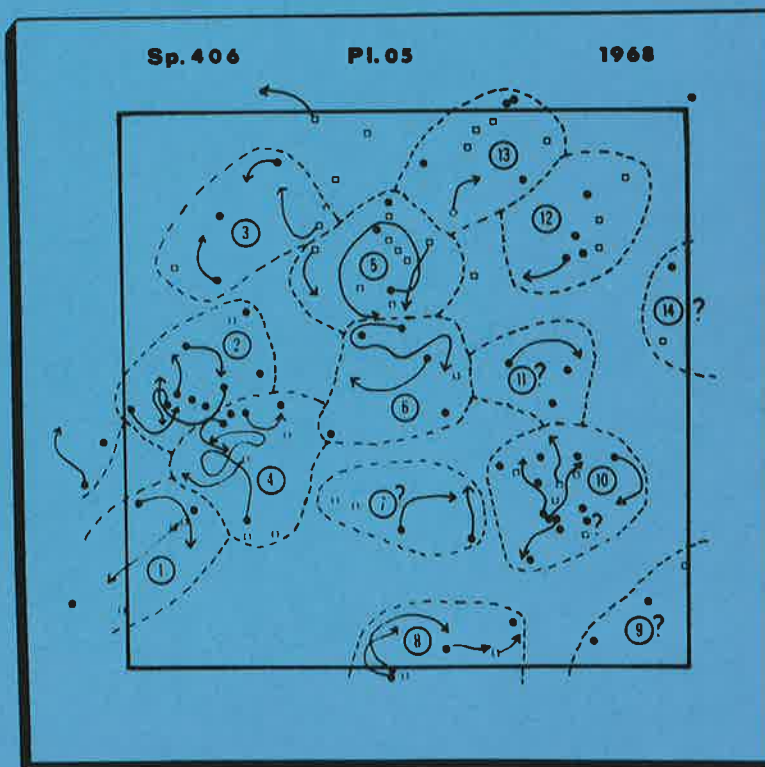




# BIRD POPULATIONS STUDIES

in the Swaine  
jack pine sawfly  
life system

J. M. McLEOD





BIRD POPULATIONS STUDIES  
IN THE SWAINE JACK PINE  
SAWFLY LIFE SYSTEM

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#### ABSTRACT

Population records for resident breeding birds in four jack pine stands in Quebec from 1964 to 1972 are presented. These include number of territories per 100 hectares, Shannon diversity indexes, and mean territory sizes in hectares for each of the species. Also included is a Fortran IV program, BIGBIRD, for summarising the data.

#### RESUME

Pour la période allant de 1964 à 1972, on présente ici les recensements des populations d'oiseaux résidant dans quatre peuplements de pin gris au Québec. Ceci inclut le nombre de territoires par 100 hectares, les indices de diversité de Shannon, et pour chacune des espèces, la superficie moyenne des territoires en hectares. On trouvera aussi un programme Fortran IV, BIGBIRD, calculant ces différentes valeurs.





## INTRODUCTION

This report presents the methodology and the data base for a 9-year study of breeding bird populations in jack pine *Pinus banksiana* Lamb. stands in Quebec between 1964 and 1972. Also presented is an outline of a Fortran IV computer program, BIGBIRD, for summarizing and analyzing the data.

The report is part of a larger study of the Swaine jack pine sawfly, *Neodiprion swainei* Middleton life system, and in line with previous Information Reports (McLeod, 1973; McLeod and Brochu, 1973; McLeod and Laguë, 1973), is intended to provide public accessibility to the data base, and to permit continuous updating and analysis. Both the source data and the computer program are available on request. An analysis of bird population trends and their relation to changes in numbers of the Swaine jack pine sawfly is in preparation.

## METHODS

The study was carried out in four 13-hectare study areas subdivided in 20 X 20 metre grids (McLeod, 1973) (Table 1).

The population estimates were made according to Kendeigh's (1947) singing male technique. Two observers, starting at opposite ends of the study areas made two consecutive observations each day, the first starting at dawn, and the second between 8:00 and 10:00 hours, for four or five consecutive days, usually during the last two weeks of June or the first week of July. The observers walked lines at 40 metre intervals, stopping every 20 metres to record the position of the singing or observed bird on maps. The direction of moving birds was also recorded. When nests were found during a census, their position and the number and stage of progeny was recorded.

Table 1. Study Areas Used in Breeding Bird Population Studies in Jack Pine Stands in Quebec.

Study Area Number	Latitude and Longitude	Age of Stand 1972	Site Class*	Number of Years of Observation
2	47°10' - 73°44'	70	3.1	1965-1972
3	48°22' - 72°28'	died 1967 at 50 years	2.6	1966
4	48°09' - 71°01'	50	2.0	1968-1972
5	47°16' - 73°37'	50	2.7	1964-1972

\* Site classes calculated from tables of Plonski (1960).

Following the census, base maps were prepared showing the position and size of territories of each species (Figs. 1 to 26). Doubtful territories, i.e. those in which the male was recorded less than three times, are indicated by a question mark. Nest positions are indicated by a star. The broken lines show the estimated limit of each territory. Each territory is assigned a number (shown circled).

Data for each territory are then entered on sampling forms according to instructions found in McLeod (1973), pages 63-72, and computer cards are prepared. The Fortran IV program entitled BIGBIRD is outlined in Appendix II. The output (Tables 3-12) is as follows:

1. For each plot-year, a frequency distribution of the number of territories per species, total number of territories, and an index of diversity is calculated.

Territories classified as doubtful are not included. To adjust for partial territories, the mean territory size of complete territories (A) for a particular species is compared with the partial territory (B), i.e. territories whose boundaries extend beyond the study areas. If (B) is less than one-half (A) it is rejected, and if equal to or greater than one-half (A) it is accepted as a complete territory.

If for a particular species, no complete territory has been recorded the territory size is compared with the average of all complete territories for all species and accepted or rejected as above. Any partial territory equal to or greater than one quarter of the total area of the study area is automatically accepted. In calculating species diversity, the Shannon index,  $\bar{H}$ , is used (Margalef, 1968). The index is calculated for each year.

2. The average territory size in tenth acre units and hectares, for complete territories only is presented, with standard errors of the means.

#### FREQUENCY OF OCCURRENCE OF BIRDS IN QUEBEC JACK PINE STANDS

The list gives frequencies of birds in jack pine stands (Table 2) whose territories were confirmed either within or adjacent to the study areas, as well as species recorded singing in or adjacent to the study areas but whose territories could not be determined. The summary gives the number of plot-years (total = 23) that a particular species occurred in these areas during the nine year study period.

A few species, notably the brown creeper, the blackburnian warbler, and the red-breasted nuthatch, appear regularly on the list but are absent or infrequent in the population records. The frequency of occurrence of these species would indicate that they are resident breeders in jack pine stands but the inconsistency in their singing combined (in the brown creeper and the red-breasted nuthatch) with their wide ranging in the jack pine stands precluded the obtention of reliable population estimates.

Other species on the list occur sporadically in the stands, or invade from other forest types. The peculiar records for waterbirds (black duck and green-winged teal) stem from the temporary inundation by a beaver dam of a portion of the northwest corner of study area 5. The black ducks were found wandering in the jack pine stands near the water's edge and the green-winged teal was flushed from a nest (no. of eggs = 15) some 20 metres from the water's edge. The next day on returning to the spot, both the bird and eggs were gone.

An additional record other than that obtained from the permanent study areas is worthy of note. A male connecticut warbler, *Oporornis agilis* was

confirmed in a jack pine stand near study area 2, on the afternoon of June 29, 1966. I was attracted by the intensity of the singing and the repeated phrases much like an oven bird but without the rising inflection at the end. I immediately began searching for the bird and was astounded by the distance I had to travel before making contact. When observed, the bird was perched on a dead branch at the base of a jack pine crown at a height of about 4 metres and singing. This is believed to be the most easterly record for this species. It had previously been reported in extreme western Quebec.

Table 2. Bird Species Recorded in Jack Pine Stands in Quebec, 1964-1972 Inclusive.

Species	Study Area and Year										No. of Plot-Years										
	2		3		4		5		Territory confirmed (c,r)*	Presence Indicated (x)**	Total										
	65	66	67	68	69	70	71	72	64	65	66	67	68	69	70	71	72	23	0	23	
Slate-coloured junco	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	23	0	23	
Hermit thrush	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	23	0	23	
White-throated sparrow	c	x	c	c	c	c	c	c	I	I	c	c	c	c	c	c	c	22	1	23	
Myrtle warbler	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	22	0	22	
Ruby-crowned kinglet	c	x	c	c	I	c	c	c	c	I	I	I	I	I	c	c	c	21	1	22	
Nashville warbler	I	c	I	c	I	x	I	I	c	x	I	c	c	I	I	x	x	18	3	21	
Olive-backed thrush	I	c	I	c	I	c	c	x	c	x	c	x	c	I	x	c	x	x	12	6	18

\* c = confirmed territory

r = partial territory (mapped but less than half of complete or average territory or outside boundaries of study area (if complete))

\*\* x = presence of bird indicated but territory not confirmed

Table 2 (Cont'd)

Species	Study Area and Year												No. of Plot-Years														
	2		3		4		5		6		7		Territory confirmed (c,r)*	Presence Indicated (x)**	Total												
	65	66	67	68	69	70	71	72	66	68	69	70	71	72	64	65	66	67	68	69	70	71	72				
Brown-capped chickadee	x	r				x	x	x	x	x	x	x	x	x										4	9	13	
Brown creeper	x	x	x	x		x	x		x	x	r	x		x	x									0	13	13	
Bay-breasted warbler	x		c			x	c	c	c	r	c	c	x	x										7	5	12	
American robin	x	x						c	c	c														5	6	11	
Blackburnian warbler	x					x	x	x	x	x														0	11	11	
Blue-headed vireo	x						c	r																8	2	10	
Red-eyed vireo																									4	5	9
Red-breasted nuthatch	x		x			x	x		x	x														0	9	9	
Tennessee warbler																									4	4	8

Table 2 (Cont'd)

Species	Study Area and Year												No. of Plot-Years							
	2	3			4			5			Territory confirmed (c,r)*	Presence Indicated (x)**	Total							
	65	66	67	68	69	70	71	72	64	65	66	67	68	69	70	71	72			
Purple finch	x		x			x	c	x		x				x				1	7	8
Evening grosbeak			x	x	x		x	x				x						0	8	8
Canada jay	x	x	x							x	x							0	8	8
Northern water thrush							x	c	x			r	r					3	4	7
Golden-crowned kinglet	x																	2	5	7
Chipping sparrow																		2	5	7
Rusty blackbird																		1	6	7
Yellow throat																		3	3	6

Table 2 (Cont'd)

Species	Study Area and Year										No. of Plot-Years		
	2	3	4	5							Territory confirmed (c,r)*	Presence Indicated (x)**	Total
	65 66 67 68 69 70 71 72	66 68 69 70 71 72	68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72	64 65 66 67 68 69 70 71 72			
Swamp sparrow		x	x x x x	x							0	6	6
Oven bird	x	x	x	r	x						1	5	6
Magnolia warbler		c	c x c c	c							4	1	5
Yellow-bellied flycatcher	x		x	x x c							1	4	5
Flicker	x	x	x	x							0	5	5
Arctic three-toed woodpecker	x		c	x							1	3	4
Black capped chickadee			x	r	x						1	3	4



Table 2 (Cont'd)

Species	Study Area and Year																No. of Plot-Years						
	65	66	67	68	69	70	71	72	3	4	5	64	65	66	67	68	69	70	71	72	Territory confirmed (c,r)*	Presence Indicated (x)**	Total
Pine siskin									x												1	3	4
Spruce grouse	x		x									x									0	4	4
Hairy woodpecker				x																	0	4	4
Cape May warbler							x														0	4	4
Alder flycatcher																					0	3	3
Cedar waxing																					0	3	3
Black duck																					0	2	2
Yellow bellied sapsucker																					0	2	2
Least flycatcher																					0	2	2

Table 2 (Cont'd)

	Study Area and Year												No. of Plot-Years		
	2	3	4	5	65	66	68	69	70	71	72	Territory confirmed (c,r)*	Presence Indicated (x)**	Total	
Mourning warbler										x		0	2	2	
Canada warbler			x									0	2	2	
American redstart									x			0	2	2	
Philadelphia vireo											x	0	2	2	
Bronzed grackle												0	2	2	
Green-winged teal												0	1	1	
Ruffed grouse												0	1	1	
Wood pewee												0	1	1	

Table 2 (Cont'd)

Species	Study Area and Year												No. of Plot-Years																
	2			3			4			5			Territory confirmed (c,r)*	Presence Indicated (x)**	Total														
	65	66	67	68	69	70	71	72	66	68	69	70	71	72	64	65	66	67	68	69	70	71	72						
Black throated green warbler															x										0	1	1		
Chestnut sided warbler																									x		0	1	1
Red wing																											0	1	1
Black and white warbler																											0	1	1

