | 2.6 | 4.6 | 9.7 |
| CONI | 0.3 | 0.2 | | 0.1 | 0.7 | 0.3 | | 0.2 | | 0.2 | 1.0 | 1.0 |
| COSN | | | V | | | | | | V | | | |
| COYE | V | | | | V | | 0.6 | | V | 0.4 | 0.6 | 0.4 |

Appendix I (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| CSWA | 0.3 | 0.1 | 3.6 | 7.8 | 20.1 | 13.7 | 8.9 | 3.6 | 6.2 | 4.3 | 39.1 | 29.4 |
| DOWO | | | | | | | | V | | V | | |
| EWPE | | | | | V | | | 0.2 | | 0.5 | | 0.7 |
| HAWO | | | | | V | | V | V | | | | |
| INBU | 0.3 | | 0.7 | | 0.1 | | 2.8 | | 3.1 | | 7 | |
| LEFL | | | 1 | V | 2.2 | 0.4 | 0.8 | 0.2 | | | 4 | 0.6 |
| LISP | 0.5 | 2.6 | 0.2 | | 0.4 | 3.7 | 0.5 | 3.6 | 1.1 | 1.2 | 2.7 | 11.1 |
| MAWA | | | | | 1.8 | | | | | | 1.8 | |
| MOWA | 3.0 | 1.8 | 3.7 | 3.0 | 14.1 | 10.2 | 6.6 | 6.8 | 4.7 | 1.8 | 32.1 | 23.6 |
| NAWA | | | 1.0 | 0.5 | 1.9 | 3.0 | | 0.9 | V | 2.3 | 2.9 | 3.9 |
| NOFL | 0.1 | 0.2 | 0.1 | 0.6 | 1.3 | 0.9 | 0.6 | V | 0.1 | 0.2 | 2.2 | 1.9 |
| OSFL | | | | | | 0.8 | | | | | | 0.8 |
| PISI | | | | | V | V | | | | | | |
| PUFI | | | | | | | | | | V | | |

Appendix I (con't)

| Spp. | Brushsaw | | Control | | Release® | | Silvana | | Vision® | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| RBGR | V | | | | 1.0 | 1.5 | 0.3 | 1.3 | | 0.4 | 1.3 | 3.2 |
| REVI | 1.3 | | 2.6 | 2.0 | 3.7 | 1.4 | 2.6 | 1.5 | 1.9 | V | 12.1 | 4.9 |
| RTHU | V | | | | | | V | | | | | |
| RUGR | | | 0.1 | | V | | | | V | | 0.1 | |
| SOSP | 2.5 | 6.4 | 1.1 | | 6.0 | 10.7 | 3.5 | 10.8 | 2.4 | 3.1 | 15.5 | 31.0 |
| SOVI | | | | | | 0.6 | | | V | | | 0.6 |
| SWTH | | | | | | 0.3 | | 0.1 | | | | 0.4 |
| TEWA | | | | V | | 1.8 | | | V | | | 1.8 |
| VEER | | V | | V | 1.2 | 1.4 | 1.3 | 2.0 | V | V | 2.5 | 3.4 |
| WTSP | 2.2 | 2.3 | 0.1 | 1.6 | 5.6 | 11.0 | 1.0 | 5.1 | 0.9 | 3.1 | 9.8 | 23.1 |
| YBFL | | | | | | 0.2 | | | V | | | 0.2 |
| YBSA | | | | | | V | | | | | | |
| Total | | | | | | | | | | | 150.5 | 163.7 |

Appendix J Number of territories per 10 ha per block and treatment

| | | Block 1 | | Block 2 | | Block 3 | | Block 4 | |
|---|---|---|---|---|---|---|---|---|---|
| Spp. | Treatment | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| NOFL | 1[1] | 0.46 | 0.77 | 0.68 | 0.23 | 0.40 | 0.16 | 0.23 | 0.45 |
| | 2 | 0.24 | 0.61 | 0.60 | 0.80 | | | 0.24 | 1.43 |
| | 3 | 0.51 | 0.17 | 0.52 | 0.17 | 0.84 | 1.12 | 1.33 | 0.92 |
| | 4 | 0.45 | 0.67 | 0.99 | 0.79 | 0.61 | 1.02 | 0.80 | |
| | 5 | 0.55 | 0.66 | 0.25 | 0.25 | 0.21 | 0.94 | 0.19 | 0.39 |
| ALFL | 1 | 9.26 | 3.24 | 5.66 | 6.58 | 7.84 | 2.64 | | 0.68 |
| | 2 | 7.80 | 17.54 | 9.02 | 8.62 | 5.83 | 7.99 | 0.24 | |
| | 3 | 12.12 | 10.44 | 4.48 | 6.21 | 7.68 | 7.12 | 4.92 | 5.02 |
| | 4 | 6.30 | 3.37 | 8.93 | 2.18 | 11.22 | 5.82 | 1.99 | 0.93 |
| | 5 | 9.54 | 7.68 | 7.62 | 4.99 | 8.08 | 10.49 | 2.12 | 2.70 |
| AMRO | 1 | 0.77 | 0.77 | 0.57 | | 1.52 | 1.04 | 0.91 | 1.36 |
| | 2 | | 0.24 | 1.50 | | 0.54 | 1.36 | 0.95 | 0.72 |
| | 3 | 0.84 | 0.17 | | | 0.56 | 2.51 | 0.82 | 0.92 |
| | 4 | | | 1.49 | | 1.84 | 1.12 | 0.53 | 1.19 |
| | 5 | | | 0.31 | | 1.78 | 2.73 | 0.39 | 1.74 |
| VEER | 1 | 2.47 | 0.46 | 5.21 | 2.27 | 5.68 | 2.48 | | |
| | 2 | 1.34 | 2.44 | 4.21 | 3.61 | 1.36 | 7.99 | | |
| | 3 | 1.01 | | 2.58 | 1.76 | 2.38 | 4.89 | 1.23 | 1.43 |
| | 4 | 2.70 | 1.01 | 3.77 | | 7.14 | 3.57 | 1.72 | 2.65 |
| | 5 | 2.85 | 3.73 | 3.75 | 2.50 | 5.25 | 8.39 | | |

Appendix J (con't)

