Productivity and Habitat Selection of Hooded Warblers in Southern Ontario

An interim report to the Endangered Species Recovery Fund of World Wildlife Fund Canada

Year One of a Two-year Study

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EXECUTIVE SUMMARY

Over the last 4 years, the number of Hooded Warblers breeding in the nursery tract of the St. Williams forest in the Regional Municipality of Haldimand-Norfolk has increased dramatically, from 6 pairs in 1995 to 19 pairs in 1998. A concurrent decline has occurred in the nearby South Walsingham forest, which has traditionally housed the largest breeding concentration of this threatened species in Canada. In 1999, we examined the productivity and habitat selection of Hooded Warblers in St. Williams, to determine why this population shift may be occurring. In particular, we wanted to know what types of gaps Hooded Warblers prefer for nesting, and whether this preference could be related to recent logging history in St. Williams.

We located 36 pairs of Hooded Warblers, and found nests for 21 of these pairs, in St. Williams in 1999. 33% of nests were depredated, and 52% of nests were parasitized by cowbirds. The number of eggs laid/nest, eggs hatched/nest and young fledged/nest were all significantly higher for unparasitized than parasitized nests. An average of 1.29 ± 0.34 young fledged/nest from all nests (parasitized and unparasitized combined). We colour-banded 19 adults and 27 nestlings from 11 nests, and found four birds that had been banded previously: two as nestlings in South Walsingham, one as an adult in St. Williams, and one with an unknown origin.

We measured habitat characteristics in a 0.04 ha circle around three types of sites: nest sites (n = 24), territory sites where no nests were found but singing males were heard more than once (n = 23), and control sites (n = 41). Habitat characteristics included: 1) size class and species of each tree, as well as for standing dead trees (> 2m in height), tip-up logs, and cut stumps; 2) canopy cover; 3) canopy height; 4) shrub density at 4 heights, starting at the ground; 5) distance to nearest trail; 6) gap dimensions, shape, age, and likely cause of formation; 7) nest height; 8) nest support species; 9) dominant shrub genera; and 10) dominant stump decay (firm, mossy, punky). We compared habitat characteristics around nest, territory and control sites using nonparametric univariate statistics. We also compared nest site characteristics in St. Williams with nest site characteristics in South Walsingham, using data collected in 1996 and 1997, to determine whether similarities in nesting habitat exist between these two different forest types. Finally, we took a cursory look at logging history from 1988-1996 in St. Williams, to see if it could be related to recent Hooded Warbler presence in this forest.

We found that Hooded Warblers in St. Williams chose nest sites in fairly small gaps with a relatively high surrounding canopy of mature trees, a dense ground cover of shrubs, and a high number of cut stumps, compared to control sites in the same forest. We also found significant differences between nest sites and territory sites where we did not find nests. Territory sites had greater shrub density at all four strata, and less total basal area and lower canopy cover than either nests or controls, probably because they were located in much larger gaps than nest or control sites. This may represent an actual preference for large gaps within Hooded Warbler territories, or it may be a result of our sampling technique, whereby nests of birds occupying large gaps were much more difficult to find. Regardless, we recommend that, when logging in a current or historic Hooded Warbler breeding site, forest managers in southern Ontario should strive to create gaps no larger than 300-1000 m^2 (0.03-0.1 ha), as this is the current range of gap sizes used by this species in St. Williams.

Many of the differences that exist between nest and control sites in St. Williams were shared between nest and control sites in South Walsingham. At both sites, Hooded Warblers showed a preference for shrubby sites surrounded by mature trees. Nest sites in South Walsingham, however, were apparently characterized by older gaps than nest sites in St. Williams. Nest sites in St. Williams had significantly more shrub cover at the lowest strata (0-0.3 m) than nest sites in South Walsingham, whereas South Walsingham had significantly more shrub cover at the two highest strata (1-2, and 2-3 m), than nest sites in St. Williams. We suggest that gaps in South Walsingham are becoming too mature for Hooded Warblers, resulting in a movement of the population to St. Williams, where recent increases in selective logging have opened up new gaps that are currently very suitable for this species.

ACKNOWLEDGEMENTS

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INTRODUCTION

Many neotropical migrant bird species that breed in the forests of eastern North America have shown recent population declines (Robbins et al. 1989a). Possible explanations include habitat loss and fragmentation on the breeding grounds, increased nest predation and parasitism by cowbirds, deforestation on the wintering grounds, and other human-induced environmental change (reviewed by Böhning-Gaese et al. 1993).

One species at risk in Canada is the Hooded Warbler (*Wilsonia citrina*). While this species has actually shown significant population increases in eastern North America based on Breeding Bird Survey data, and is considered fairly common in the eastern United States (Evans Ogden and Stutchbury 1994), it is rare in Canada, and breeding is restricted to mature forests of southwestern Ontario. These forests have undergone considerable loss and fragmentation over the last century, contributing to the current threatened status of this species in Canada (Austen et al. 1994).

Many gaps exist in our knowledge of Hooded Warblers in Canada. As a result, Bird Studies Canada, in association with the Acadian Flycatcher/Hooded Warbler Recovery Team, and in accordance with a national recovery plan (currently under review; Friesen 1997), began extensive surveys in 1997 to determine the population size and distribution of Hooded Warblers in Canada. The resulting population estimate of 144-207 pairs (McCracken et al. 1998a) was twice the 1988 estimate (Gartshore 1988), suggesting that, despite the species' relative scarcity in Ontario, it

appears to be increasing in this region. Furthermore, several new breeding sites have been colonized in the last five years, while numbers at other sites have declined (McCracken et al. 1998a). For example, the population in the South Walsingham Forest, which has traditionally been the largest in Ontario (up to 23 pairs; Gartshore pers.comm.), has been declining over the last 3 years, while the population in nearby St. Williams (12 km to the east) has increased steadily, from only 6 pairs in 1995 to 19 pairs in 1998. The reasons for this distributional change are unclear, but are likely related to changes in forest structure and management at these sites.

In 1999 we concentrated our field efforts in the St. Williams Forest, which currently supports the largest breeding population of Hooded Warblers in Canada. We examined productivity, factors affecting productivity, and habitat selection of this species. Productivity and habitat selection are both variables which have not been closely examined before in Canada, and both could have significant value to the conservation of this threatened species.

Background

I. Productivity

Little is known about productivity, and factors affecting productivity, of Hooded Warblers in Canada. Gartshore (1988) presented information on the population size and distribution of this species in Ontario, but did not include information on reproductive success. Data from nearby Pennsylvania suggest that where parasitism is negligible, females generally raise about 3 fledglings per nest (Evans Ogden and Stutchbury 1994). Detailed information on productivity, and factors affecting it, is required to determine whether the Canadian population is stable or is simply acting as a sink (Pulliam 1988) for the larger U.S. population.

II. Habitat selection

Habitat preferences of Hooded Warblers are fairly well-studied in the United States. Hooded Warblers avoid forest edges (Noss 1991), and colonize sites with a dense shrub layer in mature forests (Crawford et al. 1981, Robbins et al. 1989b). Preferred nesting sites are often associated with forest gaps (Gartshore 1988). Therefore, some types of selective logging in mature forests may benefit Hooded Warblers. Indeed, several studies have found that Hooded Warbler numbers increased after group and single-tree selective logging (e.g. Whitcomb et al. 1977, Thompson et al. 1996, Baker and Lacki 1997, Annand and Thompson 1997, Robinson and Robinson 1999).

Gaps are clearly an important factor in habitat selection of Hooded Warblers. Little is known, however, about when, and for how long, a gap becomes and remains suitable for this species. Robinson and Robinson (1999) found that the number of Hooded Warblers was highest 1-4 years after cutting, but that abundance dropped to near-zero beyond 11 years since cutting. Their study, however, examined abundance based on point counts, rather than nest numbers. Examining nest and territory numbers in relation to time since logging would be an even more valuable comparison, and could be used to help predict when a logged site will become suitable for Hooded Warblers, and for how long it will remain suitable.

Finally, little is known about the spatial characteristics (e.g. size) of gaps favoured by Hooded

Warblers. Such information could be critical in developing forest management strategies aimed at minimizing damage to, and even maximizing development of, Hooded Warbler habitat.

Study Objectives

Our objectives are twofold. First, we determine the productivity, and factors affecting productivity (i.e. predation and parasitism) of Hooded Warblers in what is currently the largest Canadian population of this species. Second, we examine habitat selection of Hooded Warblers in St.Williams to answer the following questions:

1) What habitat features (e.g. basal area, tree species composition, canopy cover and height, shrub density, and gap size and age) define Hooded Warbler nests and territories in St. Williams, compared to sites in the same forest that are not used by Hooded Warblers? While this information has been gathered for other sites (Howlett and Stutchbury 1996, Kilgo et al. 1996), the results of these studies may not apply to the St. Williams population, which is probably the most northerly sizeable population of this species in North America. Furthermore, these other studies did not compare gap characteristics between nest sites and non-use sites. If gaps are important to Hooded Warblers, as they appear to be, it is likely that gap size plays an important role in habitat selection of this species.

2. What similarities, if any, exist between nest sites in St. Williams and South Walsingham? South Walsingham is primarily a mature deciduous forest, whereas St. Williams is dominated by red and white pine plantations (Gartshore et al. 1987). By determining which habitat features are shared at nest sites in these two different forest types, we may be able to identify the most consistent habitat features for Hooded Warblers in Canada (e.g. Collins 1983).

3) How do recent logging practices in St. Williams relate to the presence or absence of Hooded Warblers? Varying degrees of thinning have occurred in the pine plantations of St. Williams over the last decade, presumably creating forest gaps that are suitable for nesting Hooded Warblers. By relating recent logging history to the presence of Hooded Warblers, we should be able to determine when, and for how long, a gap becomes and remains suitable for Hooded Warblers, and ultimately predict sites that this species might colonize, or become extirpated from, in the near future based on current or planned management.

METHODS

Study Site

This study was carried out in the nursery tract of the St. Williams Forestry Station in the Regional Municipality of Haldimand-Norfolk (N 42^{o} 42.034', W 80^{o}28.131'), which is owned and managed by the Ontario Ministry of Natural Resources (OMNR). Part of the Norfolk sandplains, the 1213 ha forest was originally dominated by oak savannah-prairie grass ecotype. Settlement of the area beginning in 1800 led to a rapid clearing of the forest for farmland, followed by reforestation of submarginal farmlands in 1908 (Wynia 1990). The forest is dominated by well-drained, Plainfield soils, and consists mainly of dry sand ridges intergrading with low, wet plains (Gartshore et al. 1987). It is the largest continuous block of forested habitat, and the best quality

oak habitat, in Carolinian Canada. As such, it is recognized by the OMNR as an Area of Natural and Scientific Interest (ANSI; Gartshore pers. comm.).

Gartshore et al. (1987) provides a detailed description of the various plant communities found in St. Williams. The current "nursery tract"consists primarily of white pine (*Pinus strobus*; natural stands and plantations), red pine (*P. resinosa;* managed for pole production), and several stands of Scots and jack pine (*P. sylvestris* and *P. banksiana*; Wynia 1990). Deciduous trees include commercially-valuable species such as red oak (*Quercus rubra*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), white oak (*Quercus alba*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), sugar maple (*Acer saccarum*), and walnut (*Juglans* spp.); as well as hemlock (*Tsuga canadensis*), white cedar (*Thuja occidentalis*), sassafrass (*Sassafras albidum*), butternut (*Juglans cinerea*), black oak (*Quercus velutina*), hickories (*Carya* spp.), beech (*Fagus grandifolia*), hornbeam (*Carpinus caroliniana*), cottonwood (*Populus deltoides*), and various other Carolinian species. Common understorey shrubs include blackberry (*Rubus* spp.), witch hazel (*Hamamelis virginiana*), American hazel (*Corylus americana*), red maple (*Acer rubrum*), red-berried elder (*Sambucus pubens*), cherry (*Prunus* spp.), poison ivy (*Rhus radicans*), spice bush (*Lindera benzoin*), maple-leaved vibernum (*Vibernum acerifolium*), grape (*Vitis* spp.), wood fern (*Dryopterus* spp.), bracken fern (*Pteridium aquilinum*), dwarf chinquapin oak (*Quercus prinoides*), and hawthorn (*Crataegus* spp.).

Ninety-six species of breeding birds have been found in St. Williams, including at least 21 "significant" species. Various significant mammals, butterflies, snakes and vascular plants are also found in this forest (Gartshore et al. 1987). The extreme northeast portion of the forest is part of a Class 1 Wetland which renders it provincially significant (Wynia 1990). Vegetative species associated with "dry sand prairie" or "dwarf chinquapin oak" habitat are also significant natural heritage features that likely existed prior to farm settlement. Summaries of rare flora and fauna found in the St. Williams Forest are presented in Gartshore et al. (1987).

A "resource management plan" (Wynia 1990) was developed in 1990 to guide timber production and sales, while preserving natural flora and fauna, water quality, and tourism and educational values of the property. Hard-copy records of all logging that has occurred in the nursery tract since 1988 are stored at OMNR Aylmer. Most logging has consisted of thinning of red pine plantations (i.e. selective removal of trees based on prescriptions), and some removal of white pine, generally for log home construction, and other species (e.g. larch, spruce) for fuelwood and pulp.

Population size and Productivity

From 27 May to 13 August 1999, we located singing male (SM) Hooded Warblers in St. Williams. We travelled all paths in the forestry station several times to ensure full coverage of possible Hooded Warbler territories. We flagged and mapped SM territories, and searched them over the season for the presence of a female, nest, and/or fledged young. We also observed each male and female to determine if they were banded, and potentially originated from the South Walsingham population. When banded birds were found, we noted the colour-band combination. For territories where nests were not found, we determined the highest level of breeding evidence observed to conclude whether SMs were a) mated, and b) produced young. Nests and locations

where females or fledged young were seen were flagged and mapped.

Nests were monitored every 3-5 days to determine hatching date and, ultimately, the date when the young would be five days old. This is the best time to band chicks as they are large enough to be banded, and unlikely to jump from the nest due to disturbance (M.Gartshore pers. obs.). For each nest, we noted the clutch size (number of Hooded Warbler eggs), whether or not the nest had been parasitized by cowbirds and the number of cowbird eggs, hatching success (Hooded Warbler chicks hatched per nest), and fledging success (Hooded Warbler fledglings produced per nest, and fledglings produced per successful nest). A fledgling was defined as a chick that made it to five days of age or older (i.e. we assumed that chicks that survived to banding age would likely survive to fledge). Hooded Warblers normally fledge at 8 days of age (Evans Ogden and Stutchbury 1994). We also calculated daily survival rates based on Mayfield (1961, 1975) over the incubation and chick-rearing stages. There was no significant difference in the number of nests lost during incubation (5/21) and the chick stage (7/17; $X^2 = 0.05$, $p = 0.82$), so there was no need to calculate survival separately for these stages. We calculated Mayfield nest success based on nest survival (i.e. at least one chick survived to fledge) from the first day of incubation to the date when chicks reached 5 days of age. Nests that were found after the young reached 5 days were not included in the Mayfield calculations, but were included in calculations of fledging success.

Habitat selection

I. Comparison of habitat features between nest, territory and control sites

We measured habitat characteristics around three types of sites: nest sites, territory sites where no nests were found but singing males were heard more than once, and control sites.

Control sites represented habitat that was not used by Hooded Warblers, but was covered by us during searches. Control sites were chosen by laying a 250 x 250 m grid over the map of the forestry station and choosing the corners of the grid as control sites, with the following restrictions: 1) control sites had to be located at least 100 m from any nest, territory site, or forest edge; 2) if a control point landed on a trail, we walked 20 paces into the forest in a randomly chosen direction; and 3) control points were stratified based on habitat used by Hooded Warblers: approximately 54% of nests and territories were located in pine dominant forest, 28% in mixed forest, and 18% in deciduous dominant forest. Therefore, 9/41 (22%) control points were located in deciduous dominant forest, 10/41 (24%) control points were located in mixed forest, and 22/41 (54%) control points were located in pine dominant forest. Forest type at each control point was determined using an Ontario Ministry of Natural Resources 1981 Forest Resources Inventory map.

Territory sites were chosen to represent the habitat within Hooded Warbler territories where nests were not found (but probably existed). They were chosen by walking 20 paces “into” the territory from a known territory edge. Approximate territory edges were defined by observations of male singing behaviour.

We measured habitat characteristics within an 11.28 m radius of the sampling point (0.04 ha

sampling area; James and Shugart 1970). Four transects 11.3 m long were laid out with strings along the four cardinal directions from the centre to help us keep track of the boundaries of the circle and to prevent double counting tree stems. The characteristics we measured were: 1) size class and species of each tree, as well as for standing dead trees (> 2m in height), tip-up logs, and cut stumps; 2) canopy cover; 3) canopy height; 4) shrub density at 4 heights, starting at the ground; 5) distance to nearest trail; 6) gap dimensions, shape, age, and likely cause of formation; 7) nest height; 8) nest support species; 9) dominant shrub genera; and 10) dominant stump decay (firm, mossy, punky). Methods for determining each of these features are given below.

Tree species and size class was assessed by recording each tree over 3 cm in diameter at breast height (dbh) and 2 m in height. Each tree was identified and its dbh was estimated into size classes using a "reach stick" (James and Shugart 1970). The dbh classes used were:

S (sapling) = 3-8 cm
A = 8-15 cm
B = 15-23 cm
C = 23-38 cm
D = 38-53 cm
E = 53-69 cm
F = 69-84 cm
G = 84-102 cm
H = > 102 cm.