## NOTES AND TERRITORY MAPS FOR INDIVIDUAL SPECIES

1. Slate-Coloured Junco (Sp. 406) (Figs. 1, A.B.C.)

Mean No. of Breeding Male Territories per 100 Hectares:  $45.4 \pm 4.30$

Mean Territory Size:  $1.67 \pm .05$  acres (.67 hectares), N = 93

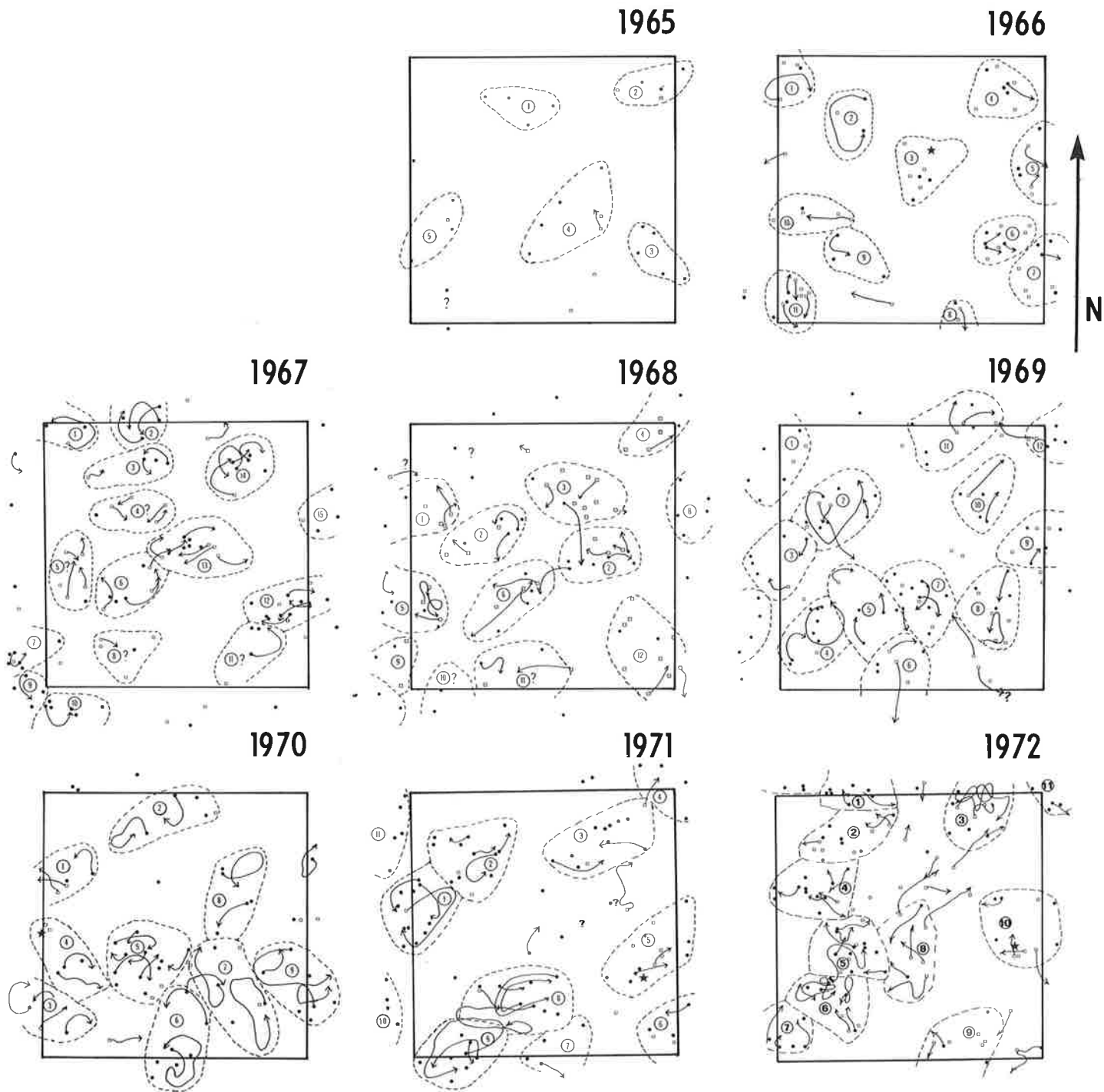
Remarks:

This is the typical bird of Quebec jack pine stands. It accounts for over half of the total number of territories. Its mean territory size is the smallest of all the jack pine birds. Its territories, scattered throughout the stands nevertheless show some odd clustering effects (cf. Fig. 1C) as though progeny of family groups may be concentrating in the same areas, the territories radiating outward from the parent territory in propitious years. Although this is the most abundant species, the territories do not fill all the available space in spite of the apparent uniformity of jack pine stands. The limiting factor may be nesting sites. Nests are found in depressions in the ground, often at the base of rotten stems or stumps covered with feather moss or reinder moss, or beneath fallen stems. They are extremely difficult to locate, and even when the bird is flushed almost from beneath the feet, the nest may not be found.

Juncos are strong singers and easily observed and so the territories are most reliably estimated. They sing at all levels in the tree crown but in the early morning are often observed posting at the top of the tallest jack pine trees within their territory. They forage at all levels but are most often observed at or near the ground.

# 1A. SLATE-COLOURED JUNCO

## STUDY AREA 02



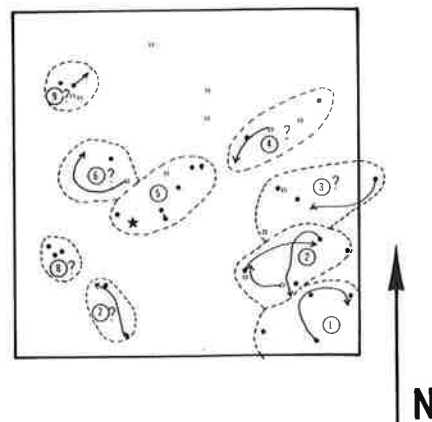
### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 1B. SLATE-COLOURED JUNCO

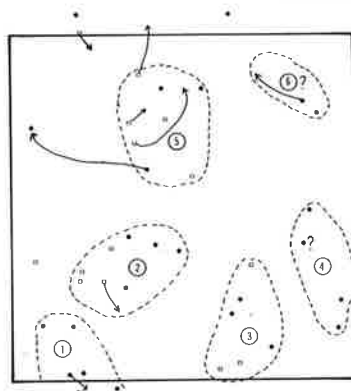
## STUDY AREA 03

1966

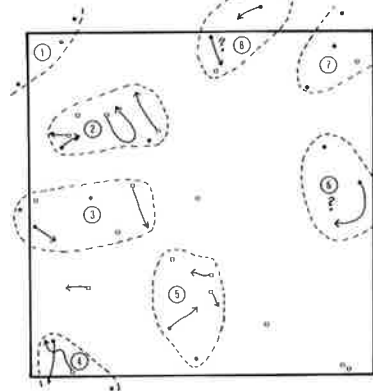


## STUDY AREA 04

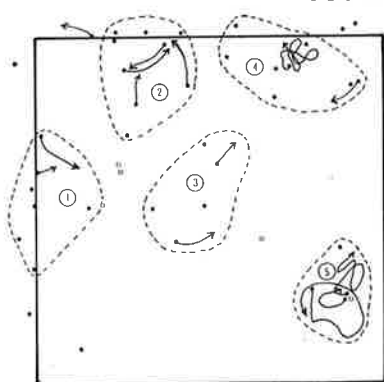
1968



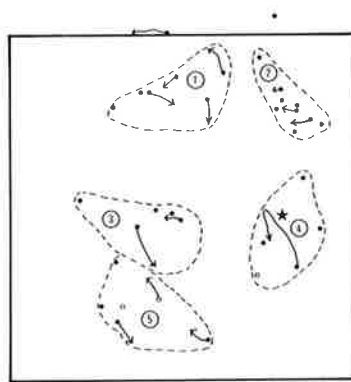
1969



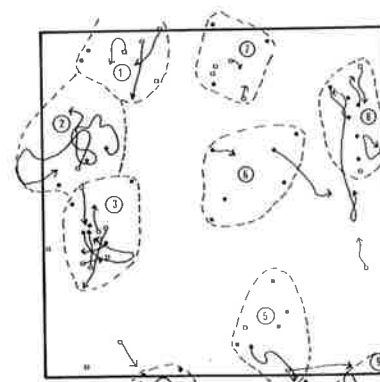
1970



1971



1972



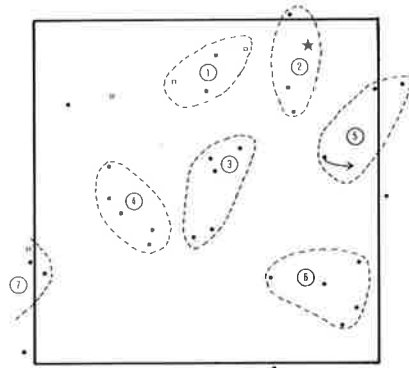
### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

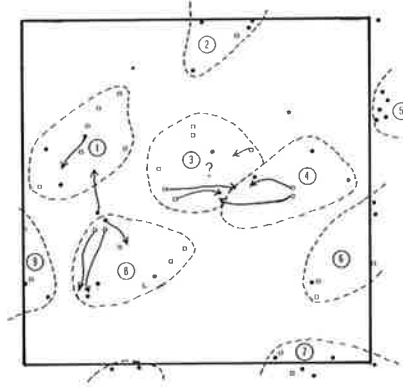
# 1C. SLATE-COLOURED JUNCO

## STUDY AREA 05

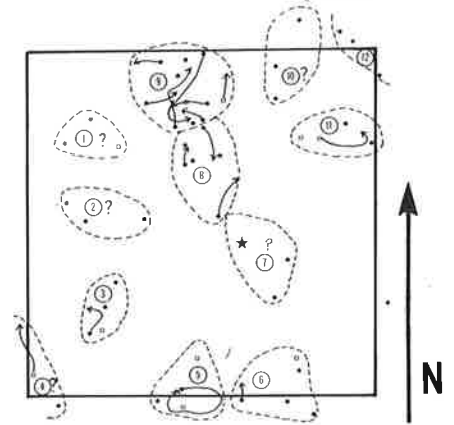
1964



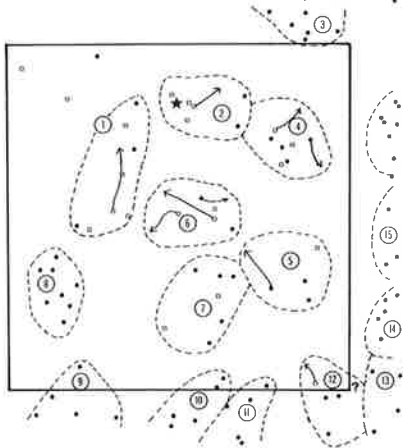
1965



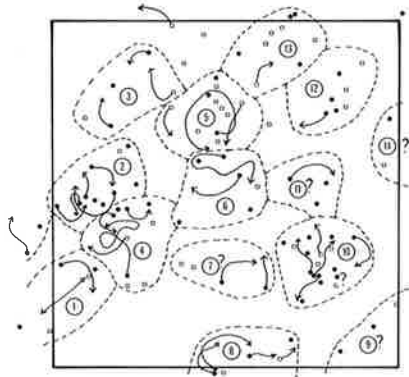
1966



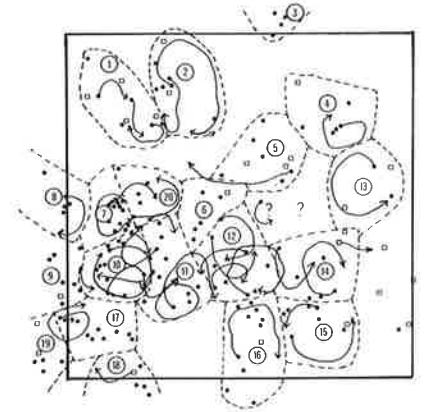
1967



1968



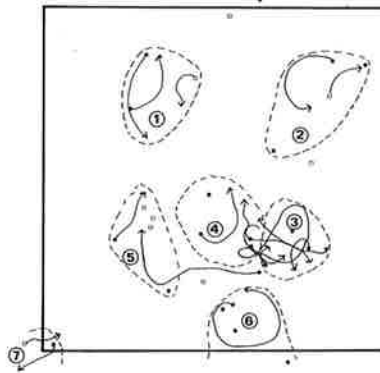
1969



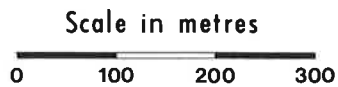
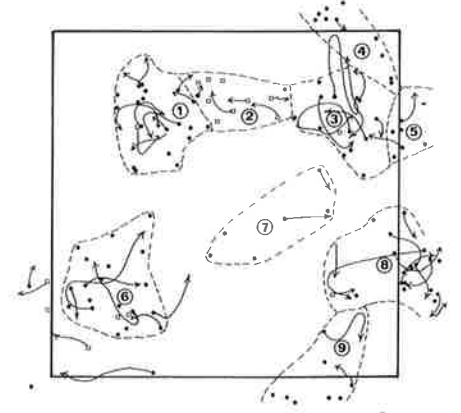
1970



1971



1972



### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

2. Hermit Thrush (Sp. 293) (Figs. 2 A,B,C,)

Mean No. of Breeding Males/100 Hect.:  $17.24 \pm 2.04$

Mean Territory Size:  $2.7 \pm .20$  acres (1.1 hectares), N = 26

Remarks:

This, the star performer of jack pine stands, is second to the junco in abundance. The absolute beauty of its song in the early morning hours goes a long way to compensate for the irritations of biting flies and fatigue, which are so much a part of census work in the boreal forest. The territories are fairly large, although variable in size, and show at first glance no recognizable distributional pattern.