| | | Block 1 | | Block 2 | | Block 3 | | Block 4 | |
|---|---|---|---|---|---|---|---|---|---|
| Spp. | Treatment | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| REVI | 1 | 0.15 | | 4.53 | 3.63 | 4.00 | 1.76 | 2.95 | |
| | 2 | | 2.44 | 1.00 | | 2.17 | 6.23 | 6.21 | 4.77 |
| | 3 | 0.17 | | 2.58 | | 2.38 | 2.23 | 3.79 | 1.43 |
| | 4 | 3.82 | 1.57 | 1.98 | | 5.20 | 2.35 | 3.45 | 1.99 |
| | 5 | 2.63 | 3.95 | 1.87 | 1.00 | 5.04 | 2.10 | 3.67 | |
| NAWA | 1 | 7.10 | 4.01 | 2.27 | 2.95 | 3.04 | | | |
| | 2 | 1.34 | 6.09 | 1.40 | | 3.12 | 4.61 | 2.39 | 1.19 |
| | 3 | 2.19 | 5.72 | 1.21 | 4.66 | 2.38 | 2.37 | 1.95 | 3.07 |
| | 4 | 2.59 | 1.80 | 0.60 | | 2.24 | 1.22 | | 1.19 |
| | 5 | 2.96 | 3.07 | 2.37 | 1.75 | 2.31 | 2.10 | | 4.44 |
| CSWA | 1 | 25.77 | 8.33 | 46.45 | 14.51 | 20.79 | 10.15 | 0.68 | |
| | 2 | 19.49 | 23.14 | 44.51 | 28.06 | 25.20 | 29.13 | 8.59 | 18.62 |
| | 3 | 24.58 | 17.51 | 29.47 | 25.00 | 19.00 | 11.45 | 20.59 | 14.04 |
| | 4 | 19.57 | 10.91 | 38.31 | 4.37 | 27.24 | 16.84 | 11.80 | 4.77 |
| | 5 | 18.64 | 18.97 | 34.08 | 19.60 | 21.83 | 16.26 | 11.97 | 8.30 |
| MOWA | 1 | 13.73 | 3.86 | 12.23 | 21.32 | 9.04 | 4.88 | 6.80 | 4.08 |
| | 2 | 12.91 | 9.26 | 8.22 | 6.41 | 9.62 | 9.49 | 8.83 | 7.16 |
| | 3 | 11.95 | 1.68 | 12.58 | 13.97 | 9.50 | 7.96 | 14.45 | 10.45 |
| | 4 | 4.95 | 7.20 | 11.71 | 7.94 | 3.67 | 5.82 | 8.75 | 9.02 |
| | 5 | 9.32 | 3.40 | 10.99 | 8.24 | 5.04 | 3.99 | 9.07 | 3.47 |

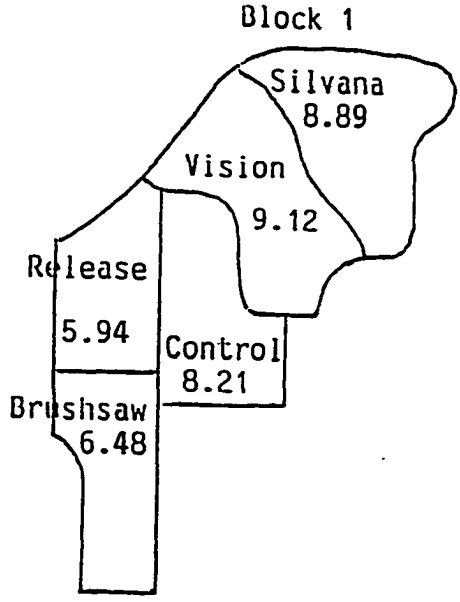
Appendix J (con't)

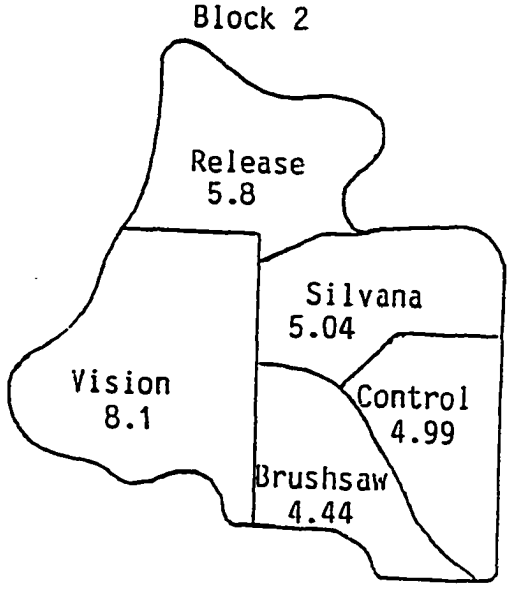
| | | Block 1 | | Block 2 | | Block 3 | | Block 4 | |
|---|---|---|---|---|---|---|---|---|---|
| Spp. | Treatment | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 | 1993 | 1994 |
| WTSP | 1 | 6.48 | 4.48 | 6.57 | 10.66 | 3.84 | 4.80 | 4.99 | 5.22 |
| | 2 | 9.14 | 11.21 | 6.62 | 2.40 | 3.93 | 5.69 | 0.24 | 3.82 |
| | 3 | 4.88 | 14.65 | 10.17 | 10.86 | 2.79 | 6.82 | 5.74 | 11.27 |
| | 4 | 5.17 | 2.70 | 6.15 | 3.17 | 5.41 | 4.08 | 1.33 | 6.76 |
| | 5 | 5.59 | 7.46 | 5.87 | 13.00 | 5.46 | 3.25 | 1.74 | 5.98 |
| LISP | 1 | 1.54 | 3.55 | 2.27 | 2.49 | 2.88 | 4.72 | 1.13 | 5.90 |
| | 2 | 4.75 | 4.38 | 2.00 | 2.00 | 2.03 | 1.36 | 0.48 | |
| | 3 | 3.54 | 5.89 | 1.72 | 0.52 | 1.40 | 4.33 | 0.41 | 3.79 |
| | 4 | 1.01 | 2.92 | 1.98 | 3.37 | 1.02 | 1.74 | 0.66 | 4.77 |
| | 5 | 2.85 | 5.26 | 2.50 | 4.37 | 1.99 | 4.62 | 2.12 | 2.32 |
| SOSP | 1 | 15.74 | 12.35 | 3.63 | 12.70 | 7.68 | 12.07 | 5.67 | 14.51 |
| | 2 | 10.71 | 10.60 | 11.43 | 5.01 | 10.30 | 10.57 | 2.63 | |
| | 3 | 12.29 | 5.89 | 3.45 | 4.83 | 8.10 | 11.31 | 6.15 | 10.96 |
| | 4 | 4.27 | 6.19 | 9.73 | 12.30 | 2.96 | 11.53 | 4.64 | 14.32 |
| | 5 | 10.96 | 9.32 | 8.74 | 8.50 | 10.81 | 9.34 | 4.63 | 5.98 |

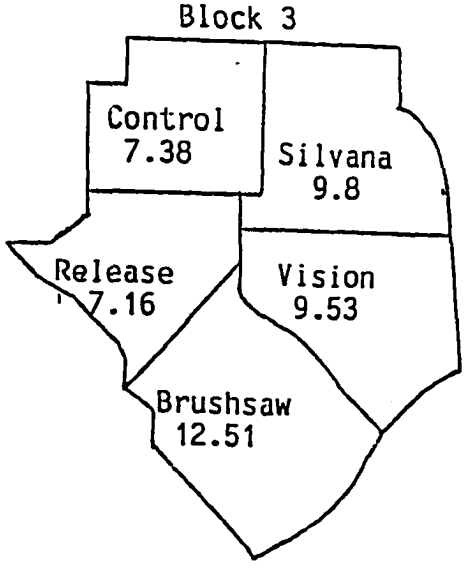
[1] 1 = brushsaw, 2 = control, 3 = Release®, 4 = Silvana, 5 = Vision®