We calculated total basal area from the number of trees in each size class using the equation:

BA = S(0.002) + A(0.0093) + B(0.0279) + C(0.0744) + D(0.1674) + E(0.2883) + F(0.4557) + G(0.6603) + H(0.744)

We calculated basal area of small trees using trees of size classes S-C. Basal area of large trees was calculated using trees of size classes D-H. McCracken et al. (1998b) found that separating basal area into small and large tree size classes was illustrative for forest interior species such as Cerulean Warblers, that show no relationship with total basal area, but show a strong preference for trees of large size classes.

Canopy cover was calculated by marking each of the four transect strings at five evenly-spaced locations. At each mark, we looked through an ocular tube and recorded the presence (1) or absence (0) of leaf cover in the centre of the tube (marked by cross-hairs). Percent canopy cover was calculated by adding up the 1's (out of a maximum possible total of 20) and multiplying by five.

We used a clinometer to measure the height of four trees, one from each "sector" of the circle, that seemed representative of the canopy in general. The four heights were averaged to provide a measure of canopy height for each site.

We used a density board to measure shrub density at four strata (Robbins et al. 1989b). The density board consisted of a sheet of cloth 3 m high and 0.5 m wide, marked with alternating 10 x 10 cm blue and white squares. The board was marked into four strata: 0-0.3 m (15 squares); 0.3-1

m (32 squares); 1-2 m (50 squares); and 2-3 m (50 squares). The sheet was held upright at the ends of each of the four string transects, and the number of squares more than 50% obscured by leafy plant matter in each strata was estimated from the centre point of the site. The number of squares obscured was then converted to a percentage and averaged for each of the four transects to give a percent coverage within each of the four strata.

A gap was defined as a hole in the forest canopy. Most gaps were oval or linear in shape. To determine gap size, we estimated by eye the length of a pair of perpendicular lines in the gap, such that the first was the longest straight line that would fit in the gap, and the second was the longest straight line that would fit in the gap with the constraint that it was perpendicular to the first (Runkle 1992). The length of the transect strings were used to help estimate gap dimensions. The area of the gap was estimated with the equation for the area of an ellipse: A = Pi*L*W/4. Gap age was estimated by determining the "release date" of saplings (white pine worked well) from bud scar counts (Runkle 1992) . When this type of growth pattern was not obvious, we used growth rings of small shrubs, assuming that their lifespan equalled the length of time since the gap was created. Cause of gap formation was determined to be either windfall, dead tree, or harvest.

II. Habitat characteristics of nest sites in South Walsingham versus St. Williams

Habitat characteristics were measured around 52 Hooded Warbler nest sites and 66 control sites in South Walsingham in 1996 and 1997 (McCracken et al. 1998b). While not all variables considered in that study are the same as those considered in our study, the number of stems and basal area of stems of various sizes, canopy cover, and shrub density at four strata, are the same and can therefore be compared between the two studies.

III. Relating recent logging practices in St. Williams to Hooded Warbler presence

Because information on stand size, composition, and logging in the last decade has not yet been digitized, we are not able to closely examine the relationship between Hooded Warbler presence/absence and recent management history. We did, however, tabulate the total number and volume of trees removed from all stands in the nursery tract of St. Williams (except those containing monocultures of scots pine, spruce or larch) from 1988-1996 (no logging has occurred since 1996), and plan to digitize other data in the second year of the study.

Statistical Analyses

We computerized field data in a way that retained as much original field information as possible. We also, however, generated summary statistics for the various site types for the following variables: nest height, tree species composition by basal area, shrub density at the four different strata, number of tree species, total basal area, basal area of small trees, basal area of large trees, number of tree stems, basal area of tip-up logs, number of tip-up logs, basal area of snags, number of snags, basal area of cut stumps, number of cut stumps, gap area, distance to nearest trail, canopy height, and canopy cover. All statistical analyses were carried out using SAS (V.6). We compared habitat characteristics of nest, territory and control sites using univariate, nonparametric statistics (chi-square contingency tables and Wilcoxon rank-sum tests as

appropriate), and present the mean and standard error for each variable. We also compared habitat characteristics of nest sites from the two forests using univariate, nonparametric statistics (Wilcoxon 2-sample tests), and present the mean and standard error for each variable. These simple statistics are useful when looking for general patterns in the data, but because many variables are probably highly correlated, multivariate statistics would be more appropriate (as per McCracken et al. 1998b). Conducting such analyses will be a high priority for the second year of this study.

RESULTS

Population Size and Productivity

We spent 243 field hours searching for and monitoring Hooded Warbler territories in 1999. Appendix A gives the number of field hours per territory, and Appendix B outlines specific information gained during each territory visit, including the level of breeding evidence observed.

We located 36 pairs of Hooded Warblers, and found nests for 21 of these pairs. Breeding evidence for the additional 15 pairs were: P (pair; n=5), FS (adults seen carrying food for young, or faecal sac; n = 1), and FY (fledged young; n = 9). An additional 12 singing males were located, 5 of which were heard only once in a given location. Thus, there were at least 36, and as many as 48, pairs of Hooded Warblers in St. Williams in 1999.

Of the 21 pairs for which we found nests, three pairs re-nested later in the season, for a total of 24 nests. We were able to determine the fate (i.e. fledged, depredated, abandoned) of 21/24 nests (Table 1).

11/21 nests (52%) were parasitized by cowbirds, with 1.36 cowbird eggs per parasitized nest. Eggs laid/nest, eggs hatched/nest and young fledged/nest were all significantly lower for parasitized than unparasitized nests (Table 2; Eggs laid/nest: $t = -2.95$, $p = 0.008$; Eggs hatched/nest: $t = -3.89$, $p = 0.001$; Young fledged/nest: $t = -2.60$, $p = 0.02$).

Table 1. Fate of nests during incubation and chick stages in the St. Williams Forestry Station in 1999. Percentages are given in brackets. The single nest for which the fate of eggs was "unknown" fledged 2 cowbird chicks. The nest was not checked often enough between late incubation and early hatching to determine whether the 3 Hooded Warbler eggs that had been laid hatched and then were lost, or were lost prior to hatching.

Fate during Incubation Stage (n = 21)				**Fate during Chick Stage (n = 16)**	
Hatched	Abandoned	Depredated	Unknown	Fledged	Depredated
15 (71)	3 (14)	2 (9.5)	1 (0.5)	11 (69)	5 (31)

Table 2. Nest success (± SE) of Hooded Warblers in the St. Williams Forestry Station in 1999. Sample sizes are given in brackets for each calculation. Mayfield calculations were based only on nests that were found before nestlings reached 5 days of age, and were visited at least twice. Mayfield daily survival rate refers to a nest's likelihood of surviving each day. Mayfield nest success rate refers to a nest's likelihood of surviving from the beginning of incubation to the day when chicks were 5 days old.

HOWA success	**Parasitized nests**	**Unparasitized nests**	**Combined**
Eggs laid/nest	2.27±0.33 (11)	3.40±0.16 (10)	2.81±0.23 (21)
Eggs hatched/nest	1.10±0.35 (11)	3.10±0.38 (10)	2.10±0.34 (21)
Young fledged/nest	0.55±0.31 (11)	2.10±0.53 (10)	1.29±0.34 (21)
Mayfield daily survival rate	0.90 (9)	0.97 (8)	0.94 (17)
Mayfield nest success	0.17 (9)	0.56 (8)	0.33 (17)
Young fledged/successful nest	2.00±0.58 (3)	3.00±0.38 (7)	2.70±0.33 (10)

Colour-banding

We colour-banded 19 adults and 27 nestlings from 11 nests. We also found four birds that were banded previously. Two were banded as nestlings in South Walsingham (one in 1996, one in 1997), one was banded as an adult in St. Williams in 1998, and one had a single silver band (that could not be read as the bird was not captured). Forty-three other individuals were known to be unbanded, and the banding status of 10 individuals was unknown as their legs were not seen.

Habitat selection

Average height of Hooded Warbler nests, from the ground to the base of the nest, was 60.0 ± 3.1 cm. Nest support species were: *Rubus* spp. (n = 13), *Sambucus pubens* (n = 1), *Pteridium aquilinum* (n = 1), *Vibernum rafinesquianum* (n = 2), *Lindera benzoin* (n = 1), *Prunus pensylvanica*/*Rubus allegheniensis* (n = 1), *Prunus virginiana*/*Rubus allegheniensis* (n =1), *Dryopterus* spp. (n = 1), *Vibernum cassinoides/Rubus allegheniensis* (n=1), and *Corylus americana* (n = 2).

Hooded Warblers preferentially chose sites in the forest that were located in gaps. Ninety-six percent (23/24) of nest sites, and 61% (14/23) of territory sites, were located in gaps. Only 39% (16/41) of control sites were located in gaps (X^2 = 20.4, df = 2, p = 0.0001).

I. Comparison of habitat features between nest, territory and control sites

We collected habitat data at 24 nest sites, 23 territory sites, and 41 control sites (Fig. 1). Forty-four species of trees were identified. Tree species composition was similar between the three plot types, with seven species shared on the top ten lists of all 3 plot types (Tables 3a, b and c). The most common tree species in every type of plot (by basal area and number of stems per plot) was white pine (*Pinus strobus*).

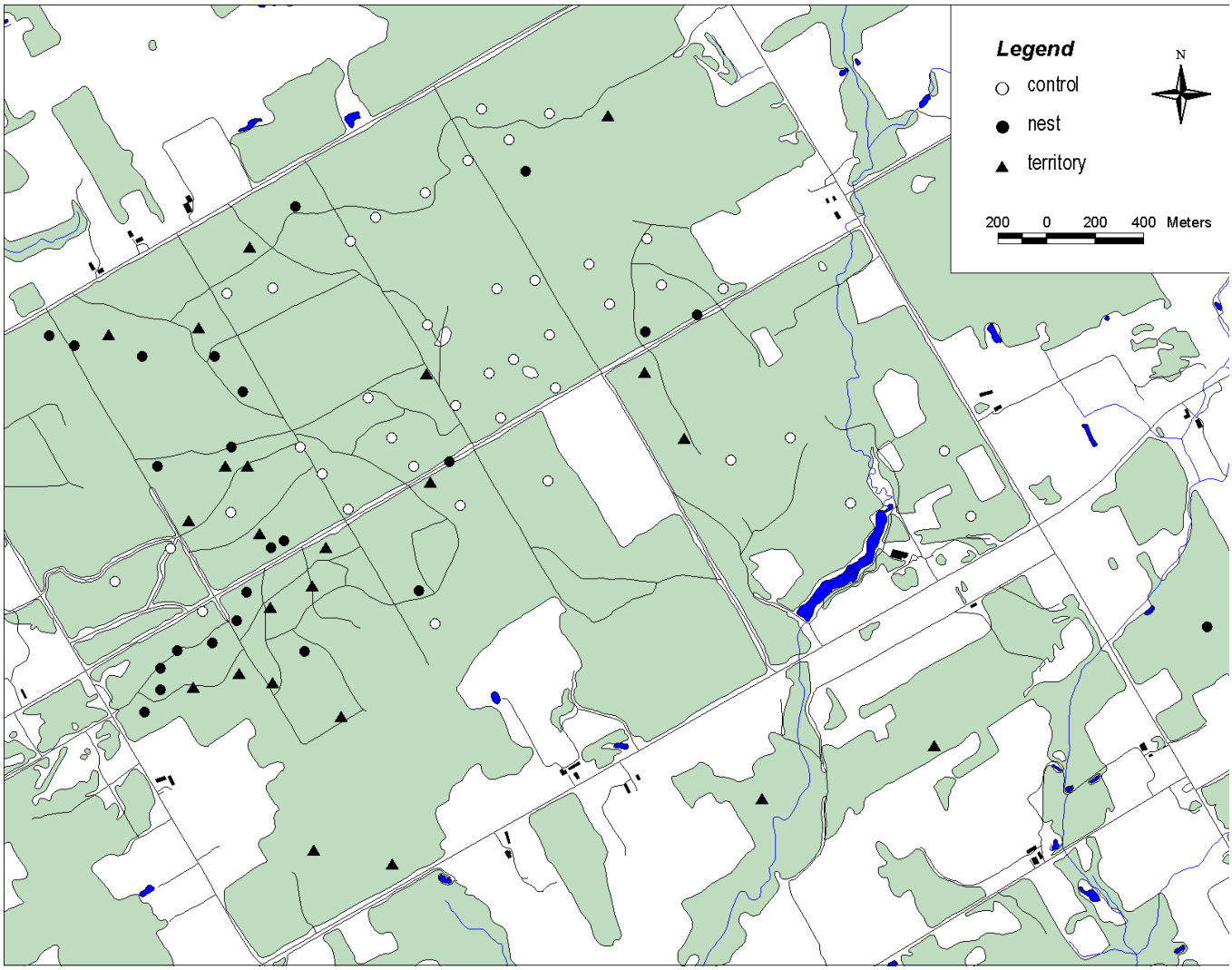


Figure 1. Map of the St. Williams Forest, showing nest, territory and control sites where habitat data were collected in 1999.

Table 3. Top ten tree species (by basal area) in: a) control plots (n = 41), b) nest plots (n =24) and c) territory plots (n = 23) in St. Williams in 1999. Means include plots where trees were not found (i.e., where basal area = 0). Species in bold are common to all three top ten lists.

a) Control Plots

Species	Mean Basal Area per plot (ha)	Number of plots with species (%)	Mean number of stems per plot
Pinus strobus	0.412	37 (90)	11.146
Pinus resinosa	0.239	18 (44)	3.610
Acer rubrum	0.111	31 (76)	6.293
Quercus alba	0.174	28 (68)	2.366
Quercus velutina	0.106	26 (63)	2.341
Prunus serotina	0.056	32 (78)	3.805
Populus grandidentata	0.048	5 (12)	0.439
Quercus rubrum	0.027	6 (15)	0.171
Pinus banksiana	0.019	1 (2)	0.488
Pinus sylvestris	0.011	2 (5)	0.073

b) Nest plots

Species	Mean Basal Area per plot in m^2	Number of plots with species (%)	Mean number of stems per plot
Pinus strobus	0.490	21 (88)	5.792
Pinus resinosa	0.322	16 (67)	4.000
Quercus alba	0.123	11 (46)	1.208
Acer rubrum	0.111	21 (88)	6.458
Quercus velutina	0.052	12 (50)	1.333
Prunus serotina	0.049	21 (88)	2.583
Acer saccharinum	0.040	1 (4)	0.083
Acer saccharum	0.022	3 (13)	0.792
Populus grandidentata	0.006	1 (4)	0.083
Quercus rubrum	0.006	2 (8)	0.125

c) Territory plots

Species	Mean Basal Area per plot in m^2	Number of plots with species (%)	Mean number of stems per plot
Pinus strobus	0.410	19 (83)	6.348
Pinus resinosa	0.299	16 (70)	4.652
Quercus alba	0.098	11 (48)	1.000
Acer rubrum	0.088	21 (91)	5.565
Quercus velutina	0.046	10 (43)	1.174
Prunus serotina	0.041	14 (61)	2.522
Populus grandidentata	0.015	3 (13)	0.217
Picea glauca	0.012	1 (4)	0.304
Ulmus americana	0.007	2 (9)	0.174
Sassafras albidum	0.002	2 (9)	0.304

Figures 2 A-S show the mean values of all habitat variables for nest, territory and control plots. Canopy height, shrub density at all four strata, number of tree stems per plot, stump basal area, number of stumps per plot, and gap area all differed significantly between nest, territory and control plots, based on Wilcoxon signed rank tests.