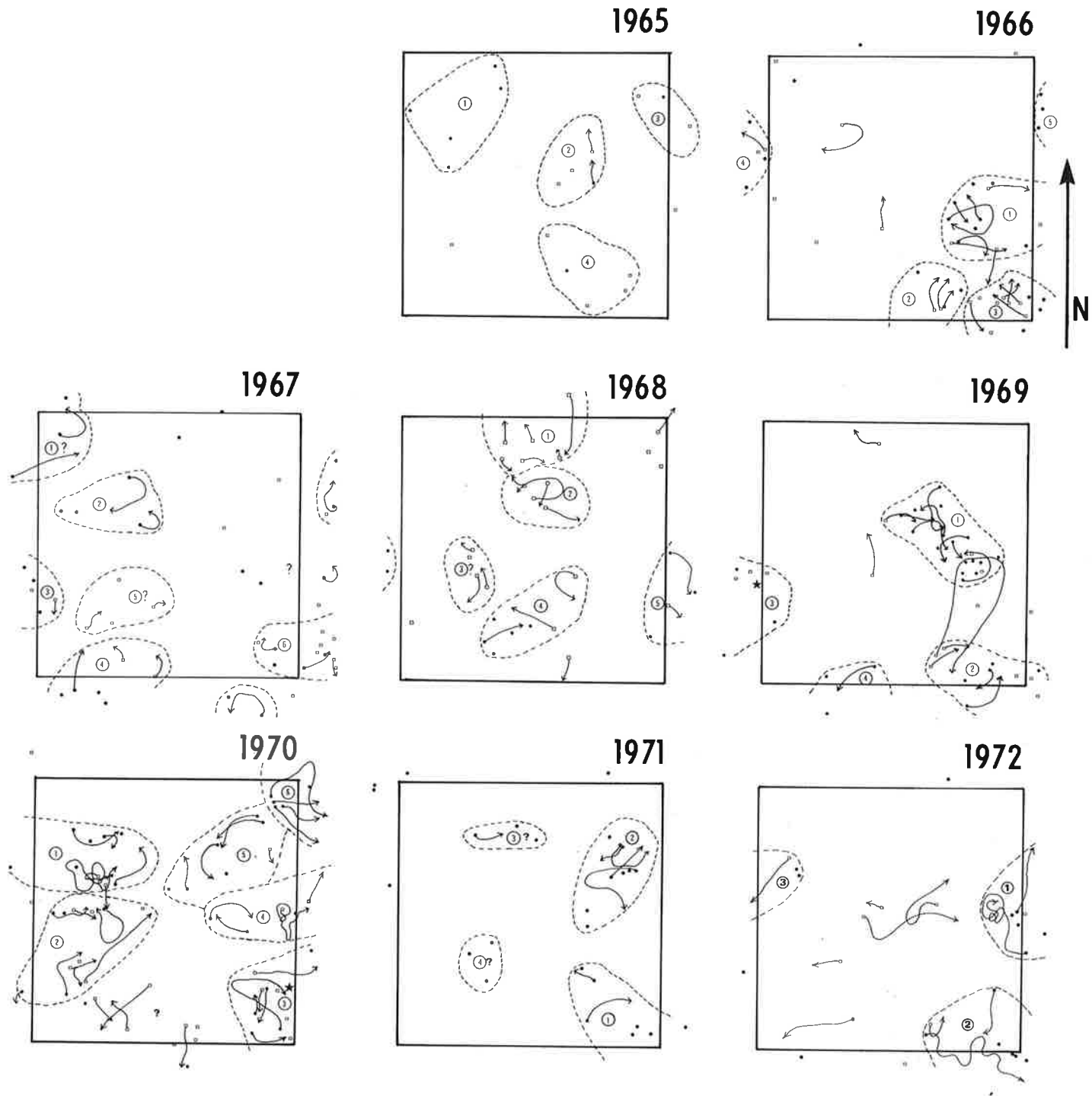
The hermit thrush does most of its singing at the base of jack pine crowns or in bushes. Only rarely is it seen posting at the top of trees. Foraging also is evenly divided between the ground cover and the crown bases. They are extremely combative, and frequent conflicts are observed at the borders of adjacent territories.

The nests are found in more or less the same sites as the junco, but are a slightly more exposed, and the blue eggs are most easily detected than the cryptically-coloured juncos eggs.



## 2A. HERMIT THRUSH

### STUDY AREA 02



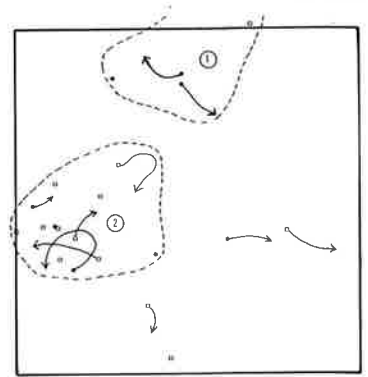
#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

## 2B. HERMIT THRUSH

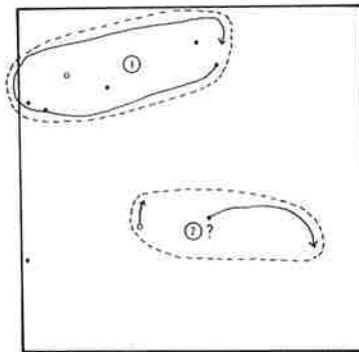
### STUDY AREA 03

1966

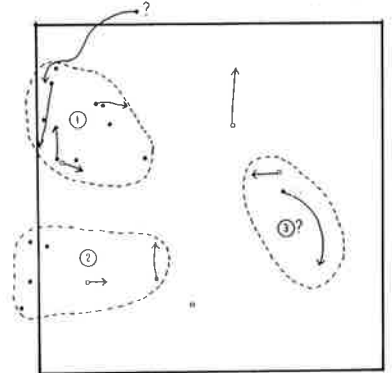


### STUDY AREA 04

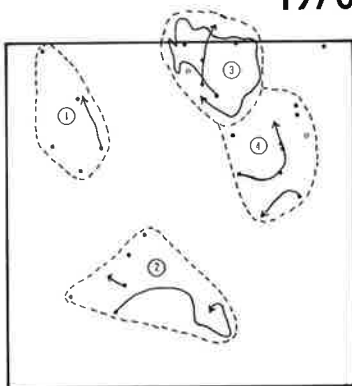
1968



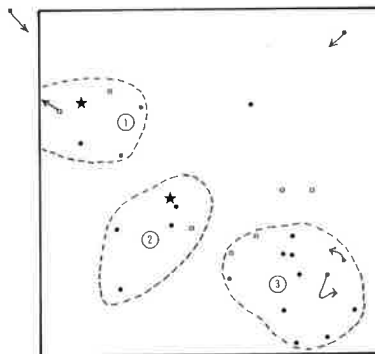
1969



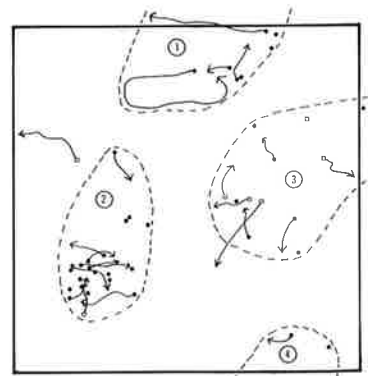
1970



1971



1972



#### Legend

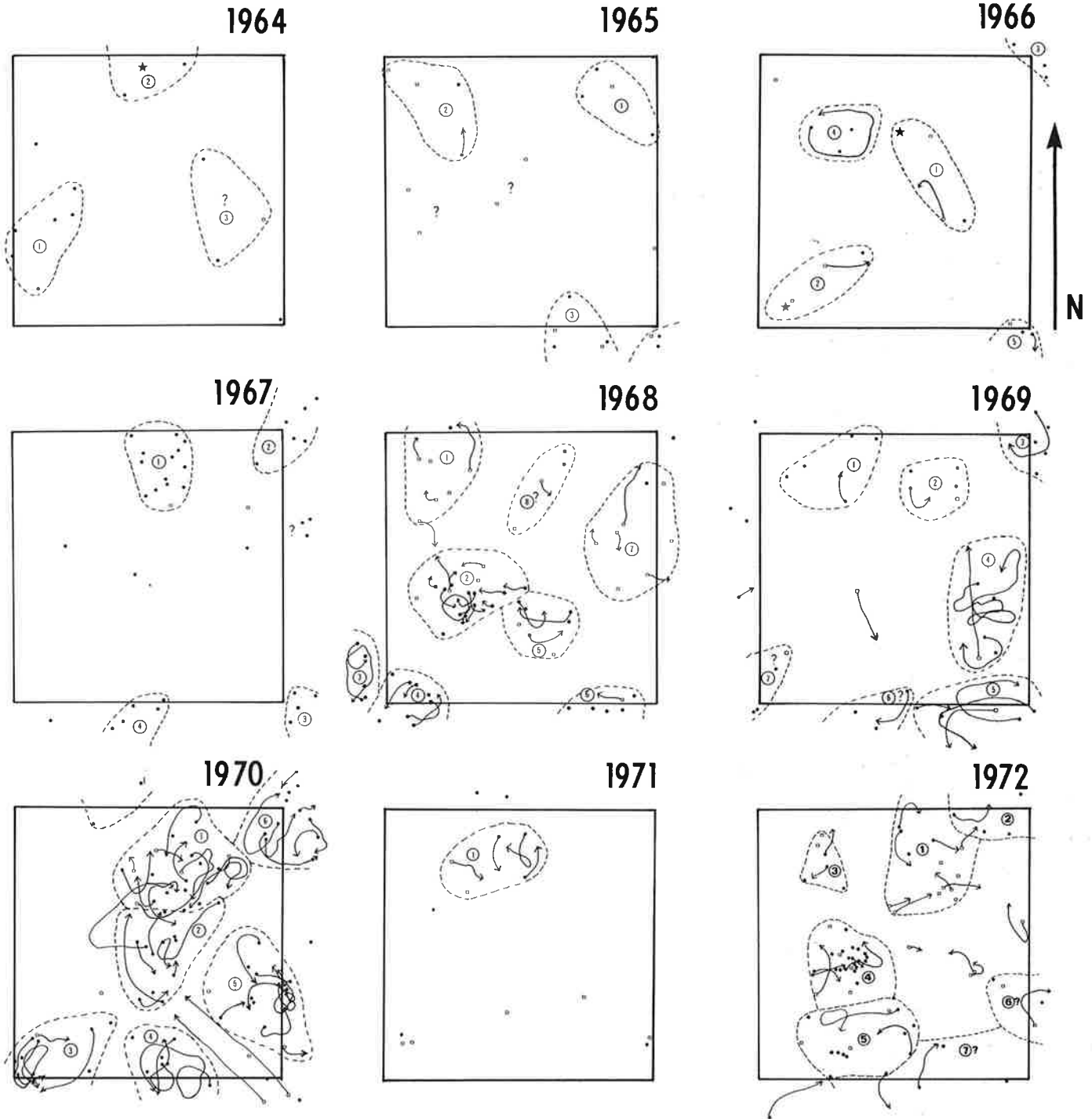
- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres



## 2C. HERMIT THRUSH

### STUDY AREA 05



#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

3. White Throated Sparrow (Sp. 414) (Figs. 3, A.B.C.)

Mean No. of Breeding Males per 100 Hect.:  $17.57 \pm 2.73$

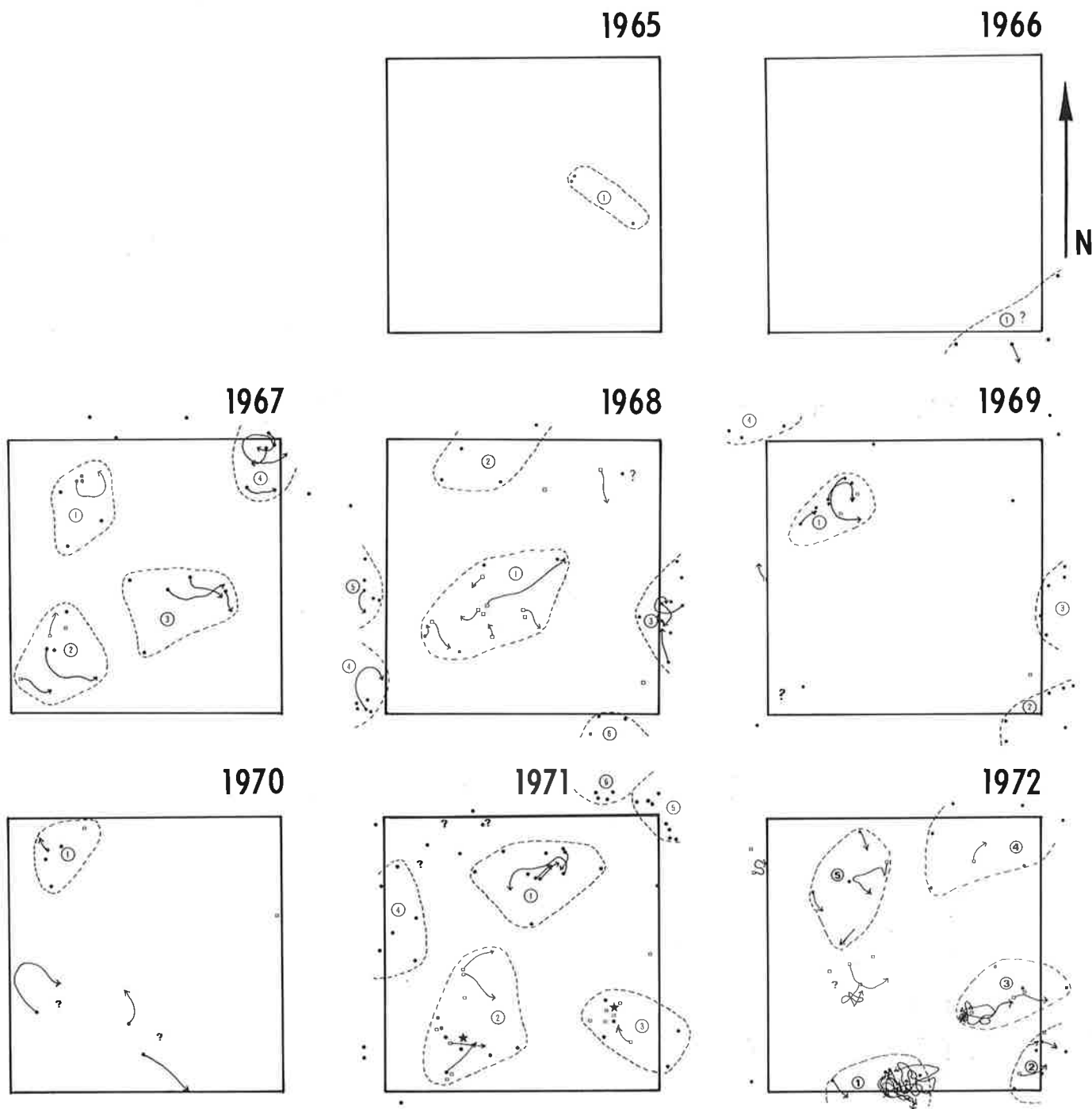
Mean Territory Size:  $2.4 \pm .18$  acres (.97 hectares), N = 30

Remarks:

Territories are scattered. Nests, unlike the slate coloured junco and hermit thrush which are in the open heath, are often found near large fallen stumps or under the shade of small spruce trees or bushes. It sings in the understory vegetation, often at eye level and in the lower crowns of jack pines. It is not a consistent singer and is more often observed than heard. Because of this its numbers may be slightly underestimated and the borders of its territories somewhat poorly defined.