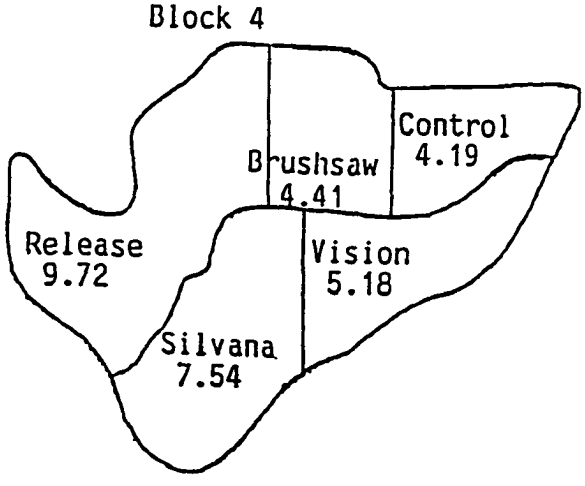
Appendix K Bird territory maps - key to maps

(maps not drawn to the same scale, areas indicated in hectares)



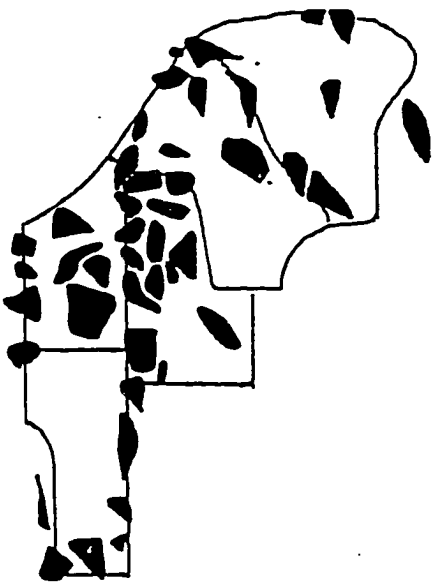
Appendix K (cont.)

Alder Flycatcher Territories

Block 1 1993

31.44% coverage

Block 1 1994



22.24% coverage

Chestnut-sided Warbler Territories

Block 1 1993

↑
N

43.98% coverage

Block 1 1994

32.8% coverage

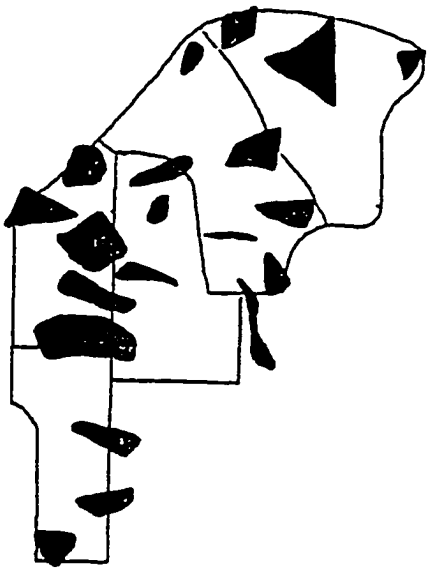
Appendix K (cont.)

Lincoln's Sparrow Territories

Block 1 1993

14.96% coverage

Block 1 1994



21.7% coverage

Mourning Warbler Territories

Block 1 1993

↑
N

38.12% coverage

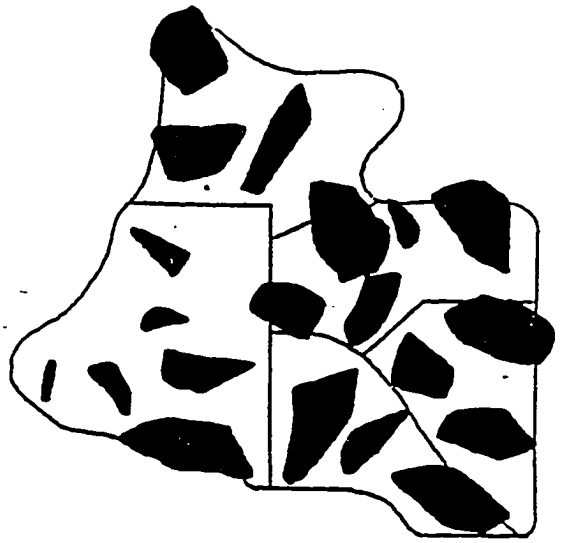
Block 1 1994

19.62% coverage

Appendix K (cont.)

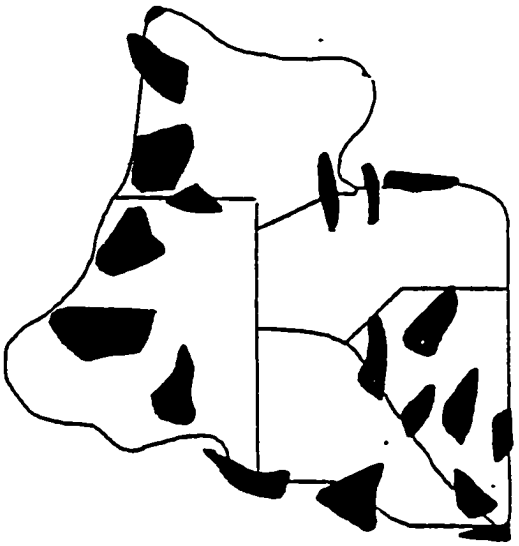
Alder Flycatcher Territories

**Block 2 1993**



37.24% coverage

**Block 2 1994**



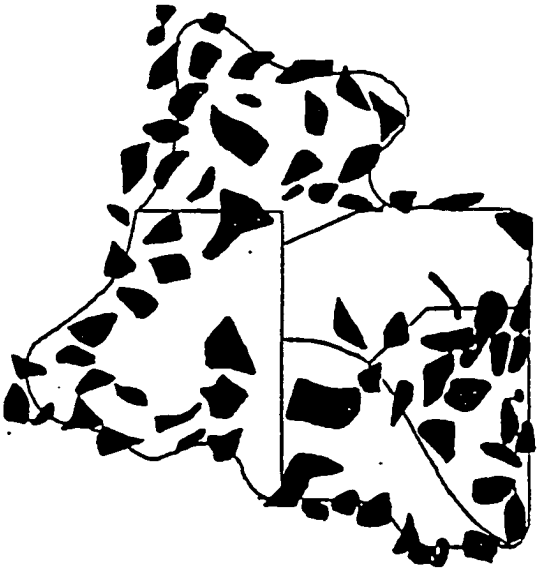
19.94% coverage

Chestnut-sided Warbler Territories

**Block 2 1993**

56.96% coverage

**Block 2 1994**

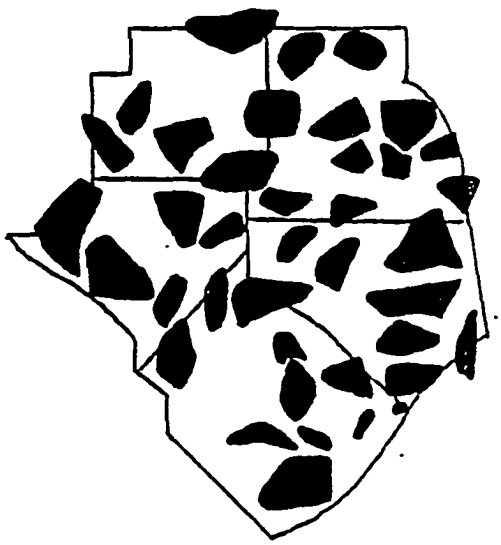


33.7% coverage

Appendix K (cont.)