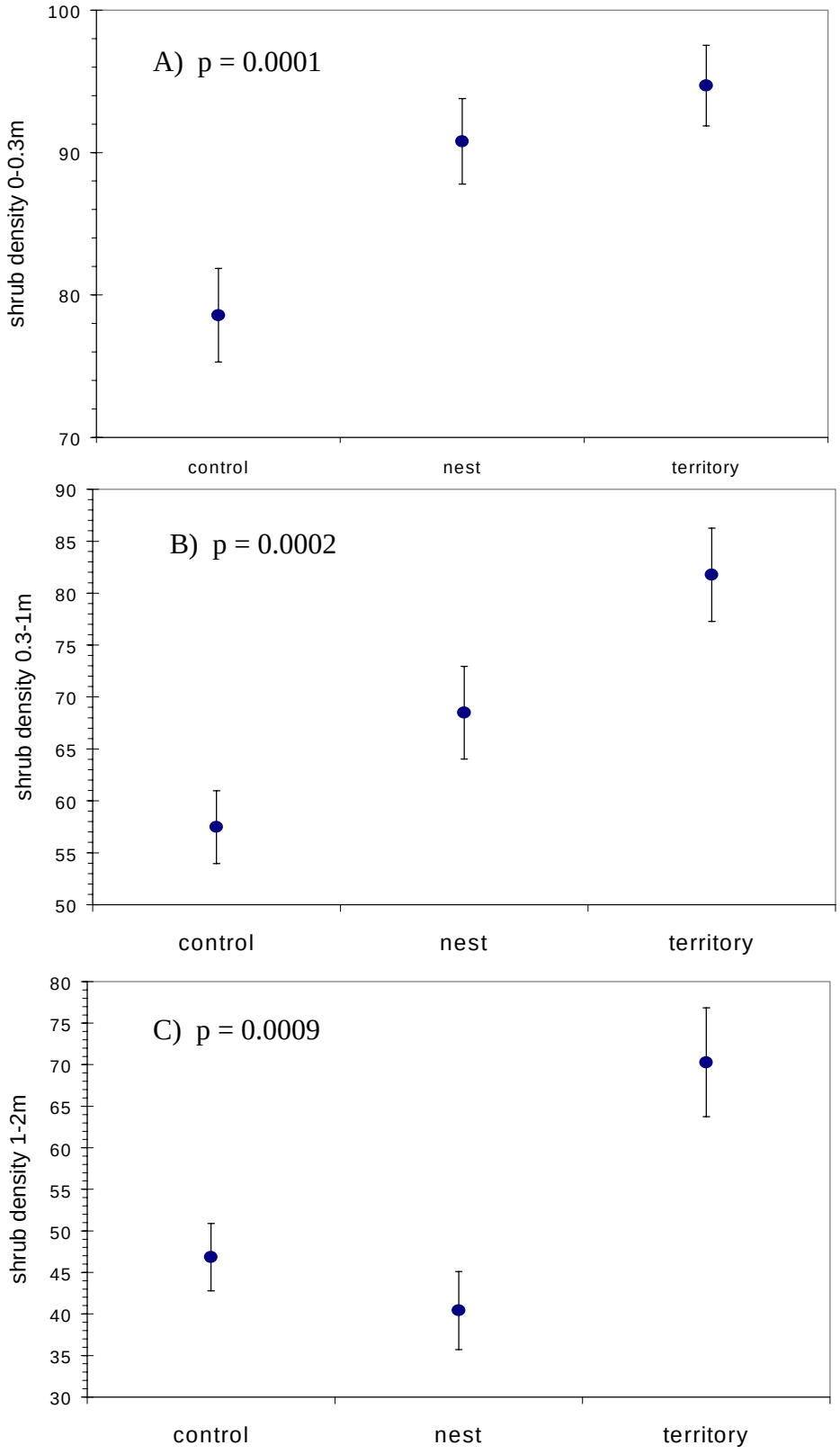
II. Habitat characteristics of nest sites in South Walsingham versus St. Williams

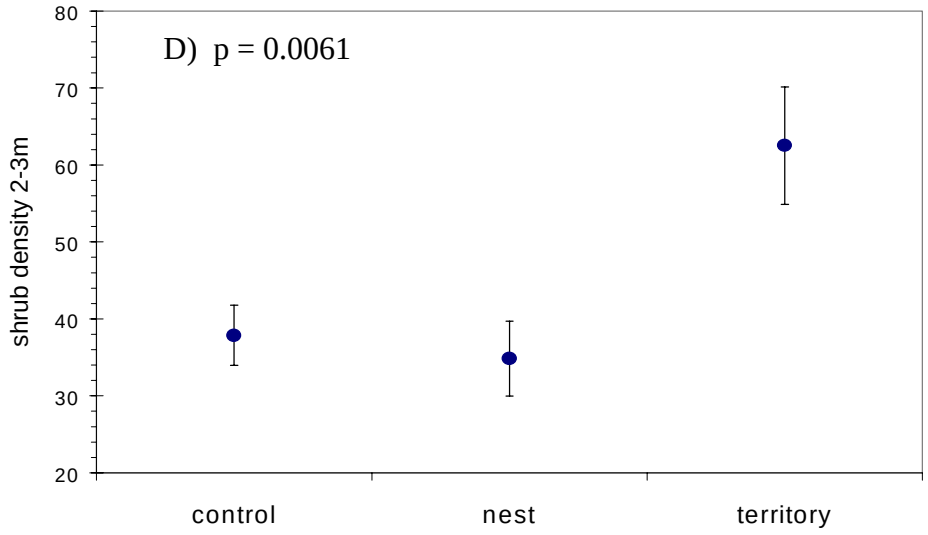
Figures 3 A-N show the mean values of all habitat variables of nest and control sites shared between South Walsingham and St. Williams. The total number of stems, total basal area, basal area of large trees, total number of tree species, basal area of tip-up logs, total number of logs, shrub density at 0-0.3 m, and shrub density at 1-2 and 2-3 m, all differed significantly between nest sites in St. Williams and South Walsingham based on Wilcoxon 2-sample tests.

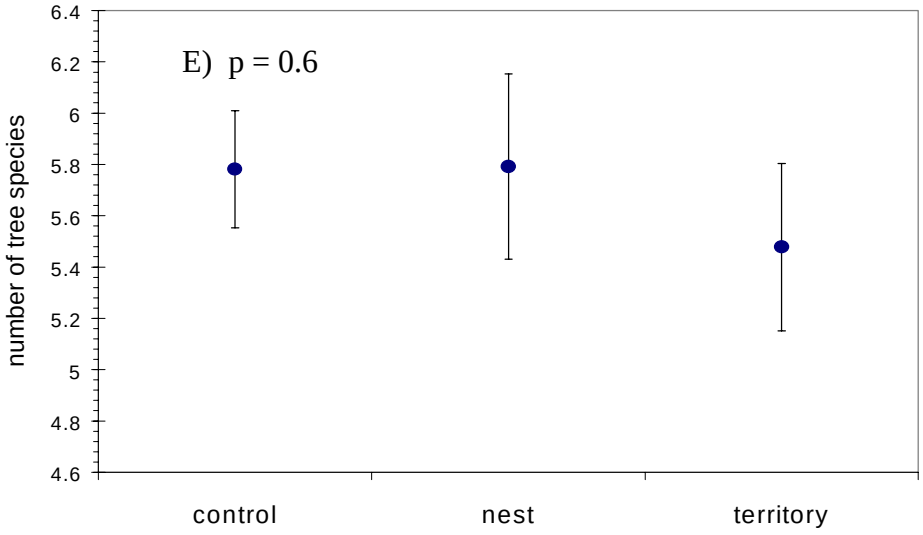
III. Relating recent logging practices in St. Williams to Hooded Warbler presence

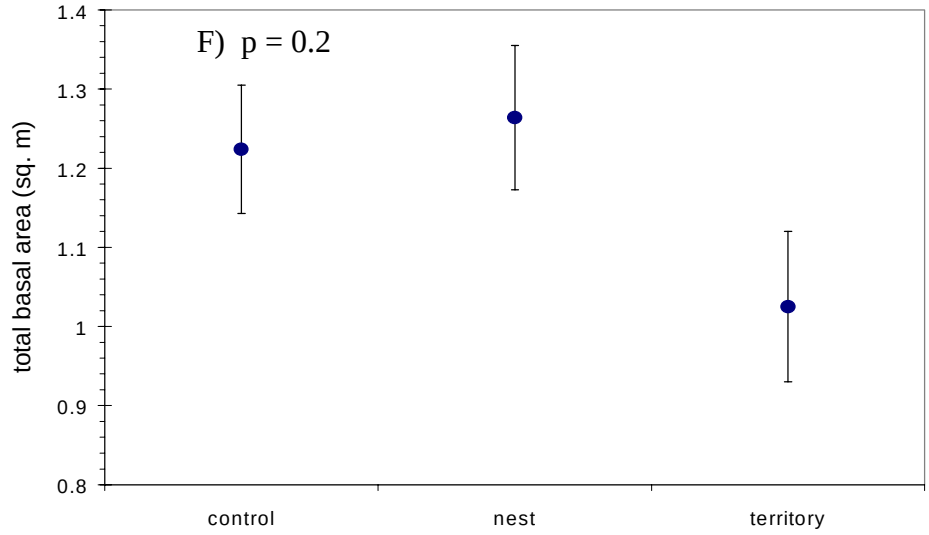
Figure 4 shows the number and volume of trees removed in the nursery tract of the St. Williams forest from 1989-1996. Relatively low volumes were removed from 1988-1992, then large volumes were removed in 1993, 1995 and 1996.

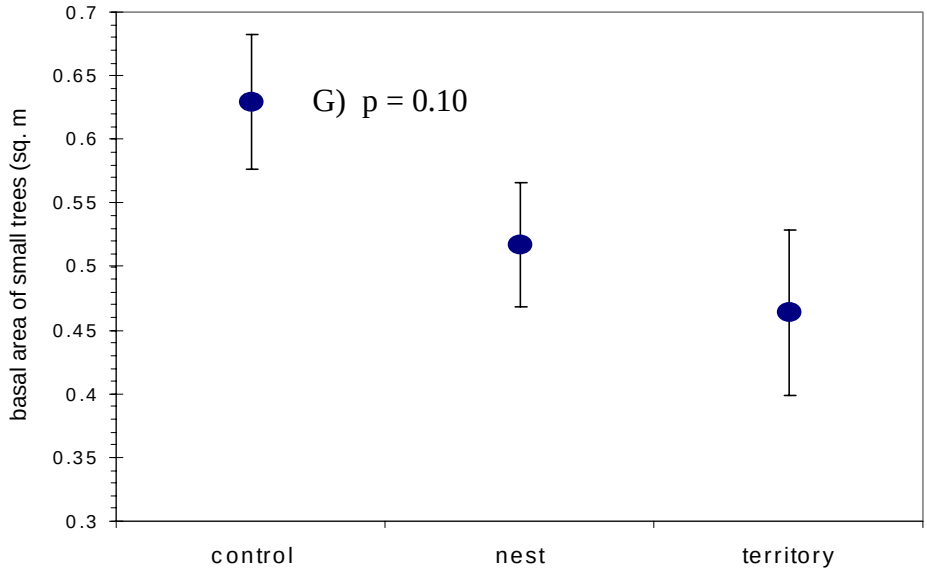
Figure 2. Mean values (± SE) of habitat characteristics measured for control (n = 41), nest (n = 24), and territory (n = 23) sites in St. Williams in 1999. P-values were obtained from Wilcoxon signed rank tests.

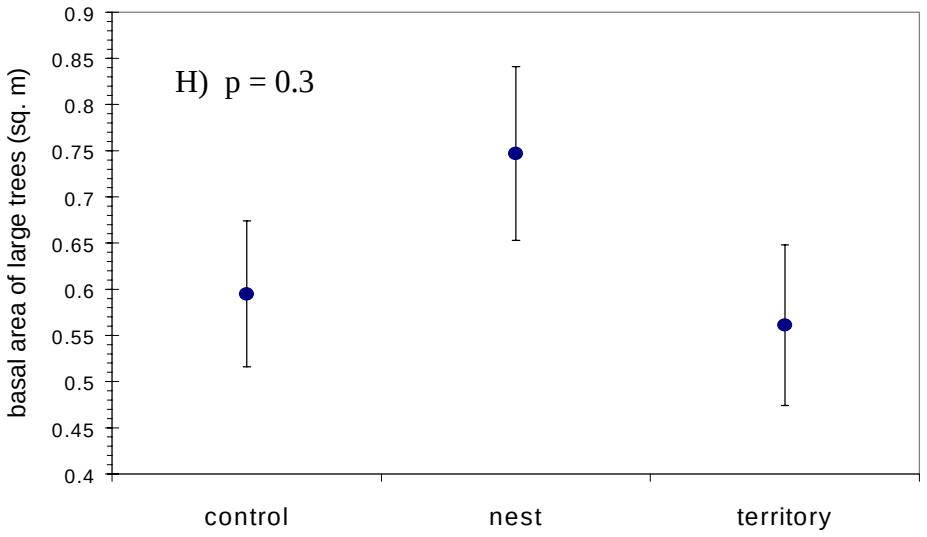


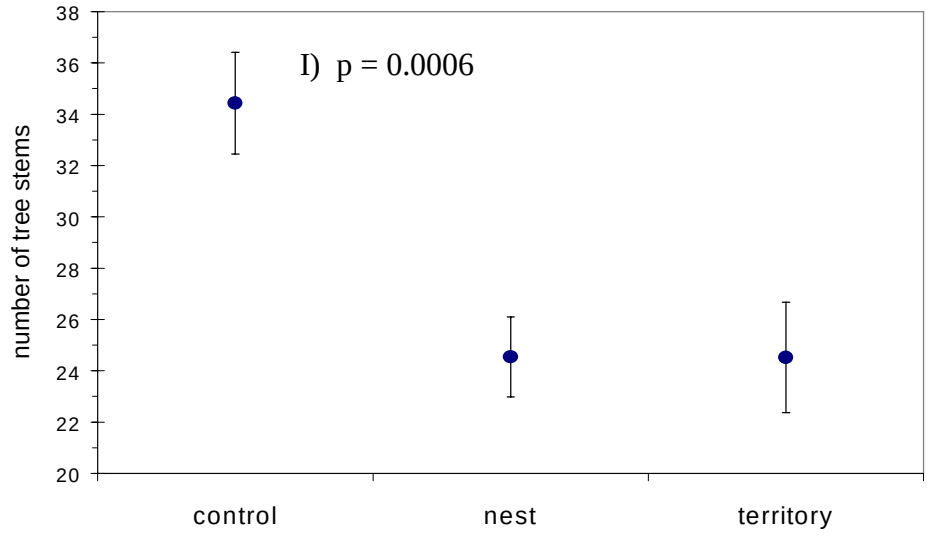

D) p = 0.0061
shrub density 2-3m
80
70
60
50
40
30
20
control
nest
territory

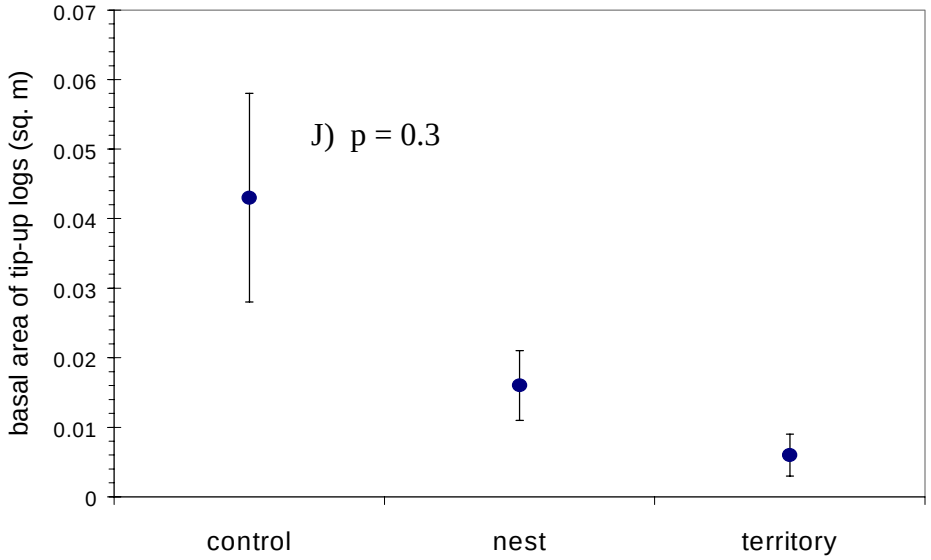

E) p = 0.6
number of tree species
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
control
nest
territory

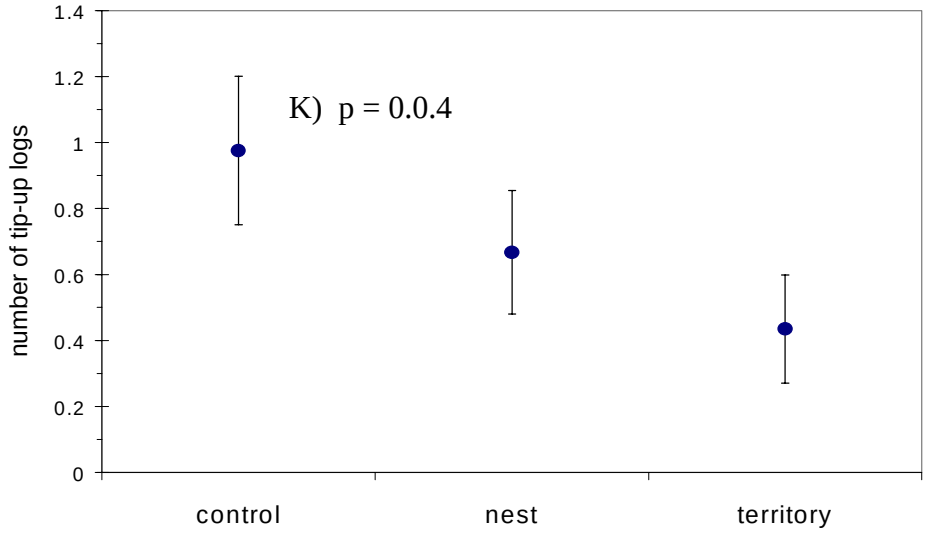

F) p = 0.2
total basal area (sq. m)
1.4
1.3
1.2
1.1
1
0.9
0.8
control
nest
territory

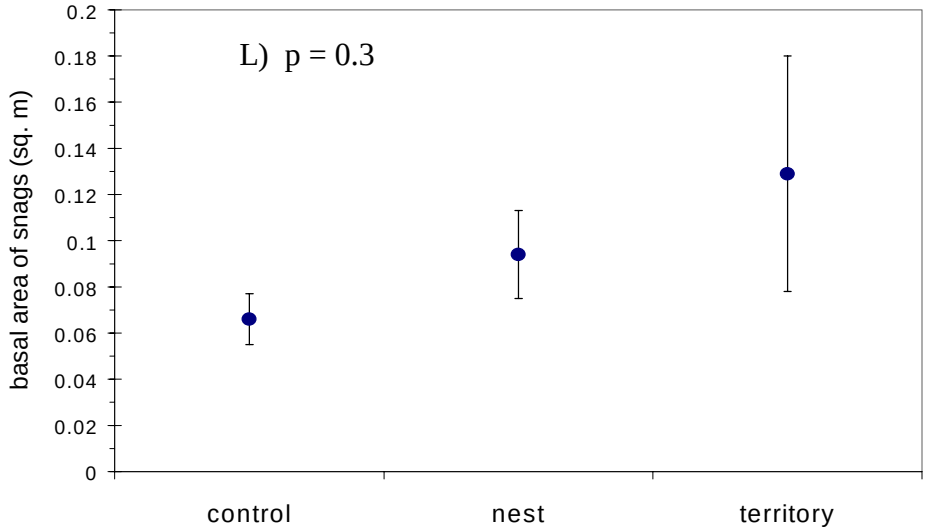

G) p = 0.10
basal area of small trees (sq. m
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
control
nest
territory