### 3A. WHITE-THROATED SPARROW

#### STUDY AREA 02



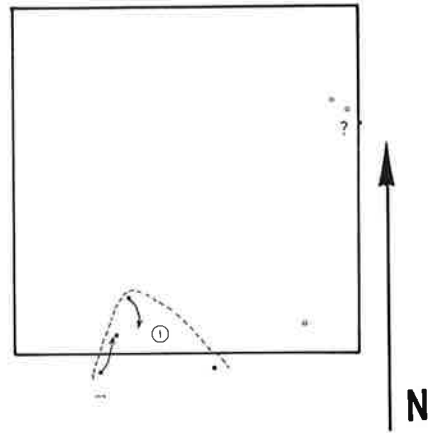
#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

### 3B. WHITE-THROATED SPARROW

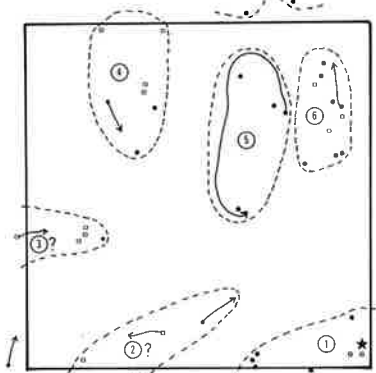
#### STUDY AREA 03

1966

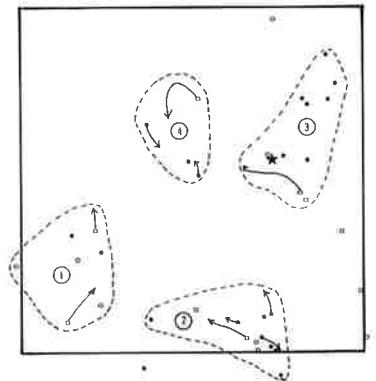


#### STUDY AREA 04

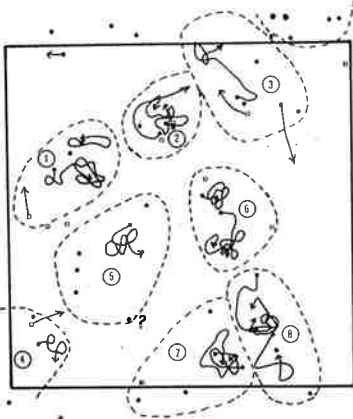
1968



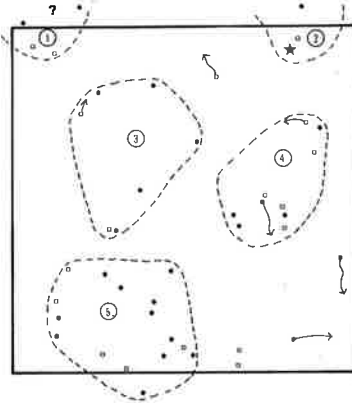
1969



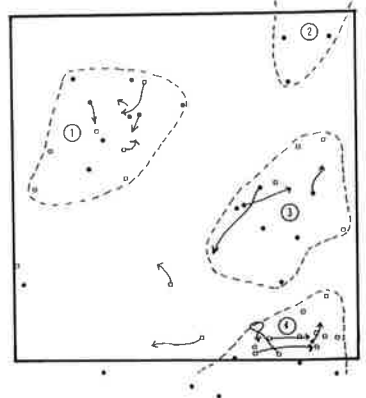
1970



1971



1972



#### Legend

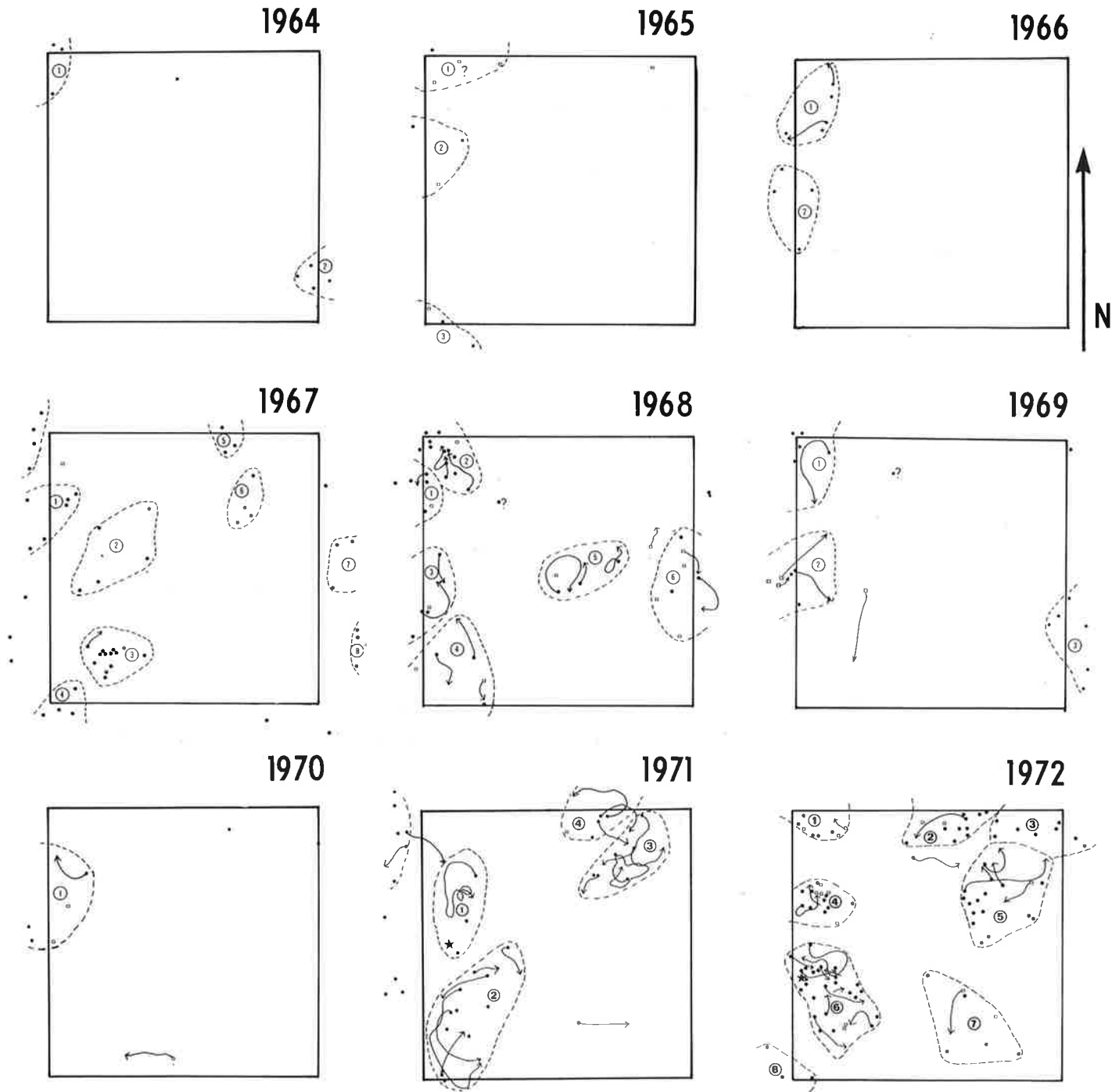
- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres



### 3C. WHITE-THROATED SPARROW

#### STUDY AREA 05



#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

4. Myrtle Warbler (Sp. 334) (Figs. 3, A.B.C.)

Mean No. of Breeding Males/100 Hect.:  $16.91 \pm 2.83$

Mean Territory Size:  $3.2 \pm .32$  acres (1.3 hectares) N = 19

Remarks:

This is the dominant arboreal nester. Although distributed through the stands, its territories are more abundant in ecotones. It was especially abundant in study area 4.

The one nest observed of this species was located in study area 5 about 6 metres up in the base of a dominant jack pine. The nest was located on a branch near the main stem, and at the time of observation was being attacked by a red squirrel which consumed the four young in the nest.

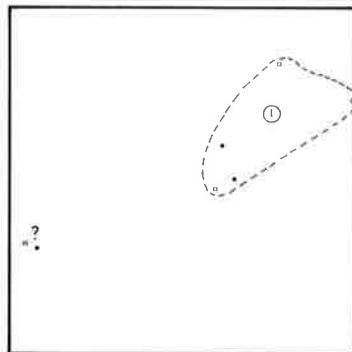
It feeds at all levels and is often seen "hawking" above the ground vegetation and the lower portion of jack pine crowns. It also sings at all levels but mostly at mid-crown of jack pines. It posts at the top of jack pines.



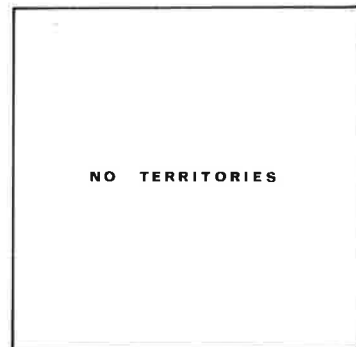
# 4A. MYRTLE WARBLER

## STUDY AREA 02

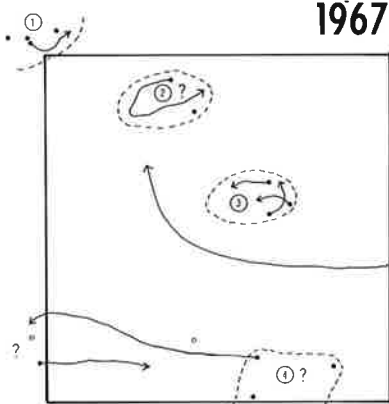
1965



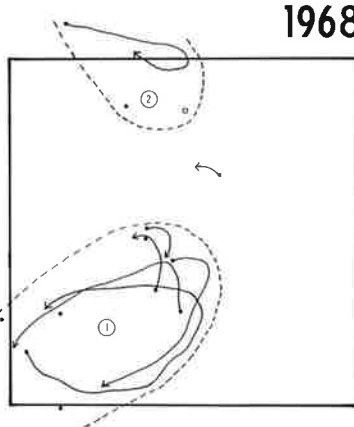
1966



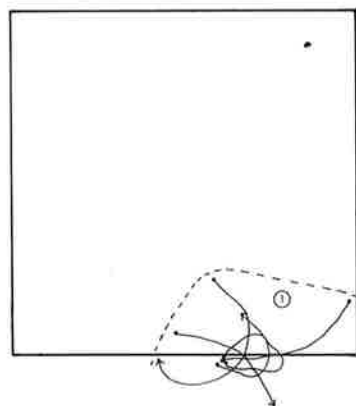
1967



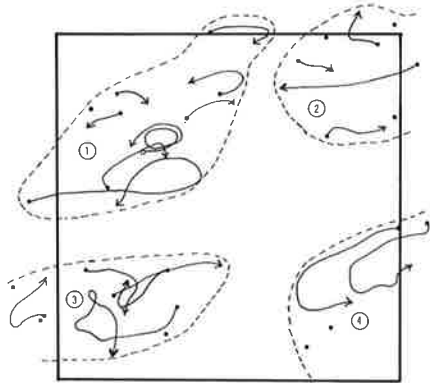
1968



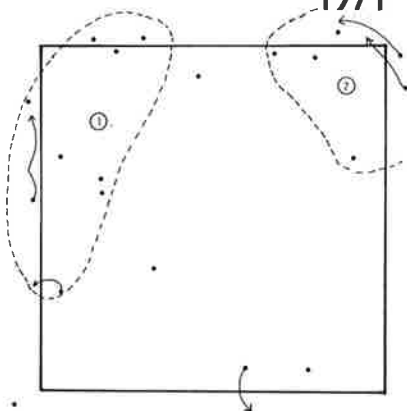
1969



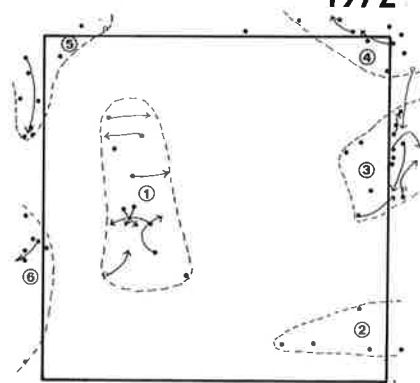
1970



1971



1972



Scale in metres



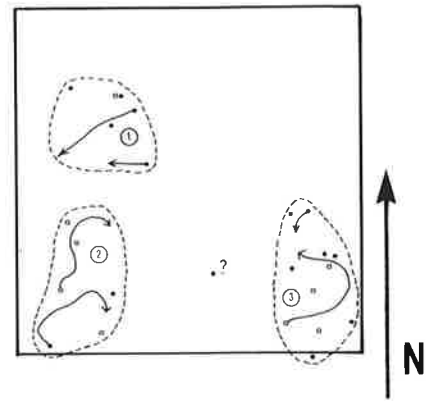
### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 4B. MYRTLE WARBLER