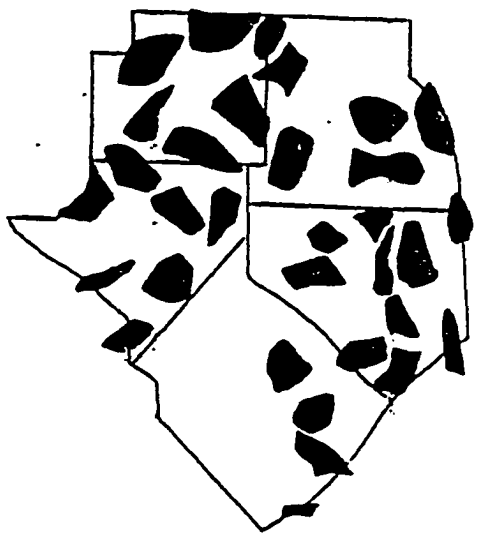
Alder Flycatcher Territories

**Block 3 1993**



35.66% coverage

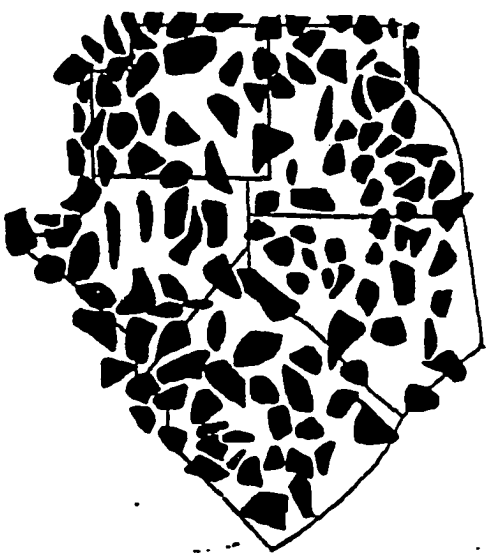
**Block 3 1994**



25.01% coverage

Chestnut-sided Warbler Territories

**Block 3 1993**



48.96% coverage

**Block 3 1994**

39.73% coverage

Appendix L Numbers of birds captured in 1993 by species and treatment

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| ALFL | 8 | 8 | 4 | 9 | 4 | 15 | 4 | 0 | 10 | 11 | 2 | 20 | 4 | 4 | 3 | 1 | 6 | 16 | 10 | 4 | 143 |
| AMGO | 1 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 20 |
| AMRE | 3 | 2 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 16 |
| AMRO | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| BAWW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| BCCH | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| BOCH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| BRCR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| BTGW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| CAWA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| CEDW | 4 | 5 | 0 | 0 | 2 | 1 | 0 | 0 | 9 | 3 | 0 | 0 | 2 | 3 | 0 | 0 | 4 | 3 | 0 | 0 | 36 |
| COYE | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 5 |
| CSWA | 14 | 8 | 0 | 3 | 23 | 12 | 0 | 0 | 13 | 10 | 0 | 5 | 11 | 1 | 0 | 1 | 25 | 8 | 0 | 2 | 136 |
| DEJU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| DOWO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Appendix L (con't)

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| GCKI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| GRJA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| HETH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| INBU | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| LEFL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| LISP | 5 | 0 | 1 | 2 | 5 | 4 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 3 | 4 | 0 | 0 | 29 |
| MAWA | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 12 |
| MOWA | 10 | 3 | 0 | 1 | 10 | 1 | 0 | 1 | 9 | 9[1] | 0 | 5 | 6 | 2 | 0 | 0 | 13 | 1 | 0 | 4 | 75 |
| NAWA | 3 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 9 | 2 | 2 | 0 | 0 | 5 | 1 | 0 | 0 | 28 |
| NOWA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| NPWA | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| OVEN | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 10 |
| PHVI | 2 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| PUFI | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 7 |

[1] more than all other treatments

Appendix L (con't)

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| RBGR | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| REVI | 6 | 3 | 0 | 0 | 7 | 3 | 0 | 0 | 4 | 4 | 0 | 2 | 3 | 5 | 0 | 0 | 7 | 9 | 0 | 1 | 54 |
| SOSP | 5 | 3 | 0 | 4 | 3 | 1 | 1 | 1 | 6 | 3 | 0 | 3 | 9 | 2 | 0 | 3 | 8 | 6 | 0 | 4 | 62 |
| SWTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| TEWA | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 2 | 2 | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 15 |
| VEER | 4 | 1 | 0 | 0 | 3 | 2 | 2 | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 22 |
| WTSP | 11 | 3 | 0 | 4 | 12 | 4 | 0 | 1 | 11 | 6 | 0 | 10 | 5 | 3 | 0 | 2 | 9 | 7 | 1 | 3 | 92 |
| YBFL | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 9 |
| YRWA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 82 | 49 | 5 | 29 | 85 | 48 | 8 | 8 | 83 | 61 | 7 | 75 | 48 | 31 | 4 | 8 | 98 | 64 | 11 | 21 | 826 |

Appendix M Numbers of birds captured in 1994 by species and treatment

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| ALFL | 1 | 2 | 0 | 0 | 9 | 7 | 5 | 4 | 10 | 4 | 5 | 2 | 3 | 1 | 0 | 2 | 11 | 7 | 3 | 5 | 81 |
| AMGO | 1 | 1 | 0 | 0 | 6 | 2 | 1 | 1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | 3 | 0 | 0 | 28 |
| AMRE | 1 | 1 | 0 | 0 | 8 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| AMRO | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 15 |
| BAWW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| BCCH | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 4 | 18 |
| BRCR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| BTBW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| BTGW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| CAWA | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 7 |
| CCSP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| CEDW | 1 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| CHSP | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 9 |
| COSN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| COWA | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Appendix M (con't)

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| COYE | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 9 |
| CSWA | 9[1] | 0 | 1 | 2 | 25 | 9[2] | 1 | 7 | 27 | 4 | 5 | 1 | 4[1] | 1 | 0 | 1 | 20 | 4 | 5 | 4 | 130 |
| DEJU | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 4 |
| DOWO | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 5 |
| HETH | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| INBU | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| LEFL | 1 | 0 | 0 | 1 | 1 | 4 | 2 | 5 | 0 | 3 | 2 | 2 | 0 | 3 | 0 | 4 | 1 | 1 | 0 | 2 | 32 |
| LISP | 4 | 2 | 0 | 1 | 3 | 0 | 0 | 1 | 8[3] | 1 | 3 | 6 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 5 | 44 |
| MAWA | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 6 |
| MOWA | 2 | 0 | 0 | 0 | 11 | 3 | 2 | 1 | 3 | 2 | 0 | 0 | 3 | 3 | 0 | 4 | 7 | 1 | 0 | 2 | 44 |
| NAWA | 0 | 0 | 0 | 1 | 3 | 1 | 0 | 2 | 6 | 0 | 1 | 0 | 2 | 0 | 0 | 10 | 8 | 0 | 0 | 21 | 55 |
| OVEN | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 10 |
| PHVI | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |

[1] fewer than control, Release® & Vision®  [2] more than brushsaw

[3] more than in Vision®

Appendix M (con't)