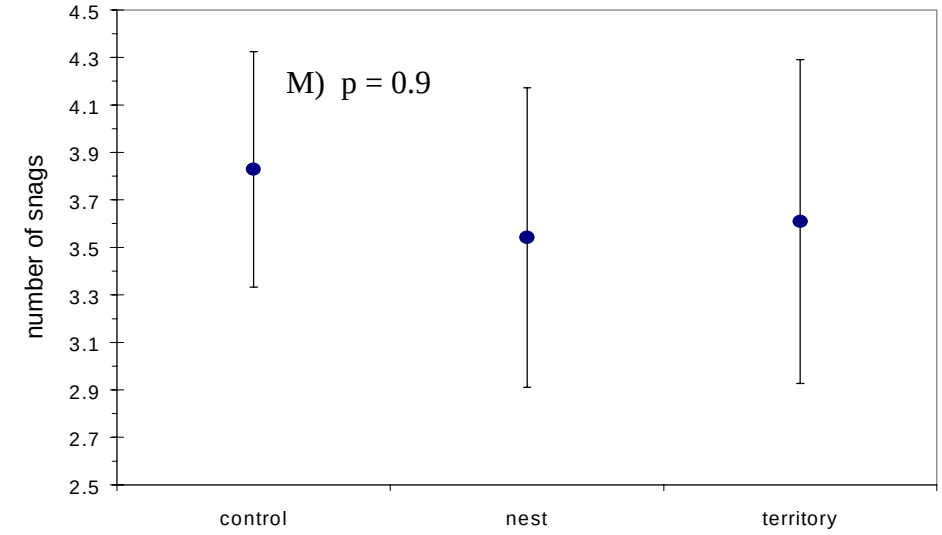

H) p = 0.3
basal area of large trees (sq. m)
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
control
nest
territory

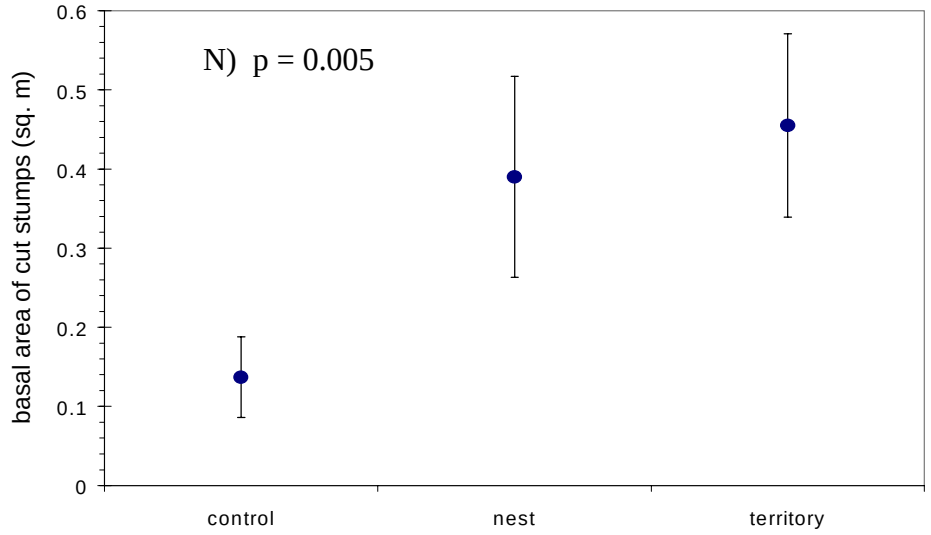

I) p = 0.0006
number of tree stems
38
36
34
32
30
28
26
24
22
20
control
nest
territory

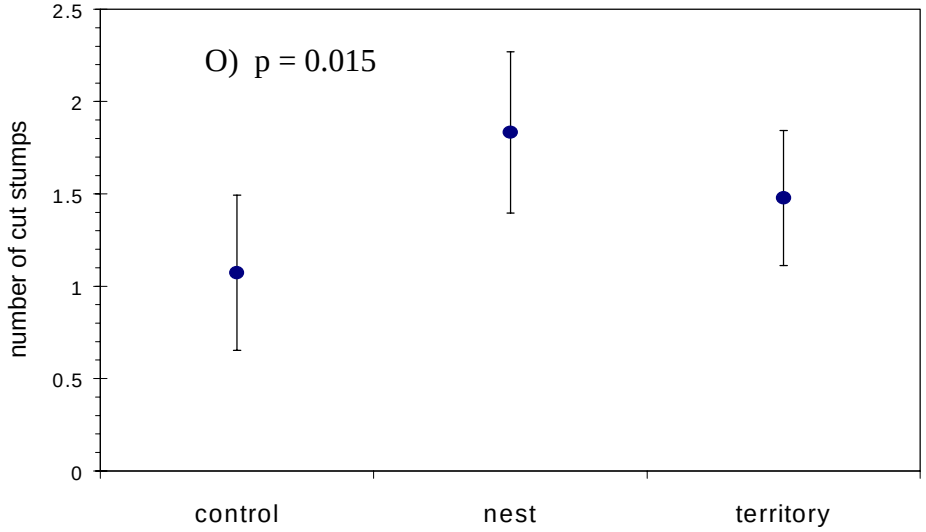

J) p = 0.3
basal area of tip-up logs (sq. m)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
control
nest
territory

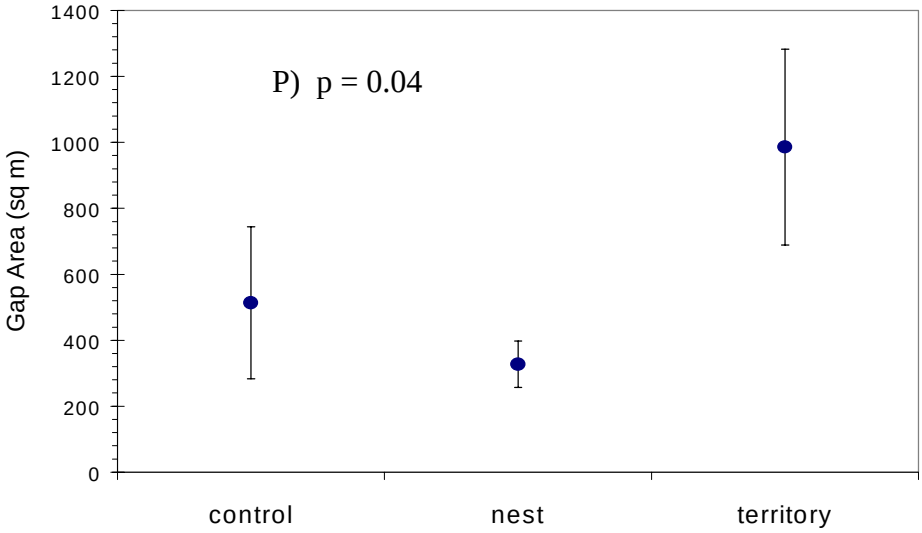

K) p = 0.0.4
number of tip-up logs
1.4
1.2
1
0.8
0.6
0.4
0.2
0
control
nest
territory

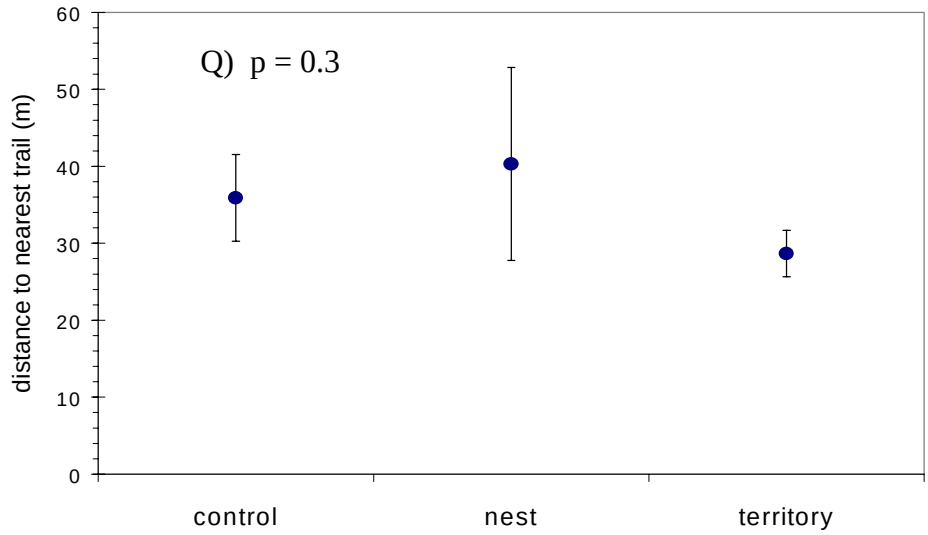

L) p = 0.3
basal area of snags (sq. m)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
control
nest
territory

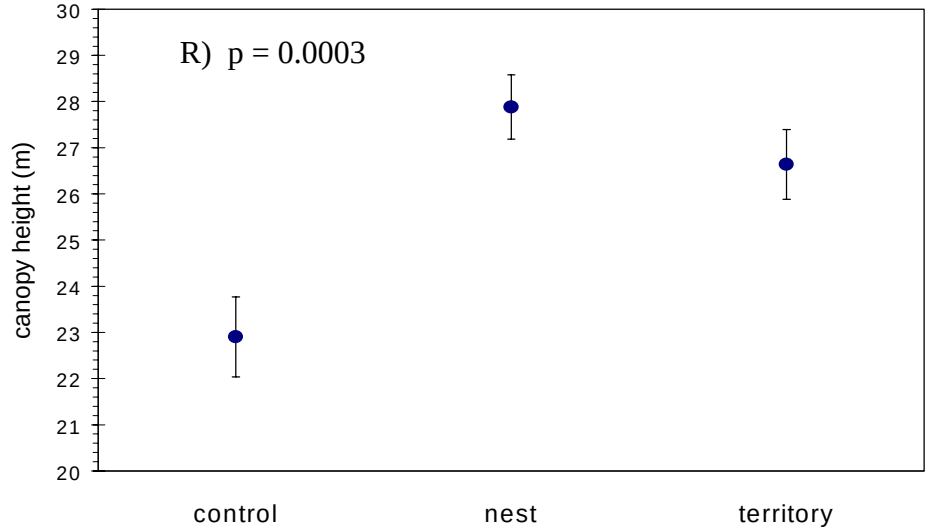

M) p = 0.9
number of snags
4.5
4.3
4.1
3.9
3.7
3.5
3.3
3.1
2.9
2.7
2.5
control
nest
territory


N) p = 0.005
basal area of cut stumps (sq. m)
0.6
0.5
0.4
0.3
0.2
0.1
0
control
nest
territory


O) p = 0.015
number of cut stumps
2.5
2
1.5
1
0.5
0
control
nest
territory


P) p = 0.04
Gap Area (sq m)
1400
1200
1000
800
600
400
200
0
control
nest
territory


Q) p = 0.3
distance to nearest trail (m)
60
50
40
30
20
10
0
control
nest
territory


R) p = 0.0003
canopy height (m)
30
29
28
27
26
25
24
23
22
21
20
control
nest
territory

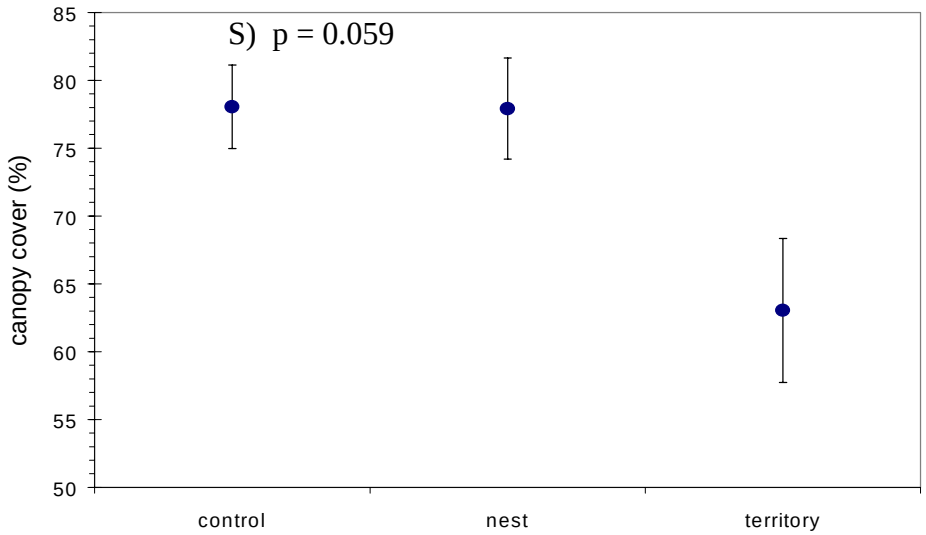
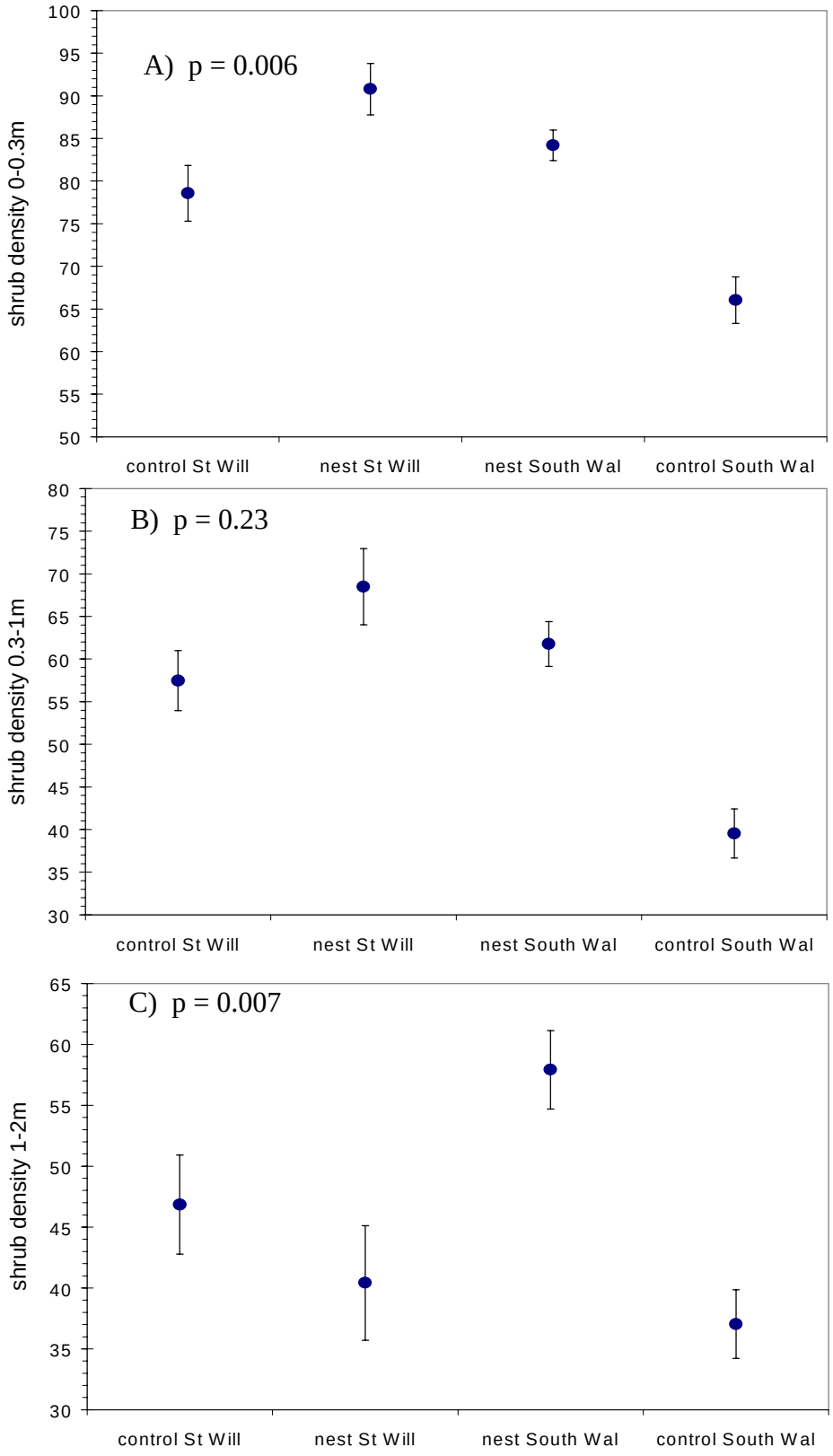
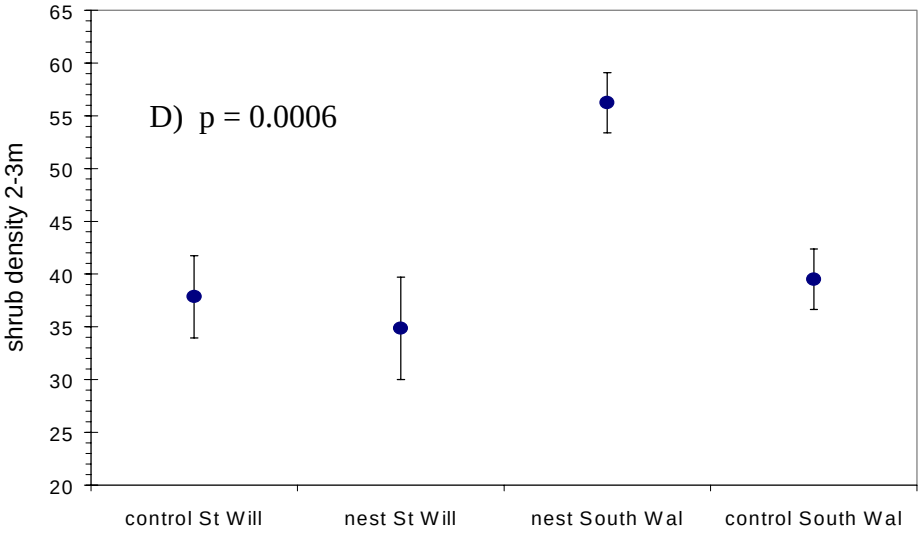
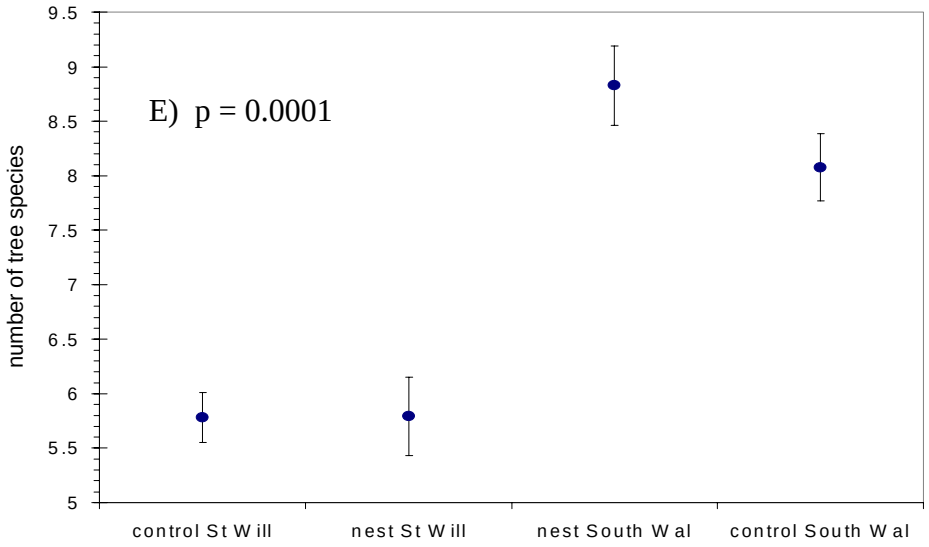
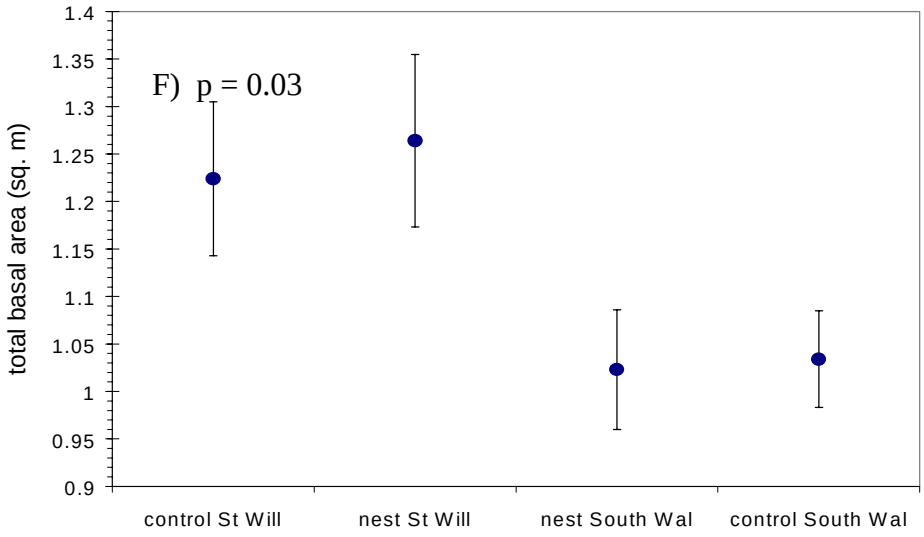