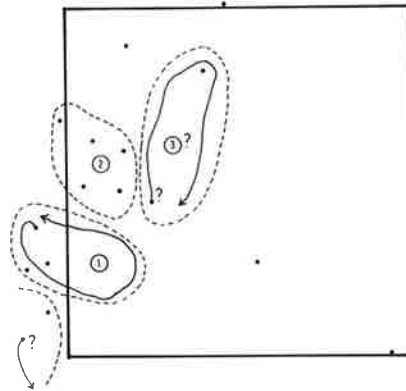
## STUDY AREA 03

1966

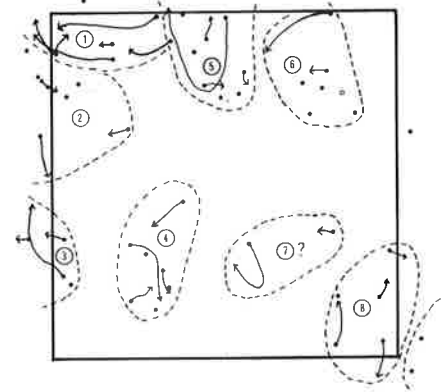


## STUDY AREA 04

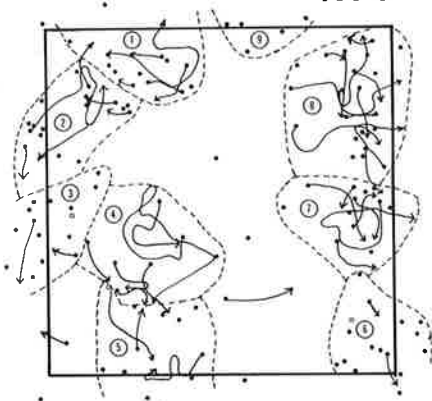
1968



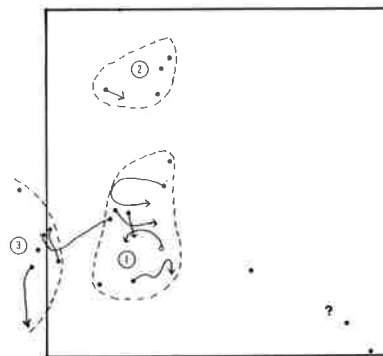
1969



1970



1971



1972

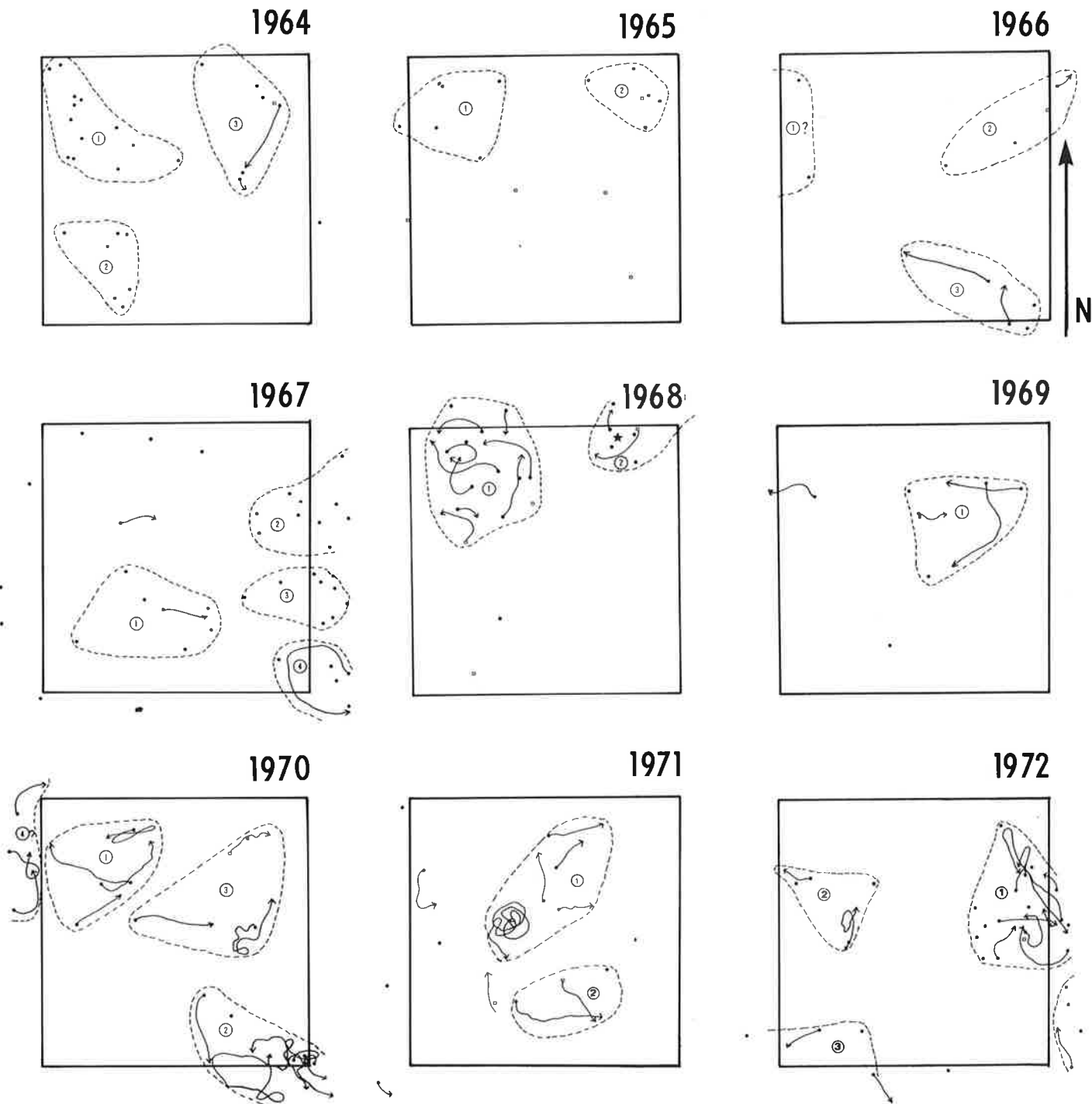


### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 4C. MYRTLE WARBLER

## STUDY AREA 05



### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres  
 0    100    200    300

5. Ruby-Crowned Kinglet (Sp. 300) (Figs. 5, A.B.C.)

Mean No. of Breeding Males/100 Hect.:  $5.31 \pm 1.31$

Mean Territory Size:  $2.6 \pm 1.1$  acres (1.0 hectares). N = 3

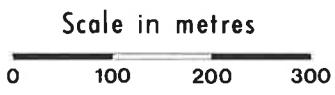
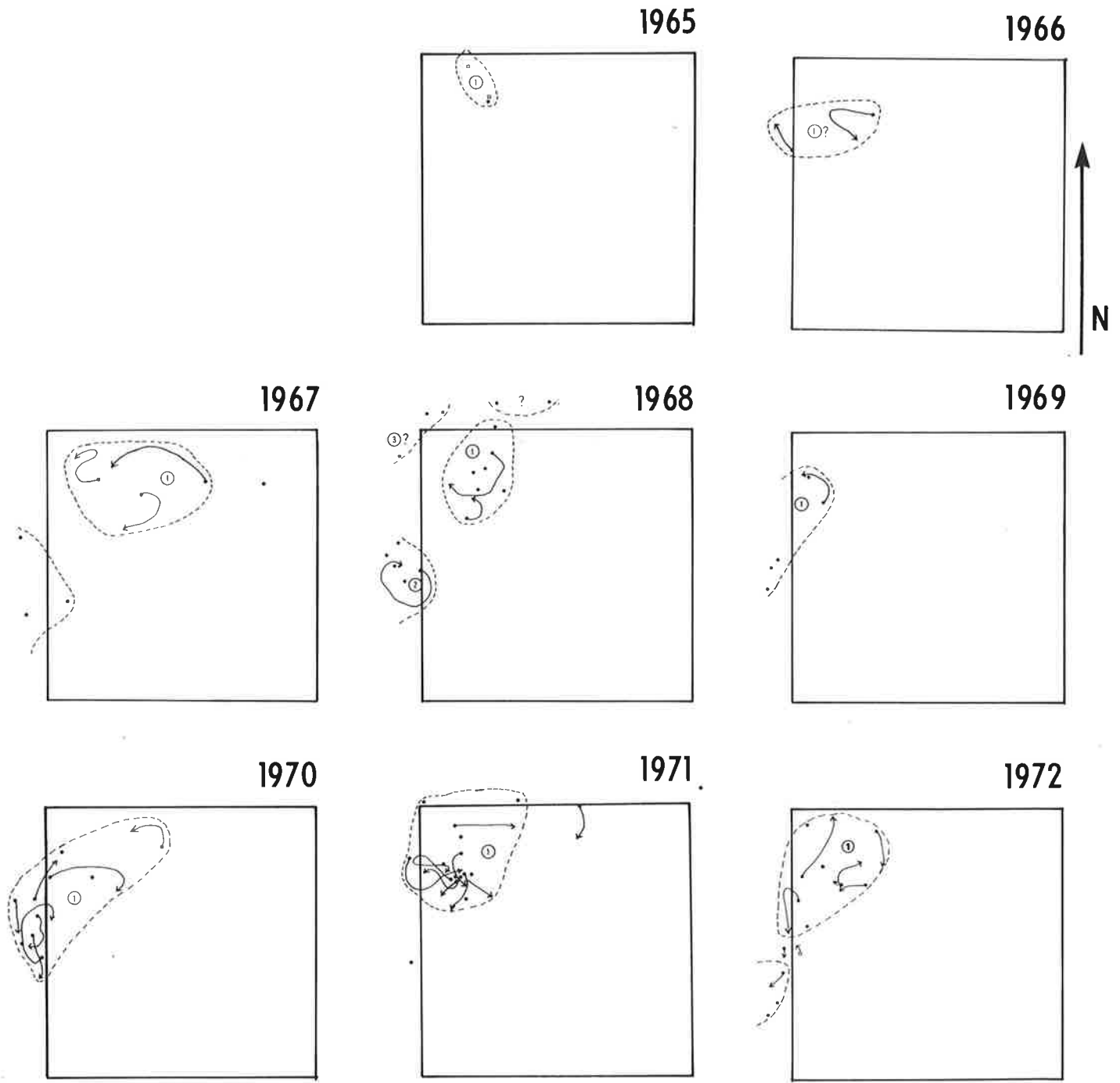
Remarks:

This species is of particular interest because of its restricted distribution. Most of the territories are in ecotones especially where there is a high proportion of fairly tall spruce or where younger jack pine are overtopped by isolated older "wolf" trees. The territories of this species tend to be in the same places year after year, especially apparent in study areas 2 and 5. Additional territories may be established adjacent to the "parent" territories, in certain years, shown in study area 2 in 1967, 1968, and 1972, and in study area 5 in 1967, 1968, and 1972.

It is a strong and consistent singer so its territories are not difficult to define. Its singing and foraging is mostly restricted to the tree crowns, and it often posts from tall jack pine or spruce.

# 5A. RUBY-CROWNED KINGLET

## STUDY AREA 02



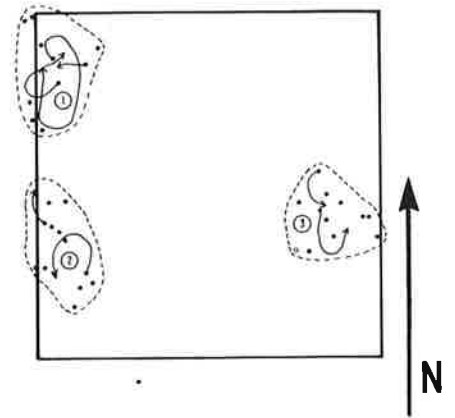
### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 5B. RUBY-CROWNED KINGLET