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| PIWA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| PUFI | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 6 |
| RBGR | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 6 |
| RBNU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| RCKI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| REVI | 0 | 0 | 1 | 0 | 4 | 2 | 3 | 5 | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 29 |
| SASP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| SOSP | 13 | 5 | 0 | 9[4] | 7 | 5 | 0 | 2 | 11 | 7 | 0 | 6 | 7 | 1 | 0 | 10 | 10 | 8 | 1 | 2 | 104 |
| SWTH | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| TEWA | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 5 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 4 | 1 | 0 | 8 | 31 |
| VEER | 3 | 2 | 0 | 0 | 4 | 1 | 0 | 3 | 8 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 5 | 2 | 0 | 0 | 32 |
| WCSP | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| WIWA | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| WTSP | 9 | 6 | 0 | 6 | 14 | 10 | 7 | 6 | 30 | 16 | 3 | 7 | 21 | 7 | 4 | 21 | 34 | 13 | 1 | 24 | 239 |

[4] more than in control & Vision®

Appendix M (con't)

| | Brushsaw | | | | Control | | | | Release® | | | | Silvana | | | | Vision® | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spp. | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | ♂ | ♀ | U | H | |
| YBFL | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 7 |
| YRWA | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 1 | 6 |
| Total | 54 | 22 | 2 | 33 | 113 | 57 | 24 | 56 | 124 | 52 | 22 | 39 | 51 | 23 | 6 | 65 | 131 | 52 | 12 | 82 | 1020 |

Appendix N Numbers of birds detected on transect counts 24 August - 15 September 1993

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| ALFL | 1 | | | | | | | | | | 2 | 8 | 3 | 5 | 1 | 2 | 3 | | 1 | 1 |
| AMGO | | | | | | | | 1 | | | 5 | | | 9 | 6 | | 1 | | | 5 |
| AMRE | | | | | | 2 | | | | | 2 | 5 | 3 | 1 | 1 | | | 2 | | |
| AMRO | | | | | | | | | | | | | | 1 | | | | | 1 | |
| BCCH | 4 | 2 | 3 | 6 | 1 | | 2 | | | 4 | | 2 | | | | 3 | 1 | | | |
| BLJA | 2 | 1 | | | 3 | | | 1 | 1 | | 4 | | | | 3 | 2 | | 1 | | |
| BWHA | 2 | | | | | | | | | | | | | | | | | | | |
| BWWA | | | | | | | | | | | | | | | | | | | | 1 |
| CEDW | | | | | | 15 | 1 | | | 7 | 3 | 12 | 5 | 8 | 1 | | 2 | 2 | 3 | 4 |
| CHSP | | | | | | | | | | | 2 | 1 | 1 | 2 | 3 | 1 | | | 1 | |
| CMWA | | 2 | 1 | | 3 | | | | | | | | | | | | | | | |
| COYE | | | | | | | | | 1 | | | | | 2 | 3 | | | | | |
| CSWA | | | | | | | | | | | 2 | 2 | 1 | | | | 1 | | | |
| DOWO | | | | 1 | | | 1 | | 1 | | | 2 | | | | | 1 | | | |

Appendix N (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| HAWO | | | | | | | | | | | 1 | | | 1 | | | | | | |
| LEFL | | | | | | | | | | | 1 | 1 | 2 | | | 1 | | | | |
| LISP | | 2 | | 2 | | | 1 | | | | 1 | | | 3 | | | | | | 1 |
| MAWA | 1 | | | | 1 | | | | | | 1 | | 2 | | 1 | | | | 1 | |
| MOWA | | 1 | 1 | | | | | 2 | | | 3 | 5 | 2 | 2 | 1 | 1 | 1 | 3 | 8 | 5 |
| NAWA | | | 3 | | | 1 | | 3 | | 2 | | | | | | | | | | |
| NOFL | 2 | | | 1 | 1 | | | 3 | | 1 | 4 | | | | | | | | | 1 |
| OCWA | 1 | | | | | | | | | | | | | 1 | | | | | | |
| OVEN | | | | | | | | | 1 | | 1 | | | | | | | | | |
| PAWA | | 3 | 2 | | | | | | | | | | | | | | | | | |
| PHVI | | | | | 2 | | | | | | | 4 | 2 | | | | | | | |
| PUFI | 4 | 2 | | 3 | | | | | | | | | | | | | | | | |
| RBGR | | | | | | | | | | | | 2 | | | 1 | | | | | |
| REVI | | 2 | 1 | | 1 | | | | | | 3 | 1 | | 2 | 5 | 1 | 1 | | | |

Appendix N (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| RTHU | | | | | | | | | | | | | | | | 2 | | | | |
| RUGR | | | | | | | | | | | | | | 1 | | | | | | |
| SOSP | 2 | 1 | 5 | 2 | 1 | 1 | 2 | 3 | | | 2 | 6 | 5 | 8 | 3 | 2 | 5 | 1 | 3 | 4 |
| SOVI | | | | | | | | | | | 2 | | | | | | | | | |
| SSHA | | | | 1 | | | 3 | | 4 | | | | | | | | | | | |
| TEWA | | | | 1 | | | | | | | | | 1 | 2 | | | | | | |
| VEER | | | | | | | | | | | | 3 | 2 | 1 | | | | | | |
| WIWR | 1 | | | | | | | | | | | | | | | | | | | |
| WTSP | 18 | 11 | 5 | 7 | 9 | 9 | 9 | 6 | 4 | 7 | 3 | 1 | 6 | 7 | 2 | 2 | 2 | 3 | 4 | 1 |
| YRWA | | | | 1 | | | | | | | | | | | | | | | | |
| Numbers | 38 | 27 | 21 | 25 | 22 | 28 | 19 | 19 | 12 | 21 | 42 | 59 | 35 | 56 | 31 | 17 | 18 | 12 | 22 | 23 |
| Species | 11 | 10 | 8 | 10 | 9 | 5 | 6 | 7 | 6 | 5 | 18 | 15 | 13 | 17 | 13 | 10 | 10 | 6 | 8 | 9 |

[1] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

Appendix O Numbers of birds detected on transect counts 14-23 September 1994.

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[2] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| AMGO | 2 | 8 | 1 | 2 | 1 | | | 2 | | | | | | | | | | | | |
| AMRO | | | | | | | | | | | 1 | | | | | | | | | |
| BCCH | | | | | | 1 | 2 | | 4 | | | 3 | 3 | 2 | 1 | | | | | |
| BLJA | 3 | | 2 | | | | 3 | 1 | 3 | 2 | | 1 | | | | | | | | |
| DEJU | 6 | 3 | 5 | 2 | 8 | 6 | 3 | 2 | 5 | | 4 | | | | 7 | | | | | |
| DOWO | | | | 1 | | | | | | 2 | | | 1 | | | | | | | |
| FOSP | | | | | | | | | | | | | | 1 | | | | | | |
| GRJA | | | | | | | 1 | | | | | | | | | | | | | |
| HAWO | | | | | | | | | | 1 | 1 | 1 | | | | | | | | |
| MOWA | | 1 | | | | | | | | | | | | | | | | | | |
| NAWA | 1 | | 1 | | | | | | | | | | | | | | | | | |
| NOFL | | | 2 | | | 1 | | 1 | | | | | | | | | | | | |
| PAWA | 1 | 2 | 1 | | | | 1 | 3 | 3 | | | | | | | | | | | |
| PISI | | | | | | | | | | | | | | 1 | | | | | | |

Appendix O (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[2] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| RCKI | 2 | | 3 | 1 | 2 | 2 | 1 | 1 | | | | 2 | 2 | | | | | | | |
| RUBB | | | | | | | | | | | | 14 | | | | | | | | |
| SOSP | 1 | 1 | | | | 1 | | 1 | | 1 | 1 | | | | | | | | | |
| TEWA | | 1 | 1 | | | | | | | | | | | | | | | | | |
| WTSP | 6 | 3 | 5 | 1 | 3 | 2 | 1 | 4 | 5 | | | | 2 | 3 | 3 | | | | | |
| YRWA | | | | | | | | | | 2 | 1 | 3 | | | | | | | | |
| Numbers | 22 | 19 | 21 | 7 | 14 | 13 | 12 | 15 | 20 | 8 | 8 | 24 | 8 | 7 | 11 | | | | | |
| Species | 8 | 7 | 9 | 5 | 4 | 6 | 7 | 8 | 5 | 5 | 5 | 6 | 4 | 4 | 3 | | | | | |

[1] Block 4 was not visited during this period.