S) p = 0.059
canopy cover (%)
85
80
75
70
65
60
55
50
control
nest
territory

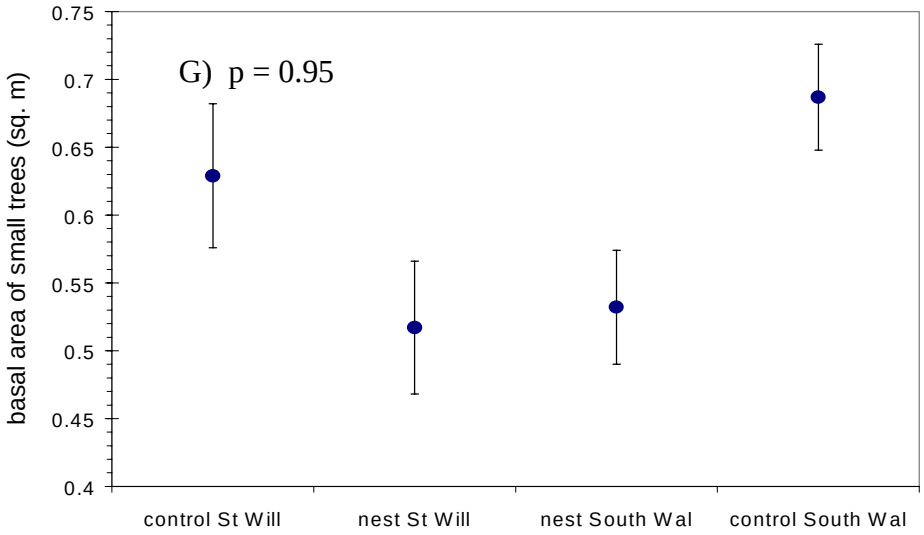
Figure 3. Mean values (± SE) of habitat characteristics for control and nest sites in South Walsingham (1996-97; n = 66 control and 52 nest) and St. Williams (1999; n = 41 control and 24 nest). P-values refer to Wilcoxon 2-sample tests comparing nest sites between South Walsingham and St. Williams.

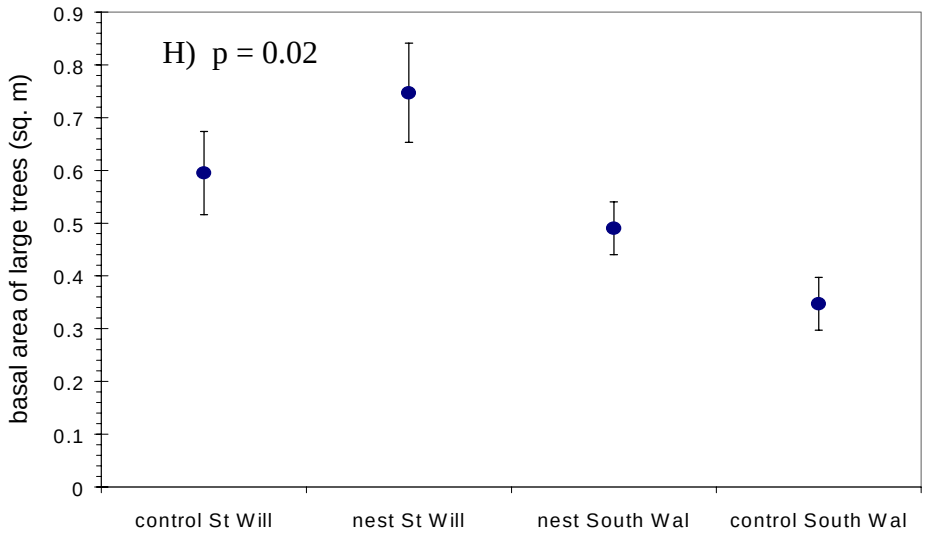


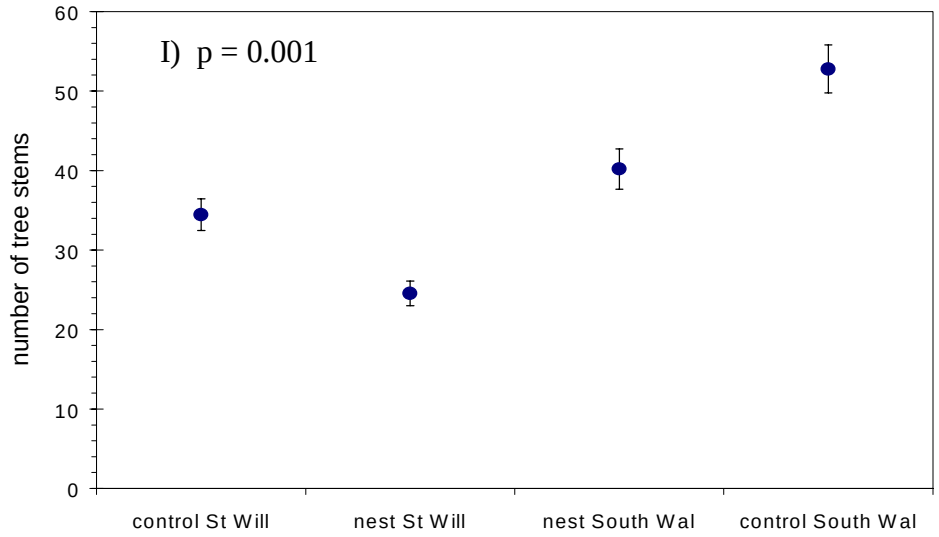

D) p = 0.0006
shrub density 2-3m
65
60
55
50
45
40
35
30
25
20
control St Will
nest St Will
nest South Wal
control South Wal

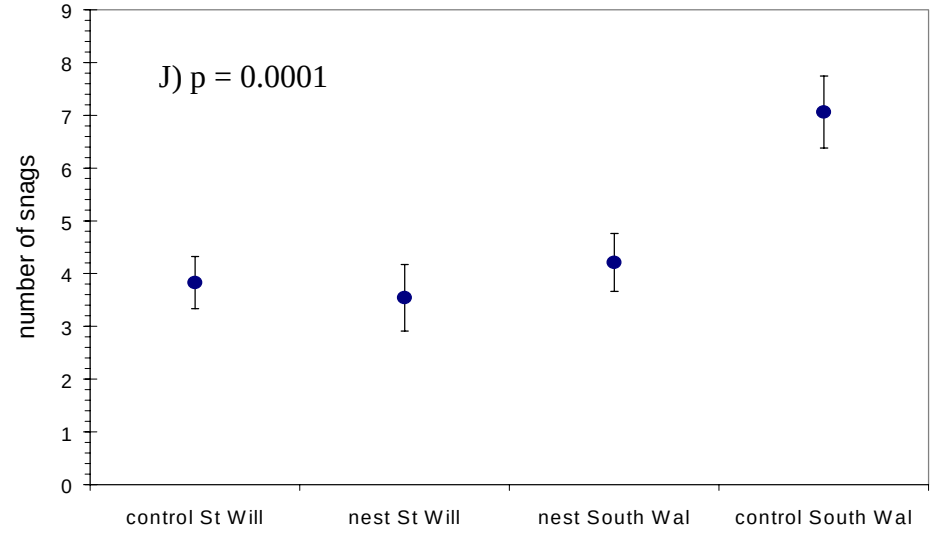

E) p = 0.0001
number of tree species
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
control St Will
nest St Will
nest South Wal
control South Wal

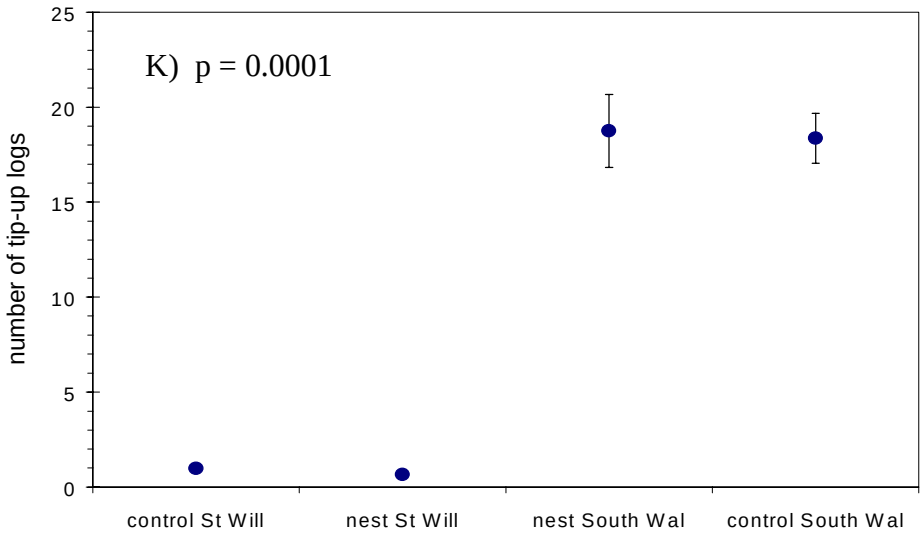

F) p = 0.03
total basal area (sq. m)
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
control St Will
nest St Will
nest South Wal
control South Wal

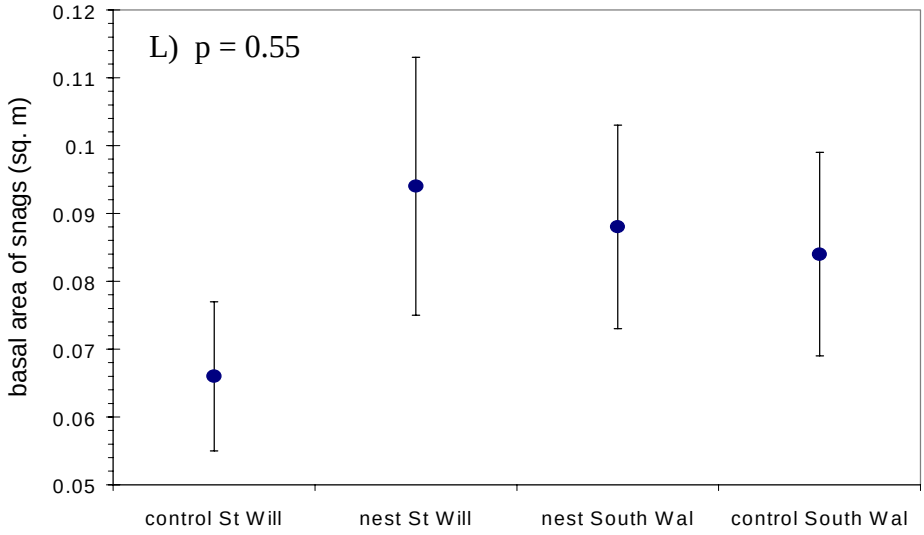

G) p = 0.95
basal area of small trees (sq. m)
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
control St Will
nest St Will
nest South Wal
control South Wal

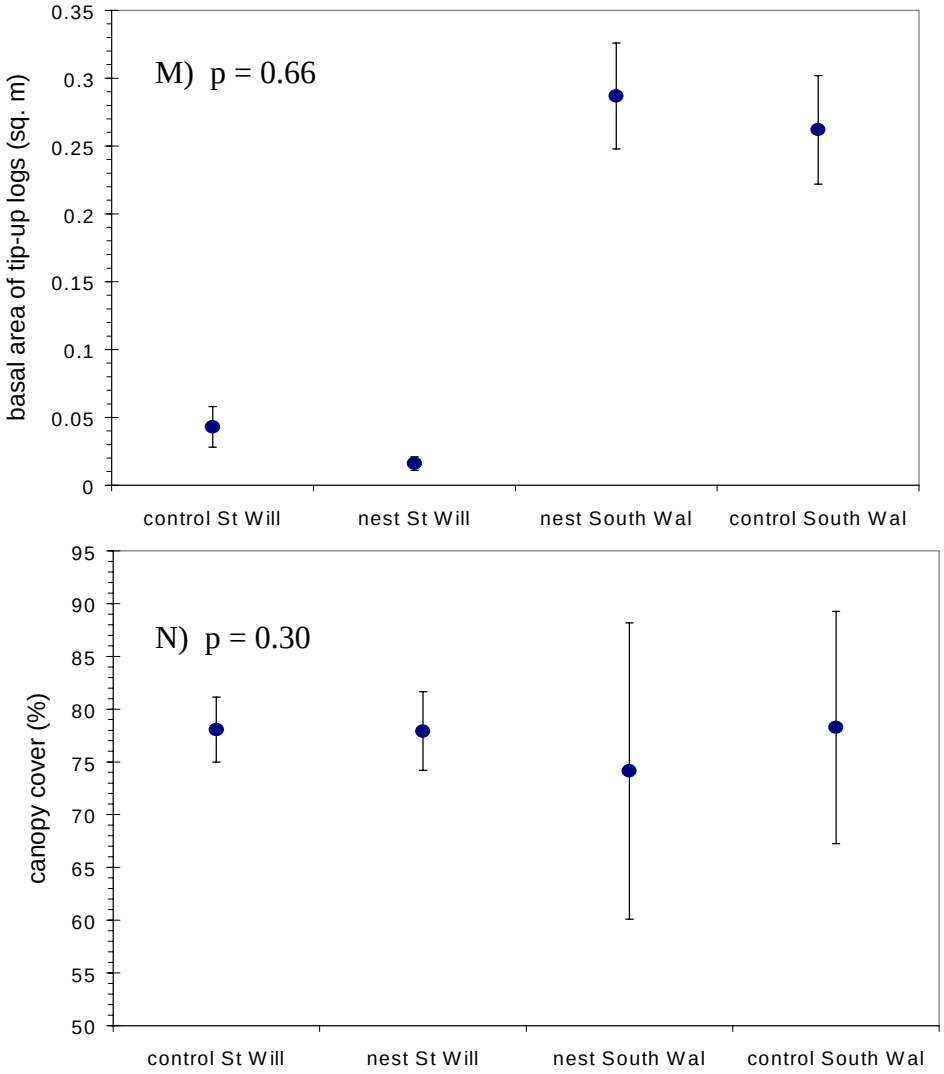

H) p = 0.02
basal area of large trees (sq. m)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
control St Will
nest St Will
nest South Wal
control South Wal