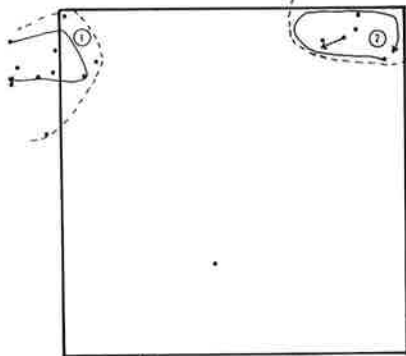
## STUDY AREA 03

1966

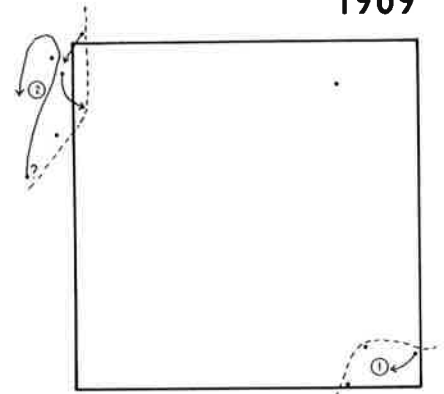


## STUDY AREA 04

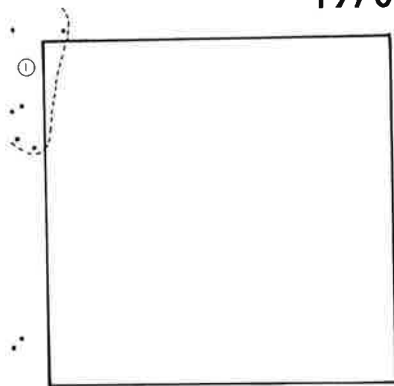
1968



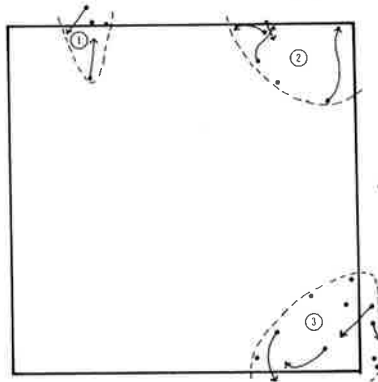
1969



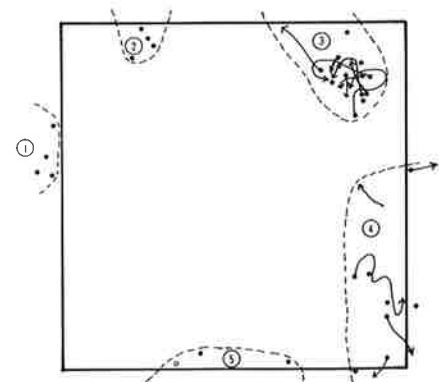
1970



1971



1972



### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

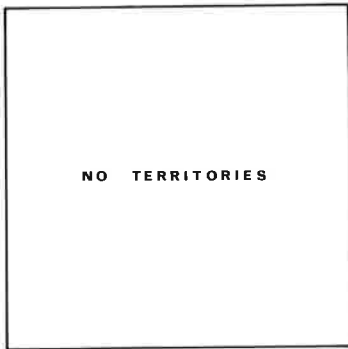
Scale in metres



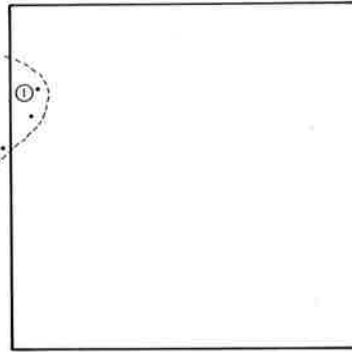
# 5C. RUBY-CROWNED KINGLET

## STUDY AREA 05

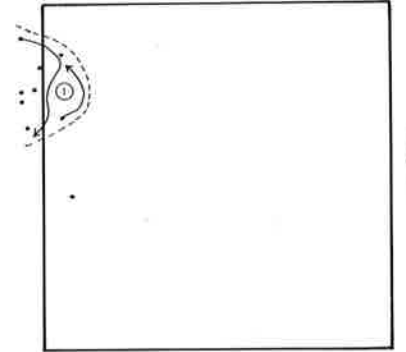
1964



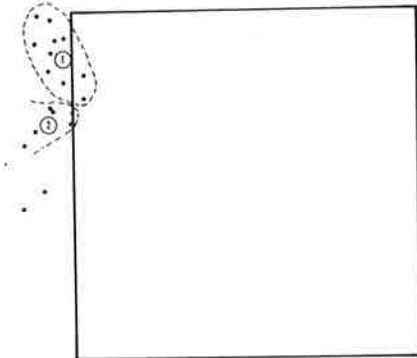
1965



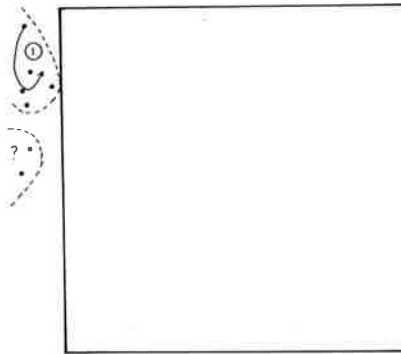
1966



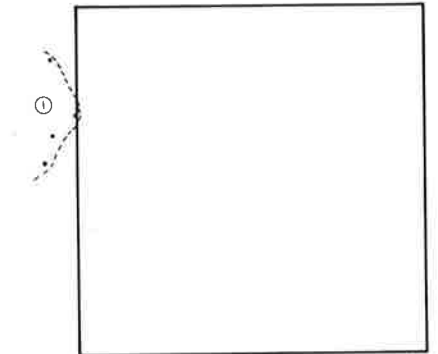
1967



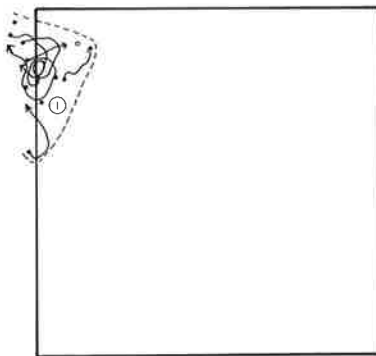
1968



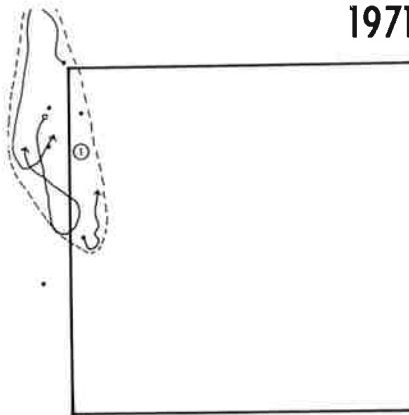
1969



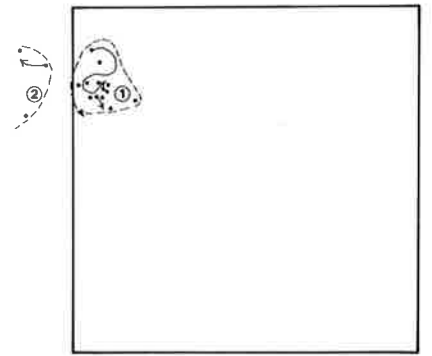
1970



1971



1972



### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres



6. Nashville Warbler (Sp. 328) (Figs. 6, A.B.C.)

Mean No. of Territories/100 Hect.:  $3.98 \pm 1.51$

Mean Territory Size:  $3.2 \pm 2.5$  acres (1.3 hectares), N = 2

Remarks:

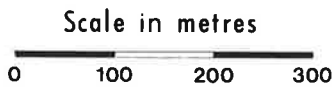
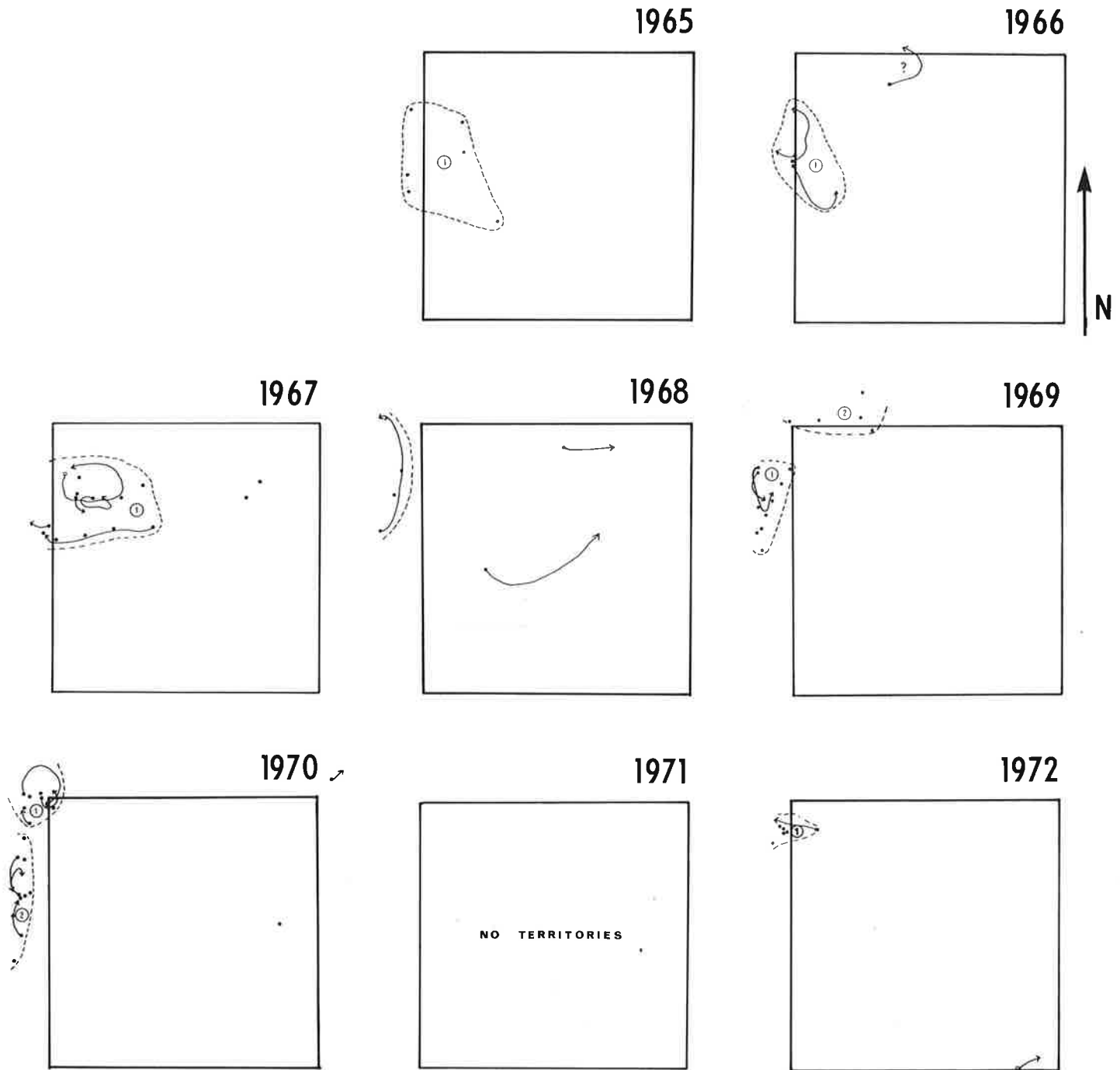
The remarks concerning the ruby crowned Kinglet can be repeated almost verbatim for the Nashville warbler. Its territories are situated in virtually the same areas as the ruby crowned kinglet. Therefore, neither of these two species are typical of pure jack pine stands although they may occur where vertical stratification is augmented in ecotones. Its territories are somewhat larger than the kinglets.

It is one of the last of the birds to start singing in the morning but once started it sings throughout most of the morning and often into the afternoon. When singing, it is almost constantly on the move, and is most often seen in the upper crowns of the jack pine trees. It posts from the top of tall jack pines. It is reputedly a ground nester but we did not succeed in finding a nest of this species nor of any warbler other than the myrtle warbler.



# 6A. NASHVILLE WARBLER

## STUDY AREA 02



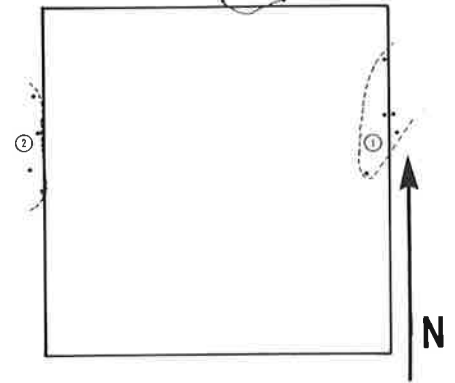
### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 6B. NASHVILLE WARBLER

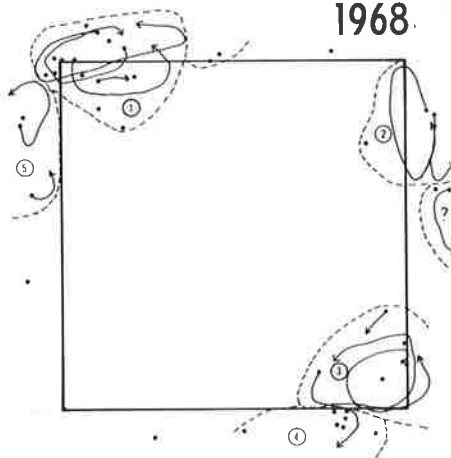
## STUDY AREA 03

1966



## STUDY AREA 04

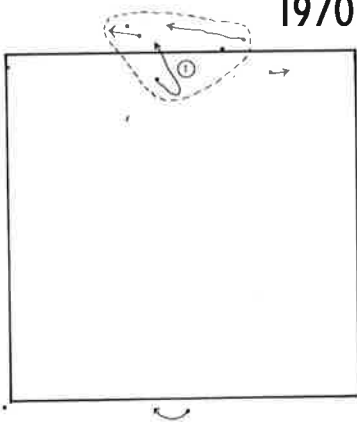
1968



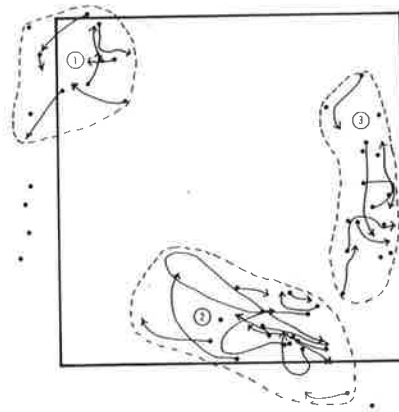
1969



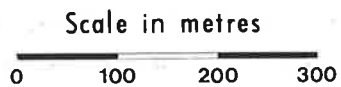
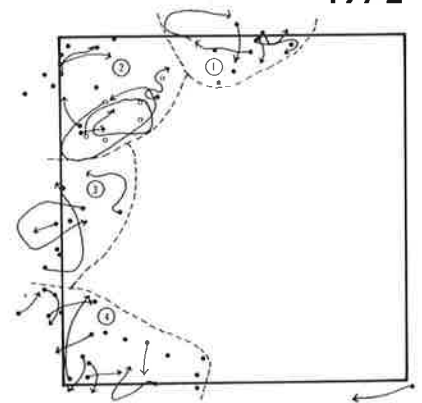
1970