[2] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

Appendix P Numbers of birds detected on transect counts 26 July - 10 August 1994.

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| ALFL | 3 | 3 | 3 | 1 | 5 | 1 | 5 | 4 | | | 4 | 5 | 6 | 1 | 5 | | | | | |
| AMGO | 6 | 4 | | 1 | 4 | 1 | 1 | | | 3 | 6 | 8 | 4 | 1 | 2 | | 3 | 3 | 1 | 7 |
| AMRE | | | | | | | | | | | 1 | 1 | | | | | | | | |
| AMRO | | 2 | | | | 1 | | | | | | 1 | 2 | | | | 5 | 1 | | 5 |
| BCCH | | | | | | | | | | 2 | | | 4 | | | | | 1 | | |
| BLJA | 1 | | | | | | | | | | | | | | | | | | | |
| BRCR | | | | | | | | | | | | | | | | | | 3 | | |
| BWWA | | | | | | | | | | | | | 1 | | | | | | | |
| CEDW | 3 | 10 | 1 | | 7 | | 5 | | | | 1 | 3 | 2 | | 4 | 1 | | | 2 | 1 |
| CHSP | | | | | | | | | | | 1 | | 1 | | 1 | | 2 | | | 1 |
| CONI | | | | | | | | | | | | | | | | 2 | | 3 | | |
| COSN | | | | | | | | | | | | | | | | | | | 1 | |
| COYE | | | | | | | | | | | | 1 | 1 | 1 | | | | | | |
| CSWA | | | 1 | 1 | 2 | | 2 | | | 2 | | 3 | | | | | | 4 | | |

Appendix P (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| DOWO | | 1 | | | 1 | 1 | | | | | | | 1 | | | | | 1 | 1 | |
| EAKI | 5 | 3 | | | | | | | | | 1 | | | | | 1 | | | | |
| HAWO | | | | | | | 1 | | | | | | | | | | | | | |
| HETH | | | | | 1 | | | | | | | | | | | | 1 | | | |
| LEFL | | | | | | | | | | | 2 | | | | | | | | | |
| LISP | 3 | 5 | 4 | 1 | 5 | | | | | | 5 | | 1 | | 4 | | 1 | 1 | 1 | 1 |
| MAWA | 4 | | | | | | | | | | | | 2 | | | | | 1 | | |
| MOWA | | 1 | 1 | 4 | 2 | 1 | 4 | 1 | 1 | 7 | 10 | 1 | 3 | 3 | 3 | 6 | | 11 | 6 | 3 |
| NAWA | | 1 | | | | | | | | | 2 | 1 | 4 | | 1 | | 1 | | | 1 |
| NOFL | 1 | 1 | | | | 1 | 1 | | | | 1 | | | | | | | | | 1 |
| PISI | | 4 | | | | | 8 | | | | | | | | | | | | | |
| PUFI | | | | | | | 1 | | | | | | 1 | | 2 | | | | | |
| RBGR | | | 4 | | | | | | | | 6 | | 10 | | 5 | 1 | 1 | | 1 | 1 |
| RBNU | | | | | | | | | | | | | 1 | | | | 1 | | | |

Appendix P (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| RCKI | | | | | | | | | | | | | | | | | 1 | | | |
| REVI | | 1 | | | | 1 | 1 | | | | 2 | 2 | | 3 | | | | | | 2 |
| RTHU | 1 | | | | | | | | | 1 | 3 | 2 | 6 | 2 | 4 | | | 2 | | |
| RUGR | | | | | | | | | | | | | | 1 | | | | | | |
| SASP | | | | | | | | | | | | | 1 | | | | | | | |
| SOSP | 7 | 3 | 6 | 3 | 17 | 2 | 5 | 1 | 6 | 6 | 18 | 2 | 6 | 3 | 7 | 5 | 2 | 9 | 3 | 6 |
| SOVI | | | | | | | | | | | | | | | | | | 1 | | |
| TEWA | 1 | | 1 | | | | | | | | 6 | 1 | 7 | 1 | 2 | | 2 | 1 | | 1 |
| VEER | | | 2 | | | | | | | | | 2 | | 2 | | | | | | |
| WTSP | 7 | 9 | 3 | 10 | 8 | 11 | 4 | 12 | 4 | 11 | 3 | 2 | | 6 | 11 | 2 | 10 | 11 | 6 | 7 |
| YBSA | | 1 | | | | | | | | | | | | | | | | | | |
| Numbers | 42 | 49 | 24 | 21 | 52 | 26 | 38 | 19 | 11 | 32 | 72 | 35 | 64 | 24 | 51 | 18 | 30 | 53 | 22 | 37 |
| Species | 12 | 15 | 10 | 7 | 10 | 9 | 12 | 4 | 3 | 7 | 17 | 15 | 20 | 11 | 13 | 7 | 12 | 15 | 9 | 13 |

[1] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

Appendix Q Numbers of birds detected on transect counts 24 August - 2 September 1994.

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| ALFL | | | | | | | | | | | | 1 | | | 3 | | | | | |
| AMGO | 1 | 1 | | | | | | | | | | | 1 | 2 | 2 | | | | | 3 |
| AMKE | 4 | 1 | | | | | | | | | | | | | | 1 | | | | |
| AMRE | | | 1 | | | | | | | | | 1 | 1 | | | | | 1 | | |
| AMRO | | | | | | | | | | | | | | | | | | 1 | | |
| BBWA | | | | | | | | | | | | | 1 | | | | | | | |
| BBWO | | | | | | | | | | | | | | | | | | 1 | | |
| BCCH | | | | | | | | 2 | | 1 | | 6 | 3 | | | | | 2 | 1 | |
| BLJA | | | 1 | | | | | | | | | 1 | 1 | | 1 | | 1 | | | |
| BRCR | | | | | | | | | | | | | | | | | | | 1 | |
| BTBW | | | | | | | | | | | | | | | | | | 1 | | |
| BTGW | | | | | | | | | | | | 1 | | | | | | | | |
| BWWA | | | | | | | | | | | | 1 | | | | | | 1 | | |
| CEDW | | | | | | | | | | | | 3 | | | | | | | | |