I) p = 0.001
number of tree stems
60
50
40
30
20
10
0
control St Will
nest St Will
nest South Wal
control South Wal


J) p = 0.0001
number of snags
0
1
2
3
4
5
6
7
8
9
control St Will
nest St Will
nest South Wal
control South Wal


K) p = 0.0001
number of tip-up logs
0
5
10
15
20
25
control St Will
nest St Will
nest South Wal
control South Wal


L) p = 0.55
basal area of snags (sq. m)
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0.12
control St Will
nest St Will
nest South Wal
control South Wal


M) p = 0.66
basal area of tip-up logs (sq. m)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
control St Will
nest St Will
nest South Wal
control South Wal
N) p = 0.30
canopy cover (%)
95
90
85
80
75
70
65
60
55
50
control St Will
nest St Will
nest South Wal
control South Wal

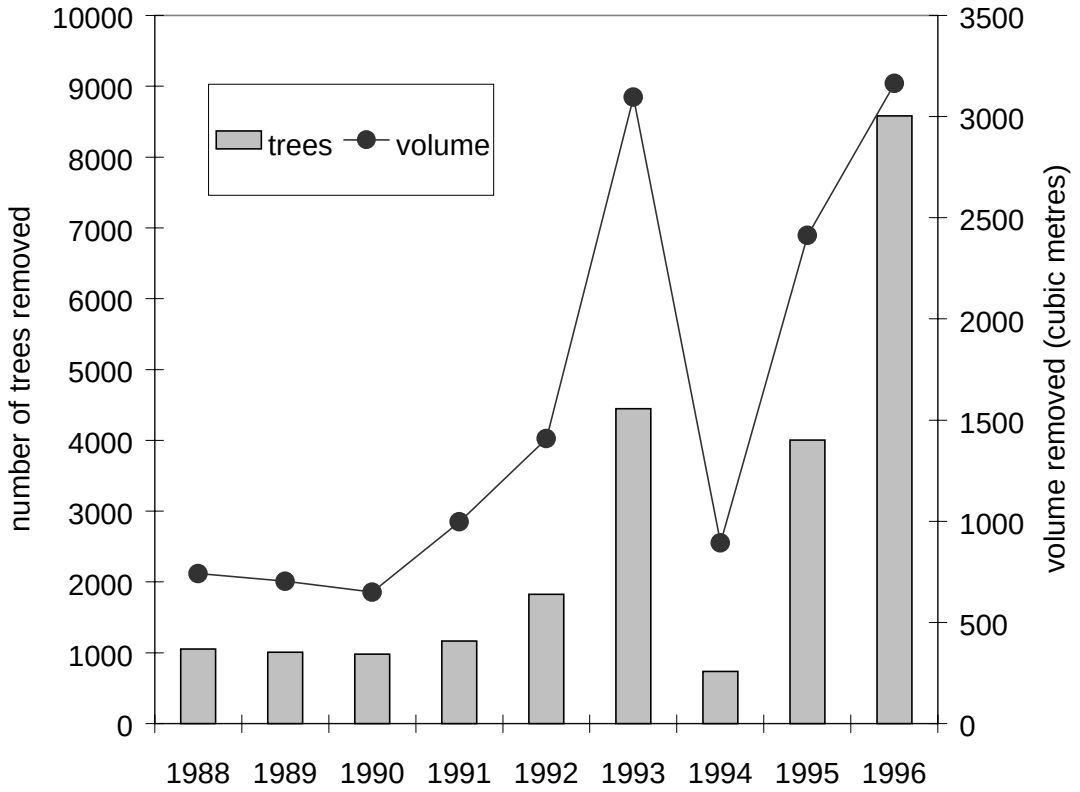


Figure 4. Number and volume of trees removed from the nursery tract of the St.Williams forest between 1988 and 1996. All trees were removed between August and May, so we considered a removal year to last from August to May (i.e. 1988 = Aug. 1988-May 1989). This was because removal of trees in September of 1988 would have the same effect on the following summer's bird population as would removal of trees in March of 1989.

DISCUSSION

Population Size and Productivity

There were at least 36, and as many as 48, pairs of Hooded Warblers in St. Williams in 1999. This is almost twice as many pairs as were found in 1998 (19 pairs), and more than six times as many as were found in 1995 (6 pairs; McCracken et al. 1998a). Only about 10 pairs of Hooded Warblers were believed to be nesting in South Walsingham this year (M. E. Gartshore, pers. comm.). The South Walsingham population has shown a steady decline in nesting pairs over the last 3 years, with 21 found in 1997, 19 found in 1998, and only 10 found this year. Also, birds that were previously banded in South Walsingham were found this year in St. Williams, suggesting that Hooded Warblers from this site are indeed shifting to St. Williams.

Productivity of Hooded Warblers in St. Williams was similar to that found in other studies. For example, the number of young fledged/successful nest (2.7) and daily survival rate (0.94) were both equal for Hooded Warblers in St. Williams and South Carolina (Sargent et al. 1997), although the Mayfield success rate was slightly higher in St. Williams (33%) then it was in South Carolina (28.7%). Slightly higher rates of reproductive success have been reported in Pennsylvania for nests where parasitism was negligible (from Evans Ogden and Stutchbury 1994), than we reported for unparasitized nests in St. Williams (i.e. clutch size: 4.0 ± 0.08 in Pennsylvania, 3.4 ± 0.16 in St. Williams; young fledged per nest: 1.6 ± 0.28 in Pennsylvania, 1.29 ± 0.34 in St. Williams). Whether Hooded Warblers in St. Williams are producing enough young to sustain their current population size is not known. Determining whether this population is a source or sink for Southern Ontario (Pulliam 1988) will be a high priority for the second year of this study.

Predation and parasitism affected 33% and 52% of nests in St. Williams, respectively. These values are similar to those found in the nearby South Walsingham forest, where 36% of nests have been depredated, and 45% of nests have been parasitized, in past seasons (M. E. Gartshore, unpubl. data). Parasitism decreased reproductive success in St. Williams, as eggs laid/nest, young hatched/nest and young fledged/nest were all significantly lower for parasitized than unparasitized nests. This suggests that parasitism is a major factor affecting the success of Hooded Warblers in St. Williams. Interestingly, however, Stutchbury (1997) found that, while removal of female cowbirds decreased the parasitism rate in a Pennsylvania population by 43%, and increased the clutch size and number of young hatched/nest, cowbird removal did not increase the number of young fledged/nest, as many nests that escaped parasitism were preyed upon. While it is impossible to determine whether removal of cowbirds would affect reproductive output of Hooded Warblers in St. Williams, it is possible that it might, given that the predation rate is relatively low at this site (33%), compared to the Pennsylvania site (44%) and to a site in South Carolina (57.9%; Sargent et al. 1997). At the same time, however, removing cowbirds would be an expensive and time-consuming task, and the success gained would probably not be enough to warrant such action.

Habitat Selection

Hooded Warblers in St. Williams chose nest sites in fairly small gaps with a relatively high surrounding canopy of mature trees, a dense ground cover of shrubs, and a high number of cut stumps, compared to control sites in the same forest. This is consistent with results found in other studies of Hooded Warblers in the United States. Robbins et al. (1989b) found that canopy height, percent of forest within 2 km, foliage density between 0.3 and 1 m above the ground, and percent ground cover, were all positive, significant predictors of Hooded Warbler presence in Maryland. Crawford et al. (1981) found a significant positive relationship with the shrub layer and the basal area of large stems, and a negative relationship with total canopy cover in the Appalachians. Finally, Kilgo et al. (1996) found that Hooded Warbler nest sites had greater measures of vegetation density in the nest patch than in non-use sites.

Our study also examined differences in habitat characteristics of territory sites. We initially measured habitat at territory sites where we had not located nest sites in order to ensure that habitat data was collected in all territories. If habitat had not differed considerably between nest and territory sites, we could have pooled these data and compared them to control sites. However, significant differences do exist between nest and territory sites. While shrub density at the two higher strata did not differ between nest sites and controls, territory sites had much greater shrub density at these two strata than nests or controls. Territory sites also had less total basal area and lower canopy cover than nests or controls.

These results are probably related to the fact that territory sites were located in much larger gaps than nests or controls. Not only were nest gaps relatively small on average, but they also showed very little variance in size (mean = 327 ± 70 m^2), whereas territory gaps had both a large average size and a large variance (986 ± 297 m^2; see Fig. 3P). This suggests that Hooded Warblers have a very rigid preference for small gaps around their nest sites, but that they may tolerate a larger range of gap sizes within their territories in general. This may be because large gaps are preferred for foraging as they have greater prey abundance, a warmer microclimate, and increased visibility compared to contiguous forest (reviewed in Smith and Dallman 1996). However, because our nest and territory sites came from different territories, several other explanations are possible. First, the larger gaps and greater shrub density of territory sites may make it more difficult for us to locate nests than in sites with smaller gaps and fewer shrubs. Or, males that choose territories with larger gaps may be less successful in finding a mate and/or nesting successfully. The latter is unlikely, however, as most (16/23) of the territory sites did have females associated with them. It would be valuable to determine whether gap size differs between nest and territory sites within the same territory, to rule out these two alternate possibilities, and to learn whether Hooded Warblers do actually require both small gaps for nesting and large gaps for foraging.

Knowing the size of gaps used by Hooded Warblers in Southern Ontario is a valuable management tool, as forest managers can attempt to match the number of logs taken with the gap size preference of this species. In southern Illinois, gaps ranging from 0.02 to 0.4 ha have generally been found to be large enough to attract gap-dependent species such as Carolina Wren, White-eyed Vireo, Kentucky Warbler, Hooded Warbler, Indigo Bunting, Northern Cardinal, and Eastern Towhee, but not large enough to attract edge and second-growth species such as Prairie

Warbler, Blue-winged Warbler, and Brown Thrasher (Robinson and Robinson 1999). This range of gap sizes may, however, be too broad for Hooded Warblers in southern Ontario. We therefore recommend that, when logging in a current or historic Hooded Warbler breeding site, forest managers in southern Ontario should create gaps no larger than 300-1000 m^2 (0.03-0.1 ha), as this is the current range of gap sizes used by this species in St. Williams. Further study of gap size preferences of Hooded Warblers in other sites in Southern Ontario could help refine this recommendation.

Many of the differences that exist between nest sites and control sites in St. Williams also exist between nest sites and control sites in South Walsingham. At both sites, Hooded Warblers show an affinity for shrubby sites surrounded by mature trees, suggesting that these characteristics represent the most consistent habitat preferences of this species. Nest sites in South Walsingham, however, appear to be characterized by older gaps than nest sites in St. Williams. Shrub density in all four strata was significantly higher at nest sites than controls in South Walsingham, whereas in St. Williams, shrub density was significantly greater around nest sites than controls only for the two lowest strata. Also, nest sites in St. Williams had significantly more shrub cover at the lowest strata (0-0.3 m) than nest sites in South Walsingham, whereas South Walsingham had significantly more shrub cover at the two highest strata (1-2, and 2-3 m), than nest sites in St. Williams. Furthermore, South Walsingham had more tree stems in both nest sites and controls than did St. Williams, although the total basal area was greater at St. Williams than South Walsingham, suggesting that St. Williams consists of larger size-class trees in general. Indeed, the basal area of large size class trees was greater for both nest sites and controls at St. Williams than in South Walsingham.

These results suggest that gaps used by Hooded Warblers in South Walsingham are more mature than those used by Hooded Warblers in St. Williams. It is possible that the population shift observed over the last 4 years could be due to the fact that South Walsingham is becoming less suitable for Hooded Warblers as gaps fill in with small saplings and trees. Recent increases in logging in St. Williams since 1993 (Fig. 4) have opened up new gaps with a rich understorey in this forest that are probably very suitable for Hooded Warblers. Conversely, South Walsingham has not been logged to a large extent since 1986 (M. Gartshore pers. comm.).

Many other studies have found a positive relationship between Hooded Warbler presence and selective logging. Baker and Lacki (1997) found that Hooded Warblers were more abundant in stands that had undergone “low-leave” (3.5 m^2 residual basal area per ha) and “high-leave” (7 m^2 residual basal area per ha) cuts than in stands that were not harvested at all. Similarly, Annand and Thompson (1997) found that Hooded Warblers were more abundant in stands that underwent group and single-tree selection cuts than in either mature stands, or stands that underwent clear cutting or shelterwood treatments. Furthermore, Rodewald and Smith (1998) found that selective cutting that also involved heavy cutting of understorey vegetation (to lower competition and promote regeneration of desirable tree species) was deleterious for Hooded Warblers, suggesting that the dense shrub layer generated by the canopy opening, rather than the opening itself, is the key habitat feature for this species.

Robinson and Robinson (1999) found that Hooded Warblers were significantly more abundant in

cut stands as opposed to uncut stands, and that they were also more abundant two to three years after selective logging than 11 years after logging. Interestingly, significant logging has not occurred in South Walsingham for 13 years, and Hooded Warblers began to decline at this site two years ago. This suggests that there is an optimal and limited time after cutting when a forest gap is suitable for Hooded Warblers. A lag probably exists between logging and the growth of herbaceous plants and shrubs, so that gap-dependent species do not appear until two or three years after cutting (Robinson and Robinson 1999). In St. Williams, heavy logging occurred in 1993, 1995 and 1996. Hooded Warblers began colonizing this site in 1995, two years after the first large-scale logging occurred. Hooded Warblers have continued to increase at this site since 1995, with a high of at least 36 pairs found in 1999. While we cannot determine whether a relationship exists between logging at this site and Hooded Warbler presence until logging information is digitized at the stand level, it seems likely that the increase in logging beginning in 1993 has contributed to the surge in Hooded Warbler numbers in this forest since 1995. Indeed, more stumps were found in Hooded Warbler nest and territory sites than in control sites in St. Williams, suggesting that selective logging has indeed had a positive impact on this species.

PLANS FOR YEAR TWO

The results presented here represent the first year of a two-year study of Hooded Warbler productivity and habitat selection in Southern Ontario. Our plans for 2000 include the following:

1. We will digitize the current St. Williams forest stand map, and link it using GIS techniques to: a) logging history over the last 10 years; and b) Hooded Warbler presence over the last 4 years in this forest. We will then use this information to examine the relationship between logging (including time since logging, and number and/or volume of trees removed) and Hooded Warbler presence.

2. We currently have data from habitat surrounding 76 Hooded Warbler nests in Southern Ontario (52 from South Walsingham, 24 from St. Williams). In 2000, we will gather data on several more nest sites from different forest stands, specifically Backus Woods (3-4 pairs in 1999; J. McCracken unpubl. data) and Point Abino (6-8 pairs in 1999; McCracken et al. 1999). We also, however, plan to gather habitat information on several unoccupied woodlots in Southern Ontario, such as the Turkey Point tract of the St. Williams Forestry Station, in order to determine what key differences exist between occupied and unoccupied woodlots that may tell us why this species is not more widespread.

3. This summer, we had planned to examine the effects of selective logging on Hooded Warblers and other VTE forest birds in the Hepburn Tract, a mature stand of Carolinian forest owned by the Long Point Region Conservation Authority, and slated for cutting in the spring of 1999. Because the logging did not occur until September of 1999, however, we were not able to gather data on “post-cut” bird responses this year. In 1998, BSC biologists conducted a site inventory and a detailed quantitative study to describe the bird and vegetation community at 30 permanently-marked sample stations. Together with detailed information on the intensity of the tree marking prescription, the 1998 work established the baseline against which to assess the immediate effects of the logging. Using an immediately adjacent uncut part of the forest, the

methodology (Forest Bird Monitoring Program style point counts and James and Shugart vegetation sampling) used in 1998 will be repeated at the sample stations in 2000 (to be repeated thereafter at 5-year intervals), in order to determine the effects of selective logging on Hooded Warblers and other VTE forest birds in Southern Ontario.

4. We colour-banded 46 Hooded Warblers in St. Williams in 1999, and hundreds more have been colour-banded in South Walsingham over the last 10 years (M. Gartshore pers. comm.). We plan to observe all Hooded Warblers in St. Williams and South Walsingham in 2000 to determine whether colour-banded birds from either site return to breed. This information will be used to determine survival, recruitment, and site-fidelity of Hooded Warblers in Southern Ontario, which can, in turn, be used to carry out an analysis of whether St. Williams is a source or sink population for Hooded Warblers in Southern Ontario. We will also continue to monitor Hooded Warbler numbers at both sites to determine whether the population shift (from South Walsingham to St. Williams) is escalating.

5. Year two activities will also focus heavily on drawing together all the habitat information for a thorough analysis involving logistic regression and a discriminant function analysis to compare nest sites in the two forest types, as well as nest and control sites in St. Williams. We intend to produce and submit at least one major scientific paper for publication in the primary literature in 2000.

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Appendix A. Number of field hours, observers, and territories covered from May to August 1999 in St. Williams. Observers: BW = Becky Whittam, JM = Jon McCracken, MEG = Mary E. Gartshore, PC = Peter Carson, TM = Tanya McGregor, BP = Ben Porchuk, HM = Hugh McArthur, CF = Charles Francis, J&JF = John and Janet Foster, SB = Sean Blaney, HV = Hilbran Verstraete.