1971



1972

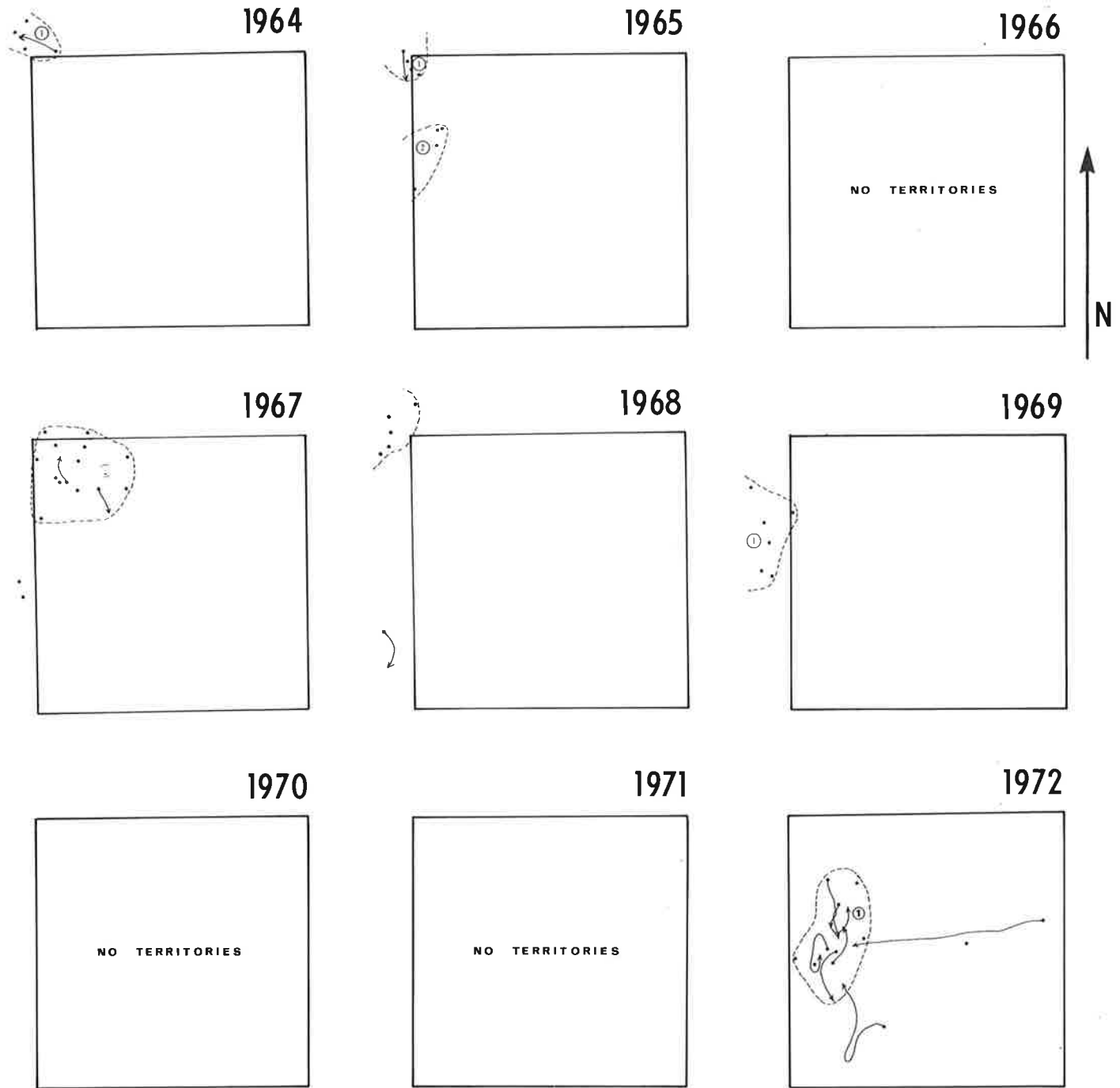


### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

# 6C. NASHVILLE WARBLER

## STUDY AREA 05



Scale in metres  
0 100 200 300

### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

7. Olive-Backed Thrush (Sp. 294) (Figs. 7, A.B.C.)

Mean No. of Breeding Males/100 Hect.:  $3.65 \pm 1.16$

Mean Territory Size:  $2.3 \pm 58$  acres (.93 hectares) N = 3

Remarks:

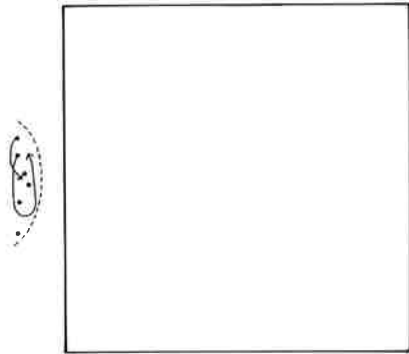
Not as common as the hermit thrush, this species is most likely to be found where there is an abundance of understory spruce although it is distributed quite widely through jack pine stands and can be considered a typical species. The single nest of this species located in study area 4 was found on the ground under a willow bush a little over a metre high.

Is is a very inconsistent singer, and when singing, often stays in the same place for extended periods, making it rather difficult to define its territorial limits.

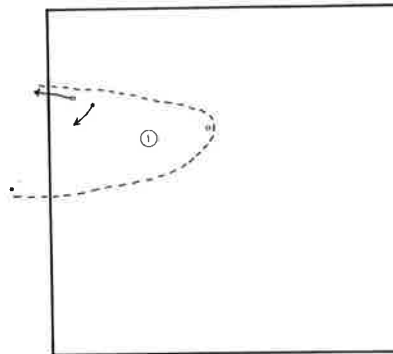
# 7A. OLIVE-BACKED THRUSH

## STUDY AREA 02\*

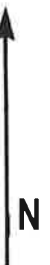
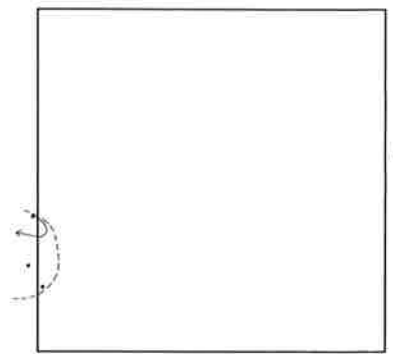
1967



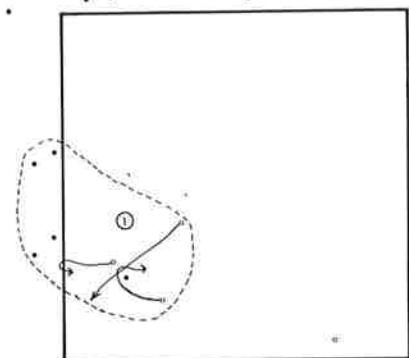
1969



1970

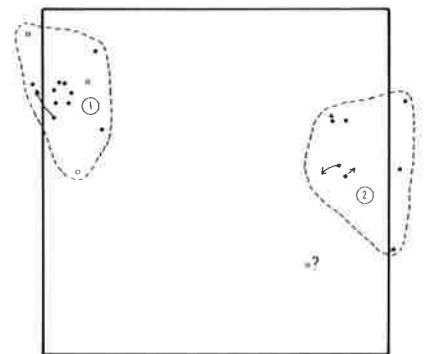


1971



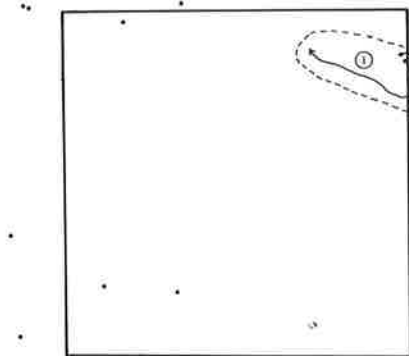
## STUDY AREA 03

1966

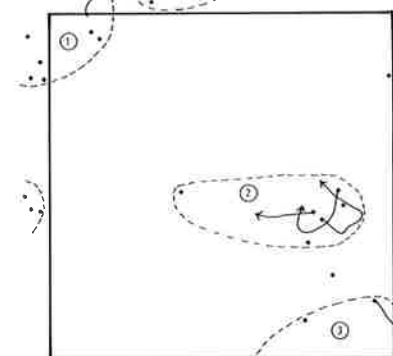


## STUDY AREA 04\*\*

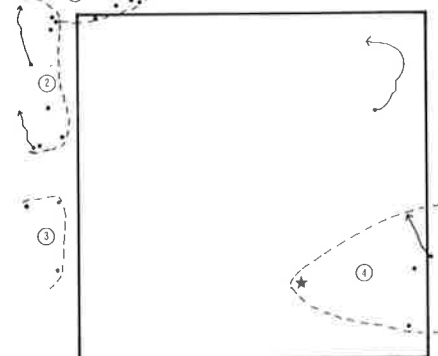
1968



1970



1972



\* NO TERRITORIES 1965, 1966, 1968, 1972

\* NO TERRITORIES 1969, 1971

### Legend

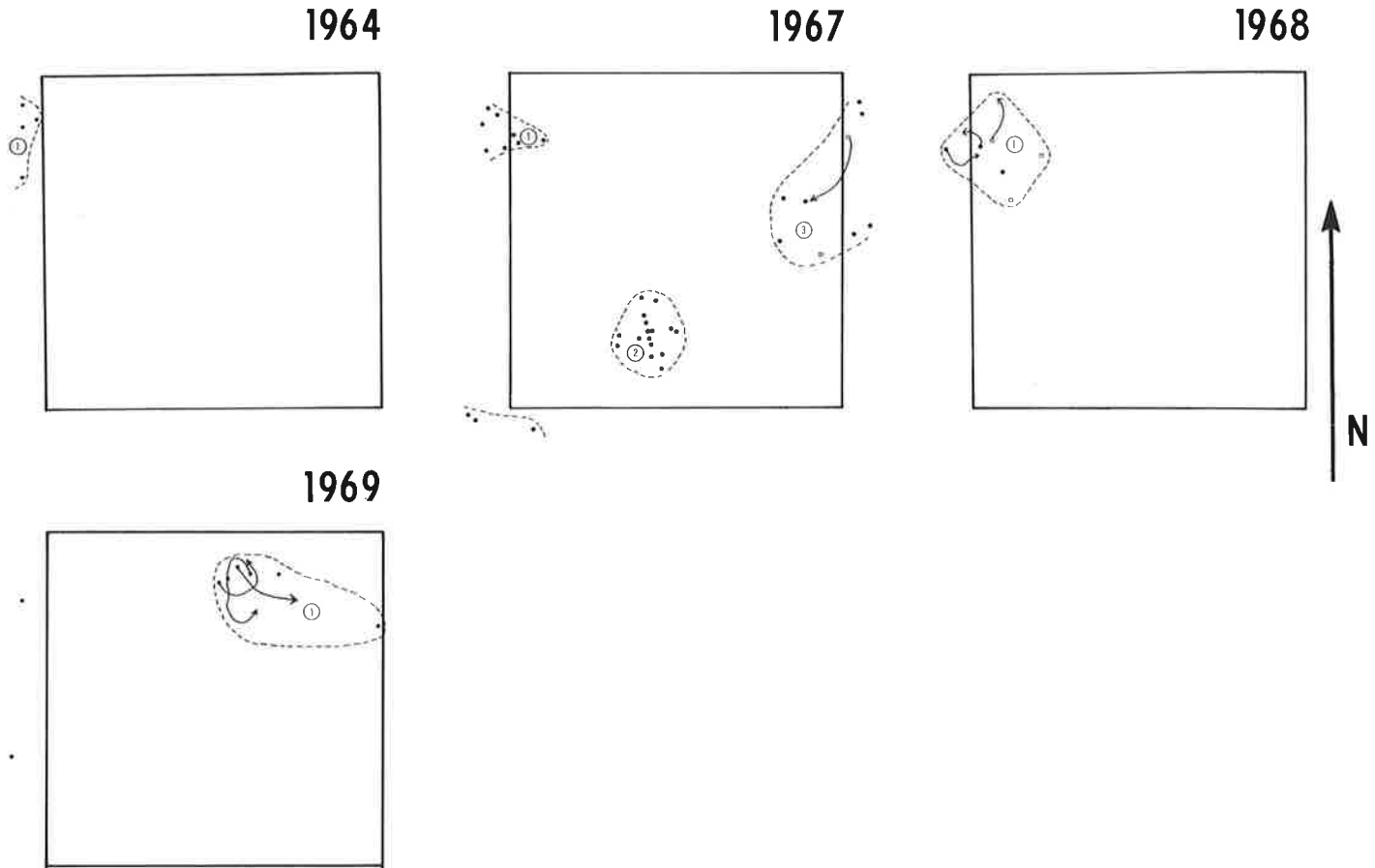
- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres

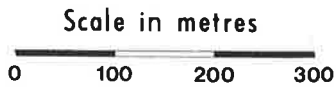


# 7B. OLIVE-BACKED THRUSH

## STUDY AREA 05\*



\*NO TERRITORIES 1965, 1966, 1970, 1971, 1972



### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

8. Bay Breasted Warbler (sp. 340) (Fig. 8)

Mean No. of Breeding Males/100 Hect.:  $2.98 \pm 1.24$

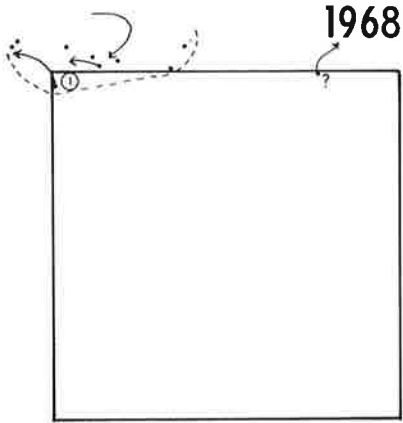
Mean Territory Size: No complete territories recorded

Remarks:

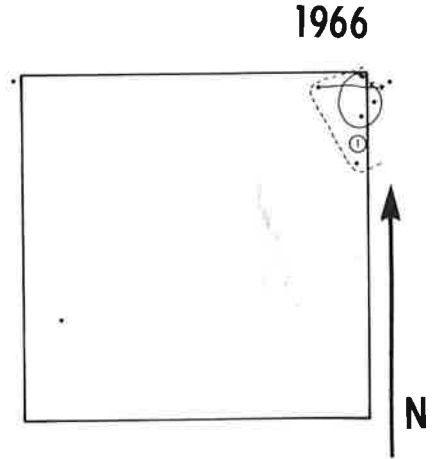
This is a dominant bird of spruce-fir forests during spruce budworm outbreaks (Kendeigh, 1947). It occurs in jack pine stands only in areas with a high proportion of spruce and other tree species.