Appendix Q (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| CHSP | | | | | | | | | | 1 | | | 3 | 4 | 2 | | | 5 | | |
| CORA | | | | | | | | | | 2 | | | | | | | | | | |
| COSN | | | | | | | | | | | | | 1 | | | | | | | |
| COYE | | | | | | | | | | | 1 | 2 | 1 | | 2 | | | | | |
| CSWA | | | 1 | | 2 | | | | | | 2 | 4 | | | | | | | 1 | |
| GOSH | | | | | | | 2 | | | | | | | | | | | | | |
| LEFL | | | | | | | | | | | | 1 | | | | | | | | |
| LISP | | | 5 | | 6 | | | 1 | 3 | 1 | 3 | 1 | 8 | | 8 | | 1 | 8 | 1 | 1 |
| MAWA | | | | | | | 1 | | | 1 | | | | | | | | | | |
| MOWA | | 1 | | | | 1 | 2 | 2 | 4 | 2 | | 4 | 3 | 1 | | | | 1 | 1 | |
| NAWA | 14 | | | | 1 | | | 5 | 1 | 4 | 2 | 2 | 2 | 5 | 7 | 2 | 4 | 1 | | |
| NOFL | 4 | | 1 | | | | 1 | | | | | 2 | 1 | | | | | | | |
| NOHA | | | | | | 1 | | | | | | | | | | | | | | |
| OCWA | | | | | | | | | | | | 1 | 1 | | | | | | | |

Appendix Q (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| PAWA | | | | | 15 | | | 2 | | | | | 6 | | | | 1 | | 1 | |
| PHVI | | | | | | | 1 | | | | | 1 | | | | | | | | |
| PISI | | | 1 | | | | | 10 | | | | 1 | | | | | | | | |
| RBGR | | | | | | | | | | | | 1 | | | | | | | 1 | |
| RBNU | 1 | | | | | | | | | | | | 1 | | | | 1 | | 2 | | |
| REVI | | | | | 1 | | | | | | | 4 | 1 | | 1 | | | | 1 | |
| RTHA | | | | | | | | | | | | | | | | | 1 | | | |
| RTHU | | | | | | | | | | | | 1 | | | | | | | | |
| RUGR | | | | | | | | | | | | 1 | | | | | | | | |
| SASP | | | | | | | | | | | 1 | | 2 | 1 | 2 | | | | | |
| SOSP | | | | | 5 | | | | 4 | 3 | 2 | 1 | | | 9 | 2 | | 2 | | 1 |
| SOVI | | | | | | | | | | | | | | | | | | 1 | 1 | |
| SSHA | | | | | | | | | | 1 | | | | | | | | | | 1 |
| SWTH | | | | | | | | | | | | 1 | | | | | | | | |

Appendix Q (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| TEWA | | | | | | 1 | | 1 | | 5 | | | | | 5 | | | | | 2 |
| VEER | | | | | | | | | | | | 2 | | | | | | | | |
| WTSP | 9 | 14 | 28 | | 45 | 2 | 7 | 5 | 14 | 14 | 3 | 17 | 4 | 1 | 5 | 2 | 2 | 7 | 6 | 3 |
| YBSA | | | | | | | | | | | | | | | | | | 1 | | |
| YRWA | | | | | | | | | | | | | 1 | | | | | | | |
| Numbers | 33 | 17 | 38 | 0 | 75 | 4 | 14 | 27 | 26 | 35 | 14 | 61 | 42 | 14 | 47 | 9 | 9 | 37 | 13 | 11 |
| Species | 6 | 4 | 7 | 0 | 7 | 2 | 6 | 8 | 5 | 11 | 7 | 25 | 19 | 6 | 12 | 6 | 5 | 17 | 8 | 6 |

[1] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

Appendix R Numbers of birds detected on transect counts 14-23 September 1994.

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| AMGO | | | | | | | | | | | 2 | 3 | | | 17 | 1 | | | | |
| AMRO | | | | | 2 | | | | | | | | | | | | | | | |
| BBWO | | | | | 1 | | | | | | | | | | | | 1 | | | |
| BCCH | | | | | | | | | | 5 | | 7 | | | | 1 | 1 | 1 | | |
| BLJA | | | 1 | 1 | | | | | | | | 2 | 1 | | | | | | | |
| BRCR | | | | | | | | | | | 1 | | | | | | | | | |
| CEDW | | | | | | | | | | | 1 | 2 | 1 | | 3 | | | | | |
| CHSP | | | | | | | | | | | | | 1 | | | | | | | |
| COYE | | | | | | | | | | | | | 1 | | | | | | | |
| CSWA | | | | | | | | | | | 2 | | | | | | | | | |
| DOWO | | | | | | | | | | | | | | | | | 2 | | | |
| GCKI | | | | | | | | | | 1 | | | | | | | | | | |
| HAWO | 1 | 1 | | | | | | | | | | | | | | | | | | |
| LISP | | | 2 | | 2 | 1 | | | | 4 | | | 7 | | 6 | | 1 | 4 | | 4 |

Appendix R (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| MAWA | | | | | | | | | | | | 1 | | | | | | | | |
| MOWA | | | | | | | | | | | | 1 | | | | | | | | |
| NAWA | | | | | | | | | | | | 4 | | | 1 | | | | | 1 |
| NOFL | | | | | | | | | | | 1 | 1 | | | 1 | | | | | |
| PAWA | 2 | 4 | 7 | 5 | 18 | 8 | 1 | | | 1 | | | 4 | | 4 | 6 | 7 | 11 | 1 | 7 |
| PISI | | | | 3 | | | | 77 | | 12 | | | | | | | | | | |
| PIWO | | 1 | | | | | | | | | | | | | | | | | | |
| RBNU | 1 | | | | 1 | | | | | | | 1 | | | | | | 1 | | |
| RCKI | | 4 | | | 1 | | | 1 | | 9 | | | | | | | 3 | | | 2 |
| REVI | | | | | | | | | | | 1 | | | | | | | | | |
| SASP | | | | | | | | | | | | | 1 | | 3 | | | 1 | | |
| SOSP | | | 1 | | | 1 | | | 1 | 1 | | | 1 | | 4 | | | | | 4 |
| TEWA | | | | 1 | | | | | | | | 2 | | | | | | | | |
| VEER | | | | | | | | | | | | | 1 | | | | | | | |

Appendix R (con't)

| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| WCSP | | 8 | 1 | | 12 | | | 10 | | 13 | | | | | 3 | | | 12 | | 15 |
| WIWR | | | | | | | | | | | | 1 | | | | | | | | |
| WTSP | 2 | 4 | 13 | 9 | 6 | 3 | 5 | 35 | 4 | 20 | 2 | 2 | 2 | | 30 | | 5 | 6 | 1 | 12 |
| YBSA | 1 | 1 | | | | | | | | | | | | | | | | 1 | | |
| YRWA | | 10 | | | | 3 | 2 | 4 | 1 | 65 | | | | | 1 | | 6 | | | |
| Numbers | 7 | 33 | 25 | 19 | 49 | 16 | 8 | 127 | 6 | 131 | 10 | 27 | 20 | 0 | 73 | 8 | 26 | 37 | 2 | 45 |
| Species | 5 | 8 | 6 | 5 | 9 | 5 | 3 | 5 | 3 | 10 | 7 | 12 | 10 | 0 | 11 | 3 | 8 | 8 | 2 | 7 |

[1] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

Appendix S Numbers of birds detected on transect counts 26 September - 3 October 1994.