Date	Visit #	Time In	Time Out	Duration	Observers	Comments
27-May	1	610	1140	5.5	BW	North of sand road. Found HOWA 1, 2, 3,4, 5, 6,
28-May	2	615	1140	5.5	BW	Northwest; Found HOWA 7, 8. Southwest; Found HOWA 9. Checked HOWA 1
29-May	3	900	1200	3	JM	SW sector; HOWA 28, 12, 25 and 24
04-Jun	4	610	1100	4.8	BW	Southeast; Found HOWA 10, HOWA 11. Northeast; heard HOWA 1, HOWA 3. Southwest; Found HOWA 12, HOWA 13,
06-Jun	5	1005	1050	0.75	JM	HOWA 24, HOWA 9
06-Jun	6				MEG, PC	Mary and Peter found N 1 (HOWA 3), N2 (HOWA 1), N 3 (HOWA 25)
07-Jun	7	615	1215	6	BW, MEG	Northeast; checked N1,2,3, Found N 4 (HOWA ?), N 5 (HOWA 24)
08-Jun	8	615	1140	5.5	BW	East; HOWA 10, HOWA 3. west; HOWA 6, HOWA 17, HOWA 4, HOWA 19, HOWA 20, checked N1 and N4
08-Jun	9	630	8	1.5	BP	South of Hwy 24
08-Jun	10	1915	2045	1.5	BW, TM	Southeast; nothing; Southwest; nothing
09-Jun	11	710	1050		BW	HOWA 1, HOWA 16, HOWA 14, HOWA 9, HOWA 21, N4, N5, HOWA 12
12-Jun	12	845	1200	3.25	BW, MEG	northwest; HOWA 18, HOWA 22, found N6, HOWA 19, HOWA 23,
12-Jun	13	1100	1245	1.75	JM	HOWA 24 (N5); HOWA 36, 27, N7
12-Jun	14	1415	1530	1.25	BW	nest checks: N1, 2, 4, 5
13-Jun	15	1030	1250	2.25	JM	Ungers Corners N16
14-Jun	16	625	900	2.5	BW	far southwest corner HOWA 29, HOWA 21, HOWA 17, HOWA 22, HOWA ?, HOWA 24, HOWA 25,
15-Jun	17	620	1210	5.5	BW	northwest; HOWA 17, HOWA 5, HOWA 22, HOWA 19, HOWA 23, HOWA 4, HOWA 24, HOWA 25, HOWA 12, HOWA 20, HOWA 14, HOWA 15, HOWA 16, HOWA 10, HOWA 3, HOWA 1
15-Jun	18	710	840	1.5	BP	south of Hwy 24
15-Jun	19	1600	1750	1.8	BW	northeast; HOWA 2
16-Jun	20	710	1000	2.8	BW	on bike; HOWA 10, HOWA 16, HOWA 3, HOWA 14, HOWA 9, HOWA 12, HOWA 26
17-Jun	21	700	1130	4.5	BW, HM	with Hugh, Northwest end; HOWA 17, HOWA 18, found N 10, HOWA 22, HOWA 19, HOWA 27, HOWA 6, HOWA ?, HOWA 24, HOWA 25,
17-Jun	22	1500	1630	1.5	B W , M E G , photographer	Banding at N9 (HOWA 26)
18-Jun	23	620	1130	5.2	BW	on bike; HOWA 10, HOWA 16, HOWA 3, HOWA 1, HOWA 14, HOWA 27, HOWA 4, HOWA ?, HOWA 2
18-Jun	24	900	1000	1	JM	HOWA 28
18-Jun	25	1335	1400	0.5	BW, MEG, J&J F	planned to band at N2 with John and Janet Foster
19-Jun	26	900	1045	1.8	BW, MEG, SB	banding at N2

19-Jun	27	1000	1045	0.75	JM	HOWA 28
20-Jun	28	900	1115	2.25	JM	HOWA 28, HOWA 29
21-Jun	29	630	1130	5	BW	on bike past HOWA 10, HOWA 16, HOWA 15, HOWA 14 found N11, HOWA 17, HOWA 5, HOWA 4, HOWA 18, HOWA 22, HOWA 19,
21-Jun	30	1600	1745	1.75	BW, MEG	banding at N11, checked N3
22-Jun	31	700	1045	3.75	BW	on bike; HOWA 16, HOWA 2, HOWA 20, HOWA 18, HOWA 22, HOWA ?, HOWA 24, HOWA 25
22-Jun	32	745	850	1	BP	south of Hwy 24
23-Jun	33	630	1130	5	BW	on bike; HOWA 16, HOWA 31, HOWA 2, HOWA 19, HOWA 23, found N13, HOWA 22, HOWA 18, HOWA 4, HOWA 6, HOWA 14, HOWA 15, HOWA 1
23-Jun	34	630	1045	4.25	HM	HOWA 29, HOWA 47, HOWA 24, HOWA 13
23-Jun	35	745	1015	2.5	JM	HOWA 40 (N14 found)
24-Jun	36	630	1100	4.5	HM	south of Hwy 24 and north of the office
24-Jun	37	635	1145	5.1	BW	on bike; HOWA 16, HOWA 1, HOWA 3, HOWA 4, HOWA 49 found N.15, HOWA 26, HOWA 33,
25-Jun	38	630	1100	4.5	BW	south of Hwy 24 - HOWA 35, HOWA 29, HOWA 32,
25-Jun	39	1310	1500	1.8	BW, MEG	HOWA 30 found N17, HOWA 4, HOWA 23
28-Jun	40	645	1100	4.25	BW	on bike; HOWA 16, HOWA 3, HOWA 27, HOWA 17, HOWA 30, HOWA 5, HOWA 47, HOWA 49, HOWA 33, HOWA 29
29-Jun	41	715	1135	4.3	BW	South of 24; HOWA 35, HOWA 28, HOWA 18, HOWA 22, HOWA 19, HOWA 17, HOWA 3
29-Jun	42	815	900	0.75	JM	section west of Manester
30-Jun	43	650	1145	5	BW	South of 24; HOWA 35, HOWA 32 found N18, HOWA 20, HOWA 14, HOWA 3, HOWA 15, HOWA 16, HOWA 29
30-Jun	44	730	1100	3.5	HM	Central area north of sand road (where "gap" in hoodies exists)
30-Jun	45	930	1030	1	JM	?
30-Jun	46	1500	1645	1.75	BW, MEG	banded at N. 18
01-Jul	47	915	1235	3.1	BW	HOWA 3, HOWA 14, HOWA 6, HOWA 18, HOWA 22, HOWA 19, HOWA 47,
02-Jul	48			1	MEG, PC	checked N12, N10
05-Jul	49	720	1115	4	BW, SR, HV	HOWA 1, HOWA 16, HOWA 14, HOWA 6, HOWA 30, HOWA 22
06-Jul	50	700	1050	3.8	BW	HOWA 35, HOWA 29, HOWA 6, found N19, HOWA 49, HOWA 14, HOWA 3
06-Jul	51	700	1035	3.5	SR, HV	Northeast sector; HOWA 1, HOWA 11, HOWA 31, HOWA 14
06-Jul	52	1350	1405	0.25	BW, PC	banded chicks at N6
07-Jul	53	655	1130	4.5	SR, HV	East sector; HOWA 11, HOWA 31, HOWA 36, HOWA 16, HOWA 14,
07-Jul	54	700	1130	4.5	BW	HOWA 29, HOWA 33, HOWA 32, HOWA 37, HOWA 38,
07-Jul	55	700	1100	4	HM	HOWA 35, HOWA 28, HOWA 13
08-Jul	56	700	1100	4	SR, HV	HOWA 14, HOWA 43, HOWA 20, HOWA 18, HOWA 17, HOWA 30
08-Jul	57	700	1000	3	HM	area north of HOWA 14. Found HOWA 41.
08-Jul	58	715	1055	3.6	BW	on bike; HOWA 16, HOWA 3, HOWA 36, HOWA 31, HOWA 2, HOWA 39,
08-Jul	59	1300	1550	2.8	BW, SR, HV	banded at N17 and N 6

09-Jul	60	655	715	1.3	BW	HOWA 43
11-Jul	61	2010	2020	0.2	SR, HV	HOWA 42
12-Jul	62	700	1100	4	BW	HOWA 43, HOWA 6 Found N20, HOWA 41,
12-Jul	63	830	1100	2.5	SR, HV	Far northeast area, north of headquarters
13-Jul	64	700	1200	5	SR, HV	HOWA 43, HOWA 42, HOWA 33, HOWA 21, HOWA 24 Found N21, HOWA 25, HOWA 12
14-Jul	65	645	930	2.75	SR, HV	western sector on sand road
14-Jul	66	700	1100	4	HM	southwest corner, and northcentral area
14-Jul	67	1300	1600	3	BW, JM, SR,HV	habitat measures for N11 and N1
15-Jul	68	645	1330	6.75	BW, SR, HV	HOWA 43, HOWA 42 found N.22, HOWA23, HOWA 22, HOWA 18, HOWA 4, HOWA 30
15-Jul	69	650	1050	4	HM	HOWA 16, HOWA 14, HOWA 20, HOWA 17, HOWA 6
16-Jul	70	815	1215	4	BW, SR, HV	habitat measures for N4, N12, N5, N3, N15, found N23
16-Jul	71	1530	1545	0.25	BW	checked N20
18-Jul	72	1400	1530	1.5	BW, MEG, SR, HV	Banding at N23
19-Jul	73	650	1200	5.1	BW, SR, HV	habitat measures for N18, N14, N8, N9, N22, N1
21-Jul	74	710	1110	4	HM	HOWA 14, HOWA 4, HOWA 5, HOWA 17, HOWA 6
21-Jul	75	715	815	1	BW	HOWA 24, HOWA 6
25-Jul	76	640	900	2.3	SR, HV	HOWA 37, HOWA 38
26-Jul	77	630	1200	5.5	BW, SR, HV	HOWA 16, HOWA 14, HOWA 6, HOWA 44, HOWA 24, HOWA 6
29-Jul	78	1200	1700	5	BW, SR, HV	habitat measures, nest check at N24
30-Jul	79	840	1200	3.2	BW, SR, HV	HOWA 41, various habitat measures
09-Aug	80			0.2	SR, HV	various habitat measures; check N24
10-Aug	81	1300	1400	1	BW, SR, HV	HOWA 35, HOWA 45 (Ben's)
13-Aug	82	1530	1600	0.5	BW, SR, HV, MEG	N24 banding

Appendix B. Date, territory visited, and breeding evidence observed, for field work carried out in St. Williams in 1999. (Breeding evidence: SH = species observed in suitable nesting habitat; SM = singing male; P = pair observed in suitable nesting habitat; D = courtship or display behaviour; A = agitated behaviour of anxiety calls of adult; N = nest building; NU = used nest or egg shells found; FY = recently fledged young or downy young; AE = adults leaving or entering nest or sitting on nest; FS = adults seen carrying food for young, or faecal sac; NE = nest with eggs; NY = nest with young)

Date	Territory	Breeding evidence	Comments
27-May	HOWA 1	SM	singing north of sand road
27-May	HOWA 2	SM	singing in far NE corner
27-May	CERW 1	SM	singing in far NE corner near HOWA2
27-May	RBWO1	SM	calling in far NE corner near HOWA2
27-May	HOWA 3	SM	singing at north edge of sand road
27-May	HOWA 4	SM	singing with HOWA 5
27-May	HOWA 5	SM	singing with HOWA 4
27-May	HOWA 6	SM	singing near flag of 1998-H1
28-May	HOWA 7	SM	singing near flag of 1998-H4
28-May	HOWA 8	SM	singing west of HOWA 7
28-May	HOWA 9	SM	singing
28-May	HOWA 1	SM	singing near sand road
29-May	HOWA 28	SM	male definitely unbanded
29-May	HOWA 12	SM	
29-May	HOWA 25	A	SM male and agitated ASY female
29-May	HOWA 24	A	agitated female
04-Jun	HOWA 10	SM	singing frequently
04-Jun	HOWA 1	SM	singing frequently
04-Jun	HOWA 11	SM	singing
04-Jun	CERW 1	SM	
04-Jun	HOWA 3	SM	
04-Jun	HOWA 12	SM	
04-Jun	HOWA 13	SM	
06-Jun	HOWA 2	NE	MEG and PC found = N1
06-Jun	HOWA 1	NE	MEG and PC found = N2
06-Jun	HOWA 14	SM	PC found
06-Jun	HOWA 25	NE	MEG and PC found = N3
6-Jun	HOWA 24		nothing
6-Jun	HOWA 9	SM	
07-Jun	HOWA 2		nest check; N1 has 3 H, 1 C eggs
07-Jun	HOWA 1		nest check; N2 has 3 H, 1 C eggs; female UB
07-Jun	HOWA 47	NE	N4, 1 H egg

07-Jun	HOWA 24	NE	N5, ASY female incubating
07-Jun	HOWA 25		nest check; 2 H, 1 C egg
08-Jun	HOWA 10		No male or female detected
08-Jun	BTBW 1	SM	singing near flag of 1998-H14
08-Jun	HOWA 3		male singing near N1
08-Jun	HOWA 6		male singing repeat mode, ranged widely. No female detected
08-Jun	HOWA 17	SM	
08-Jun	HOWA 19	SM	may have heard a female too
08-Jun	HOWA 20	SM	male singing right at sand road
08-Jun	HOWA 47	nest check	N4 no action; male singing nearby, no sign of female
08-Jun	HOWA 3	nest check	N1 female incubating. Male singing to the east
08-Jun	HOWA 16		no action
08-Jun	HOWA 45	SM	Ben found singing male
09-Jun	HOWA 15		no action
09-Jun	HOWA 16	SM	male singing regularly in repeat mode
09-Jun	HOWA 14	SM	male singing in repeat mode; also gave some "quiet" and "partial" songs. No female detected
09-Jun	HOWA 9	SM	male singing regularly
09-Jun	HOWA 21	SM	male singing a lot. No female detected
09-Jun	HOWA 47	nest check	N 4 no action
09-Jun	HOWA 24	nest check	N 5 female incubating
09-Jun	HOWA 12	SM	male singing
12-Jun	HOWA 18	D	Followed SY female; saw male try to copulate but female shook him off
12-Jun	HOWA 22	N	Saw UB-ASY female building a nest
12-Jun	HOWA 19	P	male singing; saw female zip into underbrush; no nest found
12-Jun	HOWA 23	P	chased chipping female; no nest found
12-Jun	HOWA 47	nest check	N4 - 1 hooded, 1 cowbird egg
12-Jun	HOWA 24	nest check	N5 - female incubating
12-Jun	HOWA 3	nest check	N1 - female incubating
12-Jun	HOWA 1	nest check	N2 - female incubating
12-Jun	HOWA 24	NE	female incubating N5
12-Jun	HOWA 36	SM	unbanded male
12-Jun	HOWA 27	SM	
12-Jun	HOWA 4	NE	Found N. 7. Female on 1 BHCO and 1 HOWA egg; male sing reverse song
13-Jun	HOWA-UNG	N	Unger's Corners N16; female bldg nest
14-Jun	HOWA 29	SM	male singing regularly in repeat mode
14-Jun	HOWA 21	SM	male singing
14-Jun	HOWA 27	SM	
14-Jun	HOWA 22	nest check	N6 - still being built
14-Jun	HOWA 47	nest check	N4 - 1 hooded, 1 cowbird egg

14-Jun	HOWA 24	nest check	N5 - 3 young, 1-2 days. Female UB ASY
14-Jun	HOWA 25	nest check	N3 - 1 cowbird, 2 hooded eggs
15-Jun	HOWA 17	SM	male gave one song, followed by several quiet songs a few minutes later
15-Jun	HOWA 5	SM	countersinging with HOWA 17
15-Jun	HOWA 22	nest check	N6 has 1 hooded egg. Male singing nearby, female chipping nearby.
15-Jun	HOWA 19	SM	male singing as I arrived
15-Jun	HOWA 23	SM	male singing a lot
15-Jun	HOWA 4	nest check	nest found by JM on 12 June; ASY female incubating
15-Jun	HOWA 24	nest check	female brooding
15-Jun	HOWA 25	SM	male singing near N3
15-Jun	HOWA 12	SM	male singing frequently in repeat mode near flag. Followed for 20 min but saw no female. Did not see his legs
15-Jun	HOWA 47	nest check	N4 - no adults around.
15-Jun	HOWA 20		no singing during brief stop
15-Jun	HOWA 14		no singing during brief stop
15-Jun	HOWA 16	SH	heard female chipping east of path; followed her feeding for 7 min then lost her. ASY UB
15-Jun	HOWA 3	nest check	N1 - female on nest
15-Jun	HOWA 1	nest check	N2 - 3 hooded, 1 cowbird chicks, 1-2 days old
15-Jun	HOWA 2	NE	male singing mixed mode; male is UB. Female is UB SY. Nest had 4 hooded, 2 cowbird eggs
15-Jun	RBWO1	SM	calling
15-Jun	HOWA 45	SM	Found Chestnut-sided Warbler nest
16-Jun	HOWA 10		nothing
16-Jun	HOWA 16	SH	heard some chips to north and west - did not see bird
16-Jun	HOWA 3	nest check	N1 - female incubating
16-Jun	HOWA 14		nothing
16-Jun	HOWA 26	NY	followed chipping pair to nest with 1 cowbird, 2 hooded chicks 4-5 days old. Both adults UB, female ASY
17-Jun	HOWA 18	NE	followed chipping female SY UB to nest. Female incubating
17-Jun	HOWA 22	nest check	N6 - female incubating
17-Jun	HOWA 19	SM	male singing repeat mode, regular songs, many perches
17-Jun	HOWA 27	A	male (UB) and female (UB SY) probably feeding fledglings. Heard fledglings; didn't see young or food in parents' bills but behaviour really suggested fledglings
17-Jun	HOWA 6	SM	male singing
17-Jun	HOWA 47	nest check	N4 - eggs cold. Chased chipping female W of N4. Probably incubating eggs somewhere
17-Jun	HOWA 24	nest check	N5 - nest empty, no damage to nest
17-Jun	HOWA 25	nest check	N3 - 1 cowbird, 2 hooded chicks, 1-2 days old. Female brooding
17-Jun	HOWA 26	banding	banding at N9 - caught male and female; second male hanging around. Banded 2 hooded babies, put cowbird baby back in nest.
18-Jun	HOWA 10		nothing
18-Jun	HOWA 16	SH	chased around female on east side of path again; she is sneaky and very quiet
18-Jun	HOWA 3	nest check	nest empty - depredated. Nest not damaged