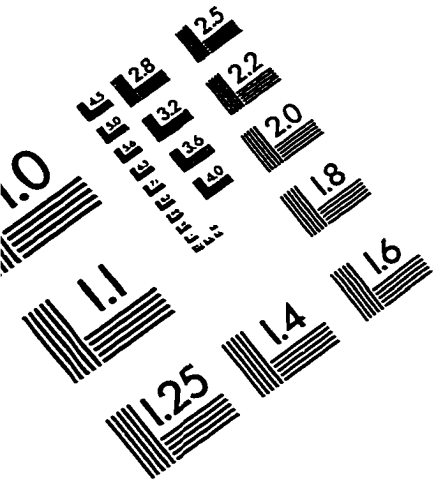
| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| AMGO | | 2 | | | | | 1 | | | 2 | | | | | | | | | | |
| AMKE | | | | | | | | | 1 | | | | | 1 | | | | | | |
| BBWO | | | | | | | | | | | | | | | | | 2 | | | |
| BCCH | | | | | 2 | | | | | 1 | | | | | | | 5 | | | |
| BLJA | | | | | | | 1 | | | | | | | | | | | | 1 | |
| DEJU | | | | | | 1 | | | | | | | | | 1 | 1 | 1 | 3 | | |
| DOWO | 1 | | | | | | | 1 | | 1 | | | | | | | | | | |
| GRJA | | | | | | | | | | | | | | | | | | | | 1 |
| HAWO | | | | | 1 | | | | | | | | | | | | | | | |
| LISP | | | | | | | | 2 | | | | | | | | | | 1 | | |
| NAWA | | | | | | | | | | | | | 1 | | | | | | | |
| PAWA | 3 | 5 | | | 3 | | 3 | | | | | | 2 | | | | 1 | | | |
| PISI | | | | | 10 | | | | | 4 | | | | | | | | | | |
| RBNU | 1 | | | | | | | 1 | | | | | | | | | | | | |

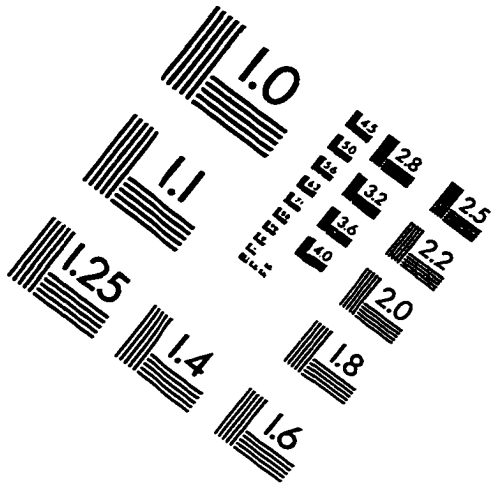
Appendix S (con't)

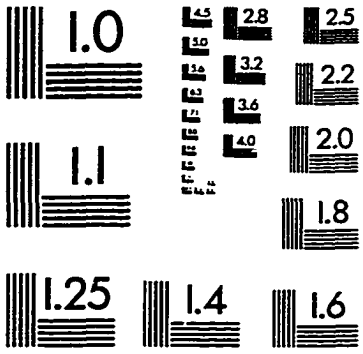
| | Block 1 | | | | | Block 2 | | | | | Block 3 | | | | | Block 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B[1] | C | R | S | V | B | C | R | S | V | B | C | R | S | V | B | C | R | S | V |
| RCKI | | | | | 1 | | | | | | | | | | | | 1 | | | |
| RUGR | | | | | | | | | | | | | 1 | | 1 | | | | | |
| SOSP | | | | | | 1 | | | | | | | | | 1 | | | | | |
| SSHA | | | | | | | | | | | | | | | | | | | 1 | |
| TRSP | | | | | | | | | | | | | | | | | | 1 | | |
| VEER | | | | | | | | | | | | 1 | | | | | | | | |
| WCSP | | 1 | 1 | | 1 | | | | | 2 | | | | | | | | | | 2 |
| WIWR | | | | | | | | | | | | | | | | | 1 | | | |
| WTSP | | | | | 4 | 1 | | | 1 | 4 | 2 | 4 | | | 11 | | 2 | | 2 | 2 |
| YRWA | | | | | | | 2 | | | | | | | | | | 3 | | | |
| Numbers | 5 | 8 | 1 | 0 | 22 | 3 | 7 | 4 | 2 | 14 | 2 | 5 | 4 | 1 | 14 | 1 | 16 | 5 | 4 | 5 |
| Species | 3 | 3 | 1 | 0 | 7 | 3 | 4 | 3 | 2 | 6 | 1 | 2 | 3 | 1 | 4 | 1 | 8 | 3 | 3 | 3 |

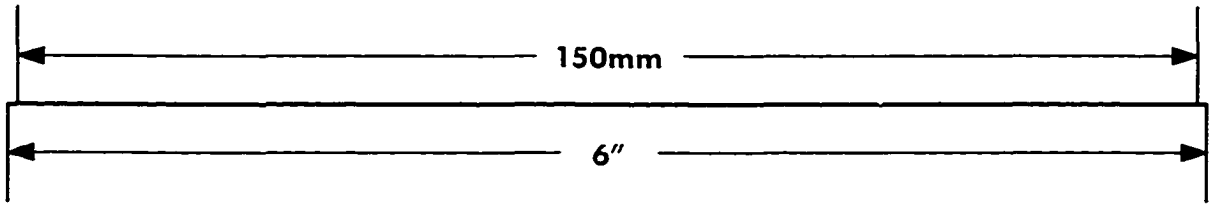
[1] Treatments were B=brushsaw, C=control, R=Release®, S=silvana, and V=Vision®.

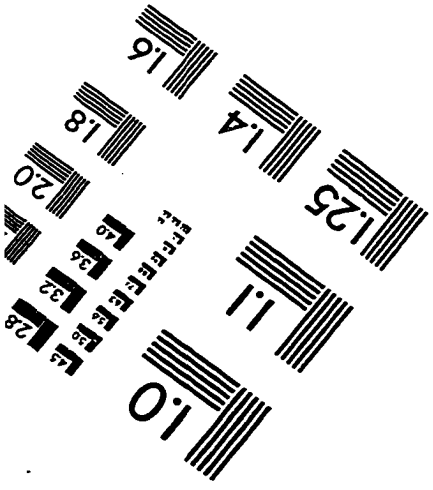
# IMAGE EVALUATION TEST TARGET (QA-3)

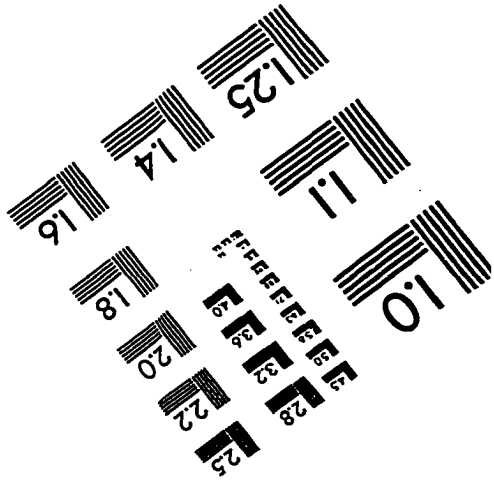
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