18-Jun	HOWA 14	SH	heard chipping east of flag on south side of road; could be male or female; did not see
18-Jun	HOWA 27	FS	still lots of chipping; saw female with food briefly but still did not see fledglings
18-Jun	HOWA 4	nest check	N 7 - female on nest, male singing nearby
18-Jun	HOWA 47	SH	Saw female - UB ASY, very dark, like a male. She foraged near AB nest then to the west, then flew far to east. Did not find nest
18-Jun	HOWA 2	nest check	N 8 - female incubating
18-Jun	HOWA 1	nest check	planned to band at N2 but young too small; only 3 days
18-Jun	HOWA 28		no sign of male
19-Jun	HOWA 1	banding	banded at N2; banded male and female and 3 chicks (released cowbird chick); second male came to investigate
19-Jun	HOWA 28	SM	male is singing away
20-Jun	HOWA 28		not singing today
20-Jun	HOWA 29	SM	
20-Jun	BTBW 2	SM	this is the bird just north of Hwy 24
21-Jun	HOWA 15	FY	found male (UB) and female (UB ASY) feeding fledglings near edge of forest at meadow. One chick for sure
21-Jun	HOWA 16		nothing
21-Jun	BTBW 1	SM	singing in forest north of meadow - diff location than previously but probably same bird
21-Jun	HOWA 48	NY	found N11, with four hooded babies about 8 days old. Female is banded: silver/yellow on left, orange/green on right. Light ASY female
21-Jun	HOWA 17	FY	found female UB ASY feeding at least one fledgling 12-15 days old
21-Jun	HOWA 5	FY	found female feeding at least two fledglings (heard not seen); female is UB ASY with dark chin
21-Jun	HOWA 4	nest check	N7 - female incubating, male singing nearby
21-Jun	HOWA 18	nest check	N10 - four hooded eggs, warm
21-Jun	HOWA 22	nest check	N6 - female incubating, 4 hooded eggs
21-Jun	HOWA 19	SM	male chips before every song; UB. No sign of female after 30 min. wait
21-Jun	HOWA 48	banding	banded at N11, female stayed very close.
21-Jun	HOWA 25	nest check	nest empty; depredated
22-Jun	HOWA 16	SM	
22-Jun	BTBW 1	SM	male heard and seen; singing frequently in repeat mode
22-Jun	HOWA 2	nest check	N 8; 1 cowbird, 2 hooded chicks, 1-2 days
22-Jun	HOWA 20	SM	male singing regularly in repeat mode
22-Jun	HOWA 18	nest check	N10, female incubating
22-Jun	HOWA 22	nest check	N6 female incubating
22-Jun	HOWA 47	NE	renest of N4; called it N12. Three hooded, 2 cowbird eggs. Female incubating
22-Jun	HOWA 45		nothing
23-Jun	HOWA 16	SM	male singing repeat mode
23-Jun	BTBW 1	SM	male singing in the distance, to the N
23-Jun	HOWA 31	SM	new male, singing regularly in repeat mode
23-Jun	HOWA 2	SM	singing in mixed mode
23-Jun	CERW 1	SM	

23-Jun	HOWA 19	SM	
23-Jun	HOWA 23	NY	found nest with 3 hooded chicks, about 3 days old = N13. Female feeding chicks, male singing nearby
23-Jun	HOWA 4	nest check	N7 female incubating
23-Jun	HOWA 6	SM	
23-Jun	HOWA 48	P	male singing to the west. Can hear female or chicks nearby
23-Jun	HOWA 15	SM	male singing at NE corner of meadow (and north of sand road, slightly east into forest) UB
23-Jun	HOWA 1	FY	male and female feeding fledglings
23-Jun	HOWA 40	NY	banding at N14 (Jon found this morning). Caught and banded female and young. Male is already banded.
23-Jun	HOWA 29	SM	
23-Jun	HOWA 47	P	male singing, female chipping nearby
23-Jun	HOWA 24	P	male singing, female chipping nearby; could not find nest
23-Jun	HOWA 13	P	male seen singing, female heard chipping but not seen, and no nest found
23-Jun	HOWA 40	NY	found N14; 1 BHCO yg and 1 HOWA yg; female unbanded; male appears to be banded
24-Jun	HOWA 16		nothing
24-Jun	HOWA 1	SM	countersinging with HOWA 3
24-Jun	HOWA 3	SM	countersinging with HOWA 1
24-Jun	HOWA 4	nest check	N7 young hatched, 2-3 days old, 1 cowbird 1 hooded chick
24-Jun	HOWA 49	N	nest being built; called it N15
24-Jun	HOWA 26	SH	can hear chipping far north of the nest
24-Jun	HOWA 33	SM	new male, singing regularly in swampy clearing, repeat mode
24-Jun	HOWA 48	FY	N11 banded female feeding fledged young far south of nest
24-Jun	HOWA 35	SM	Hugh found new male south of Hwy 24
24-Jun	LOWA 1	SM	Hugh found singing male south of Hwy 24
25-Jun	HOWA 35	P	Male singing a lot from various perches; female UB-SY feeding and chipping; male chased female. No nest found after 1 hour of watching/searching
25-Jun	HOWA 29	SM	
25-Jun	BTBW 2	SM	
25-Jun	HOWA 32	SM	male singing south of road; charles found this bird
25-Jun	HOWA 37	P	male singing to the east of HOWA 32. Female seen briefly
25-Jun	HOWA 30	NE	found N17 with 4 hooded eggs. Female UB ASY
25-Jun	HOWA 4	nest check	N4 - 1 small hooded chick; cowbird chick depredated?
25-Jun	HOWA 23	nest check	N13 - chicks 6-7 days old
25-Jun	HOWA 18	nest check	N10 female incubating
25-Jun	BTBW 3	SM	near N13
28-Jun	HOWA 16	SM	no female detected after 30 min
28-Jun	HOWA 3	SH	chipping female; probably incubating second nest
28-Jun	HOWA 27		nothing
28-Jun	HOWA 17		nothing
28-Jun	HOWA 30	nest check	N17, 4 hooded eggs, female not around

28-Jun	HOWA 5	SM	Male singing very regularly
28-Jun	HOWA 47	nest check	female incubating, male singing mixed mode nearby
28-Jun	HOWA 49	nest check	N15 has 1 cowbird, 1 hooded egg
28-Jun	HOWA 33	SM	
28-Jun	HOWA 29		nothing
29-Jun	HOWA 35		nothing
29-Jun	HOWA 28		nothing
29-Jun	HOWA 29		nothing
29-Jun	HOWA 18	nest check	N 10 has 4 hooded chicks, 2 days old
29-Jun	HOWA 22	nest check	N6 female incubating
29-Jun	HOWA 19	P	heard faint chips as I entered woods, male began singing in mixed mode, may have heard 2-3 birds chipping
29-Jun	HOWA 17	SH	nothing found after 15 min
29-Jun	HOWA 3	SM	
30-Jun	HOWA 35	SH	heard a single hooded chip but nothing else
30-Jun	HOWA 32	NY	N18 found with 3 hooded chicks, about 4 days old. Both parents UB, female SY
30-Jun	HOWA 20		nothing
30-Jun	HOWA 14		nothing
30-Jun	HOWA 3	SM	
30-Jun	HOWA 16	SM	male singing in repeat mode
30-Jun	HOWA 35		nothing
30-Jun	HOWA 29	SM	heard male sing 3-4 times and heard a number of chips but could not pinpoint anything
30-Jun	BTBW 2	SM	
30-Jun	HOWA 32	banding	banded at N18 - both adults, 3 young
01-Jul	HOWA 3		nothing
01-Jul	HOWA 14	SM	male sang a few times; saw barred owl. Heard chipping for about 20 seconds but found no female or nest
01-Jul	HOWA 46	SH	heard chipping just north of sand road near flag for 1998-H9.
01-Jul	HOWA 18	nest check	N10 female brooding
01-Jul	HOWA 22	nest check	N6 female brooding - four chicks, 1 day old
01-Jul	HOWA 19	SM	male singing, but no sign of female after 10 min
01-Jul	HOWA 47	nest check	N12 has two cowbird babies. Used to have 3 hooded, 2 cowbird eggs.
02-Jul	HOWA 18	nest check	N10 had one 5-6 day old young dead. Its wings were raised over head in fixed position - possible injury.
02-Jul	HOWA 47	banding	banded adults at N12. Only 2 cowbird chicks remained
05-Jul	HOWA 3	P	heard male singing to the north, female chipping east of first nest site
05-Jul	HOWA 16		nothing
05-Jul	HOWA 14		nothing
05-Jul	HOWA 20		nothing
05-Jul	HOWA 5	P	Saw female - UB
05-Jul	HOWA 30	nest check	N17 has chicks 1-2 days old
05-Jul	HOWA 22	nest check	N6 has 4 chicks, 5 days old

06-Jul	HOWA 35		played tape; no response
06-Jul	HOWA 29	SM	played tape; male came in - he is UB. Heard no female
06-Jul	BTBW 2	SM	
06-Jul	HOWA 46	N	found N19, empty. Female UB SY, male banded. This is the male from N12 banded a few days ago.
06-Jul	HOWA 49	nest check	N15 has 2 cowbird eggs, no hooded eggs. Eggs are cold. Nest is abandoned
06-Jul	HOWA 14		played tape; no response
06-Jul	HOWA 3	SM	
06-Jul	HOWA 22	banding	banded chicks at N6. Weather threatening rain so didn't do adults
06-Jul	HOWA 1		played tape; no response
06-Jul	HOWA 11		played tape; no response
06-Jul	HOWA 31		played tape; no response
06-Jul	HOWA 36	SM	played tape; heard some singing
07-Jul	HOWA 11		nothing
07-Jul	HOWA 31		nothing
07-Jul	HOWA 36	SM	played tape; saw male - UB. No female seen or heard
07-Jul	HOWA 16		nothing
07-Jul	HOWA 14		played tape; no response
07-Jul	HOWA 29	FY	saw female UB ASY feeding fledgling, about 15 days old.
07-Jul	BTBW 2	SM	
07-Jul	HOWA 33	SM	played tape; male responded. He is UB. No female detected
07-Jul	HOWA 32	P	Male singing, female chipping. Feeding fledglings
07-Jul	HOWA 37	FY	new male; saw big fledgling
07-Jul	HOWA 38	FY	new pair; saw silver band on female. At least one fledgling, not banded
07-Jul	HOWA 35		nothing
07-Jul	HOWA 28		nothing
07-Jul	HOWA 13	FY	confirmed male is UB, saw one fledgling
08-Jul	HOWA 14		nothing
08-Jul	HOWA 43	P	Heard female chipping; played tape and banded male came in. Female is UB ASY
08-Jul	HOWA 20		nothing
08-Jul	HOWA 18		saw male, UB
08-Jul	HOWA 17	SH	heard single chip but nothing else
08-Jul	HOWA 16	FY	played tape; male responded. He is UB. Also found a female! She is UB SY. Was feeding 2-3 fledglings, heard not seen. Note that this female is SY, while other female that I've called HOWA 16 is ASY. Perhaps this male has two females?
08-Jul	HOWA 3	SM	
08-Jul	HOWA 36	SM	played tape; male sang. He is UB. Heard 3-4 chips but did not see female
08-Jul	HOWA 31		nothing
08-Jul	HOWA 2		nothing
08-Jul	CERW 1	SM	
08-Jul	HOWA 39	SM	male singing regularly, lots of perches. Appears unmated

08-Jul	HOWA 41	A	Hugh found this new pair. Male is UB. Female was agitated and furtive - probably a nest nearby
08-Jul	HOWA 30	banding	N 17 banded male and 1 young (7-8 days old).
08-Jul	HOWA 22	banding	N 6 banded both adults.
09-Jul	HOWA 43		played tape; no response. Rainy and cool.
11-Jul	HOWA 42		played tape; no response
12-Jul	HOWA 43		played tape; male responded. He is banded
12-Jul	HOWA 46	NE	Found N20 with 3 hooded eggs. Male singing in the distance
12-Jul	HOWA 41		played tape; banded male from N14 responded. Banded female also around with fledglings
12-Jul	HOWA 40	FY	male and female feeding fledglings
13-Jul	HOWA 43	SM	played tape; male responded. Confirmed bands
13-Jul	HOWA 42	FS	UB SY female seen carrying food
13-Jul	HOWA 33		nothing
13-Jul	HOWA 21	P	UB ASY female seen. UB male also seen
13-Jul	HOWA 24	NE	heard female chipping; UB male seen. UB SY female also seen. But then, another female seen nearby - UB ASY. Found N21, with 3 hooded, 2 cowbird eggs
13-Jul	HOWA 12	SH	heard chipping but did not find bird
13-Jul	HOWA 25		played tape; no response
14-Jul	HOWA 3	FY	habitat measurements at N1. Heard male singing, saw one fledgling, heard more
14-Jul	HOWA 14		habitat measurements at N11
14-Jul	HOWA 47?	SM	Banded male seen. SR said bands are y/s on left, y on right, but not sure. I think this is probably the male banded at N12 (s/y on left, o/y on right).
15-Jul	HOWA 43		nothing
15-Jul	HOWA 42	FY	Found empty nest = N22. Also found female UB SY feeding at least two fledglings. Male also around. Young heard but not seen. Male also UB.
15-Jul	HOWA 23		habitat measures at N13. Heard male singing, and heard female and fledgling chips about 125 m east of nest site.
15-Jul	HOWA 22		habitat measures at N6. Heard male singing faintly. Heard strong chips to the west.
15-Jul	HOWA 18		habitat measures at N10.
15-Jul	HOWA 4		habitat measures at N7
15-Jul	HOWA 30		habitat measures at N17
15-Jul	HOWA 16		male and female heard
15-Jul	HOWA 14		nothing
15-Jul	HOWA 20		nothing
15-Jul	HOWA 17		nothing
15-Jul	HOWA 46		nothing
16-Jul	HOWA 47		habitat measures at N4
16-Jul	HOWA 47		habitat measures at N12
16-Jul	HOWA24		habitat measures at N5
16-Jul	HOWA 44	NY	new pair; found nest just east of N5. Called it N23. 3 hooded babies, about 6 days old. Female is SY UB. Male is UB
16-Jul	HOWA 25		habitat measures at N3

16-Jul	HOWA 49		habitat measures at N15.
16-Jul	HOWA 46	nest check	female incubating at N20
18-Jul	HOWA 44	banding	Banded three adults (two male, one female) at N23, and 3 nestlings.
18-Jul	HOWA 24	nest check	N21 female incubating (Scott and HV found this nest yesterday)
19-Jul	HOWA 32		habitat measures at N18. Male sang a few times, heard some chips but didn't see female
19-Jul	HOWA 40		habitat measures at N14. Male singing, female chipping
19-Jul	HOWA 2		habitat measures for N8
19-Jul	HOWA 26		habitat measures for N9. Saw female and male on way back to path, both very agitated. Heard chicks chipping. Probably second brood
19-Jul	HOWA 42		habitat measures for N22. No hoodies around
19-Jul	HOWA 3		habitat measures for N1. All is quiet
21-Jul	HOWA 14	SM	male singing, could not see legs
21-Jul	HOWA 4		nothing
21-Jul	HOWA 5		nothing
21-Jul	HOWA 17		nothing
21-Jul	HOWA 46	SM	male singing, could not see legs
21-Jul	HOWA 24	nest check	N21 has been knocked to the ground. Support stem is bent right over. Can hear a hoodie chipping nearby.
25-Jul	HOWA 32	FY	Found male, female and one banded fledgling from N18
25-Jul	HOWA 37	NE	Heard male singing, male is UB. Also saw UB female. Found N24 in middle of trail; 1 hooded egg.
26-Jul	HOWA 16	SM	played tape; male responded, followed chips but didn't see female
26-Jul	HOWA 14	FY	played tape; male responded. This male is UB, therefore NOT male from N11 (traditionally called HOWA 14). Also think I heard fledglings
26-Jul	HOWA 46	nest check	N20 - eggs are cold - abandoned. All three eggs infertile (checked)
26-Jul	HOWA 44		habitat measures at N23
26-Jul	HOWA 24		habitat measures at N21
26-Jul	HOWA 46		habitat measures at N19 and N20
29-Jul	HOWA 37	nest check	N 24 has three hooded eggs; female incubating (had 1 egg on Monday)
30-Jul	HOWA 41	SH	Saw UB SY female, chipping a lot
09-Aug	HOWA 37	nest check	N24 has 3 chicks, about 2 days old
10-Aug	HOWA 35		nothing
10-Aug	HOWA 45	FY	heard male singing, fledglings and female heard chipping (more than two birds present chipping)
13-Aug	HOWA 37	banding	N24 - banded three young. Will try for adults later. (Need to check with MEG to see if she did this)