# 8. BAY-BREASTED WARBLER

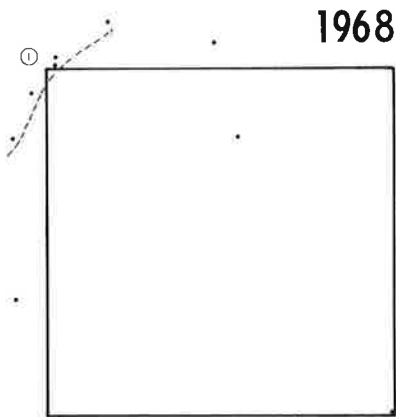
STUDY AREA 02\*



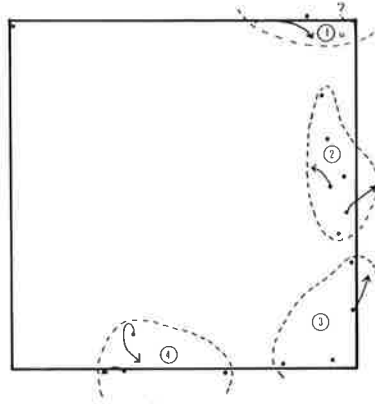
STUDY AREA 03



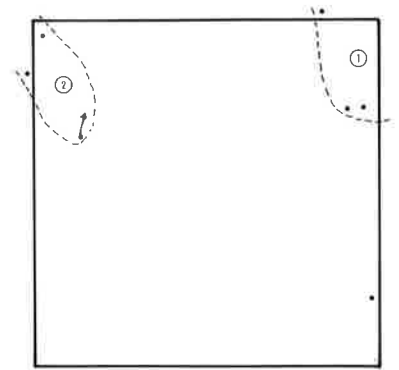
STUDY AREA 04\*\*



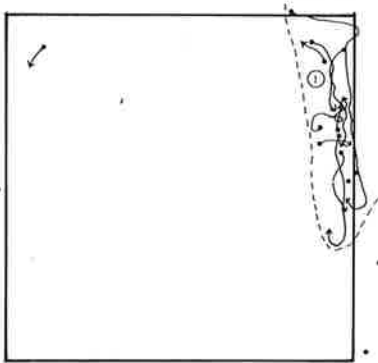
1969



1971

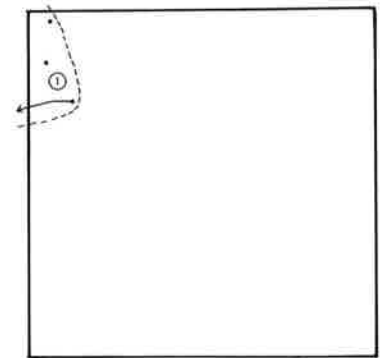


1972



STUDY AREA 05\*\*\*

1966



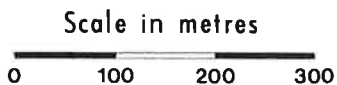
\* NO TERRITORIES 1965-1968, 1969-1972

\*\* NO TERRITORIES 1970, 1972

\*\*\* NO TERRITORIES 1964, 1965, 1967-1972

Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest





9. Solitary Vireo (Sp. 312) (Fig. 9)

Mean No. of Breeding Males/100 Hect.:  $2.98 \pm 1.04$

Mean Territory Size: No complete territories recorded

Remarks:

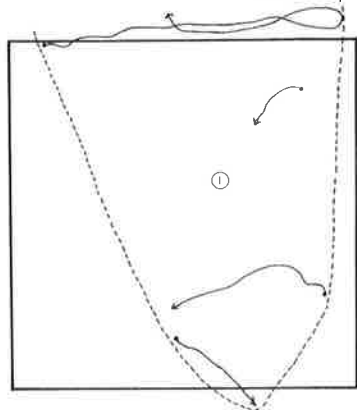
A medium sized bird, this vireo has by far the largest territory of any of the species in jack pine stands so far recorded, so large that we have not yet registered a complete territory in any of our permanent study areas.

It is a typical species of jack pine stands, since its territories are not restricted to edges. It is a fairly easy species to follow since it forages in the lower crowns of jack pines, is almost constantly on the move, and sings continuously as it forages. Occasionally it will "post" on the top of tall jack pine trees.

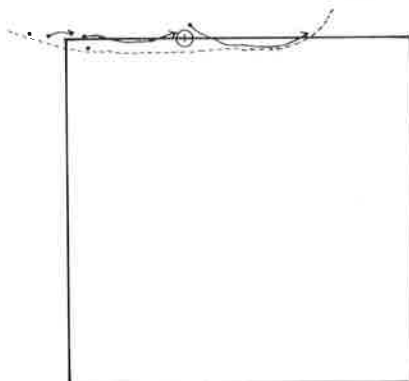
# 9. SOLITARY VIREO

STUDY AREA 02\*

1970

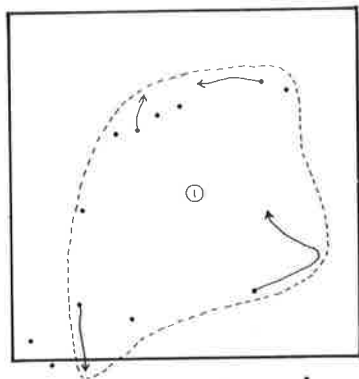


1971



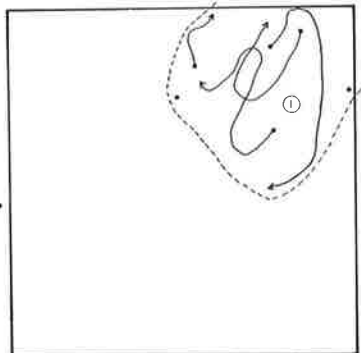
STUDY AREA 04\*\*

1971

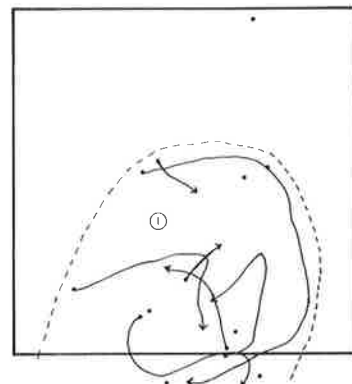


STUDY AREA 05\*\*\*

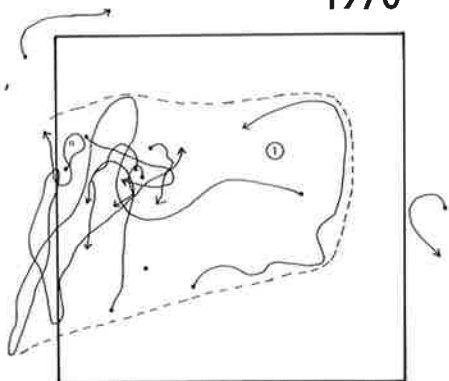
1968



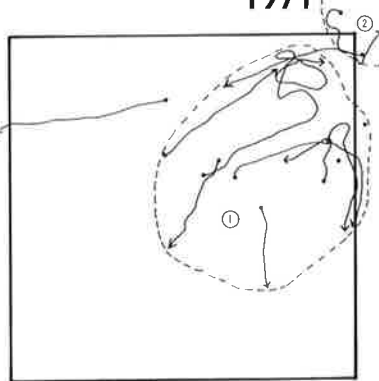
1969



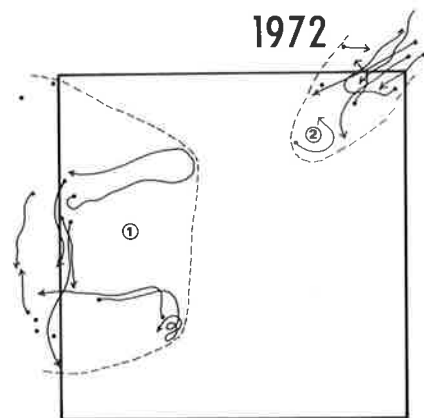
1970



1971



1972



\* NO TERRITORIES 1965-1969, 1972

\*\* NO TERRITORIES 1968-1970, 1972

\*\*\* NO TERRITORIES 1964-1967

NO TERRITORIES, STUDY AREA 03

Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest



10. Red-Eyed Vireo (sp. 314) (Fig. 10)

Mean No. of Breeding Males/100 Hect.:  $1.66 \pm .67$

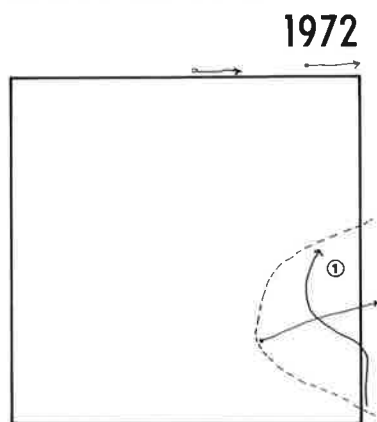
Mean Territory Site: No complete territories recorded

Remarks:

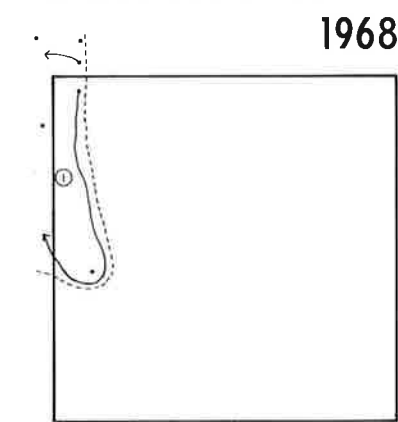
This is not a typical bird of jack pine stands but its territories radiate out from edge areas, especially where jack pine stands are adjacent to aspen or birch stands. It forages more in the upper crowns than the blue headed vireo and wanders less.

# 10. RED-EYED VIREO

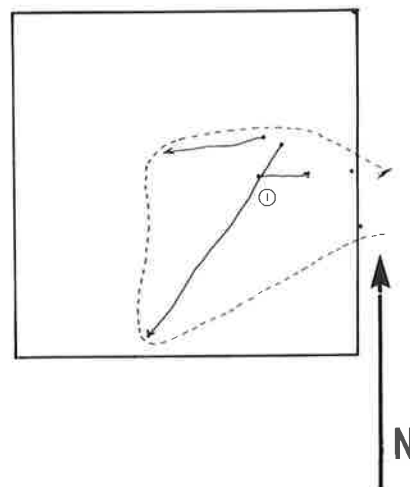
STUDY AREA 02\*



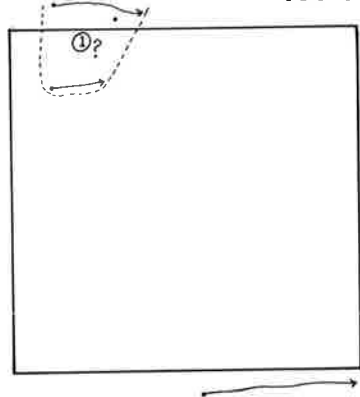
STUDY AREA 04\*\*



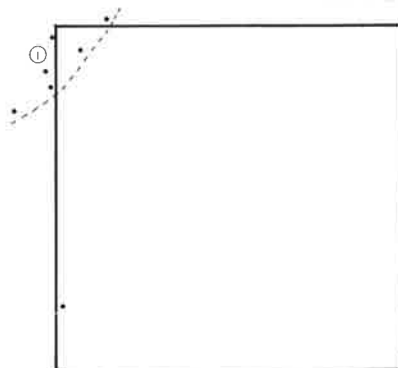
1969



1970

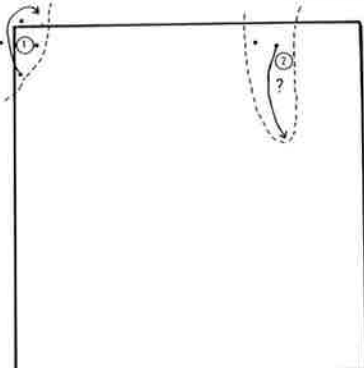


1972



STUDY AREA 05

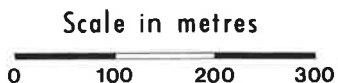
1966



- \* NO TERRITORIES 1965-1971
- \*\* NO TERRITORIES 1971
- \*\*\* NO TERRITORIES 1964-1965, 1967-1972
- NO TERRITORIES, STUDY AREA 03

Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest



11. American Robin (Sp. 291) (Fig. 11)

Mean No. of Breeding Males/100 Hect.:  $1.66 \pm .67$

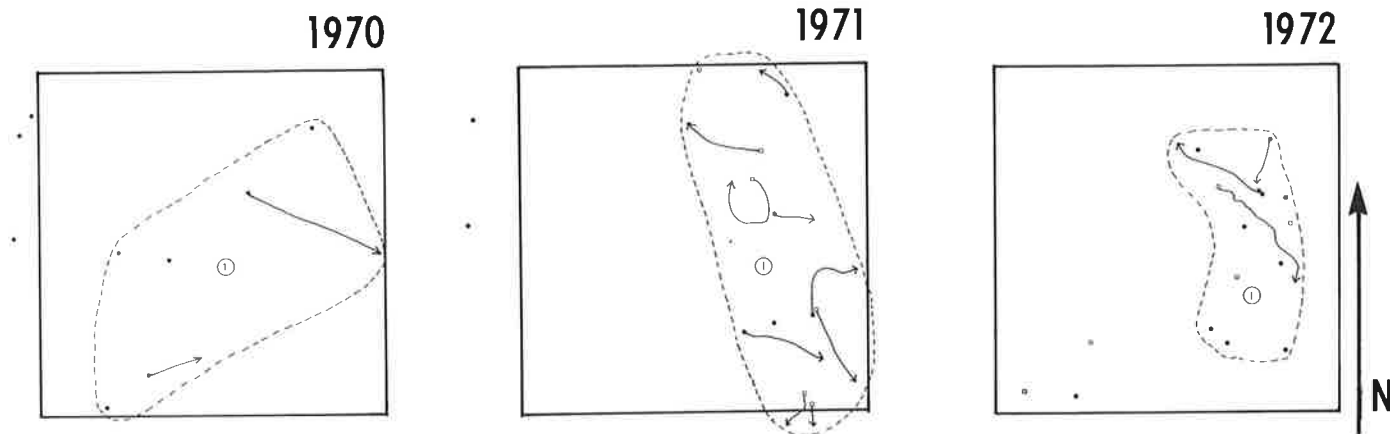
Mean Territory Size:  $9.7 \pm 3.7$  acres (3.9 hectares), N = 2

Remarks:

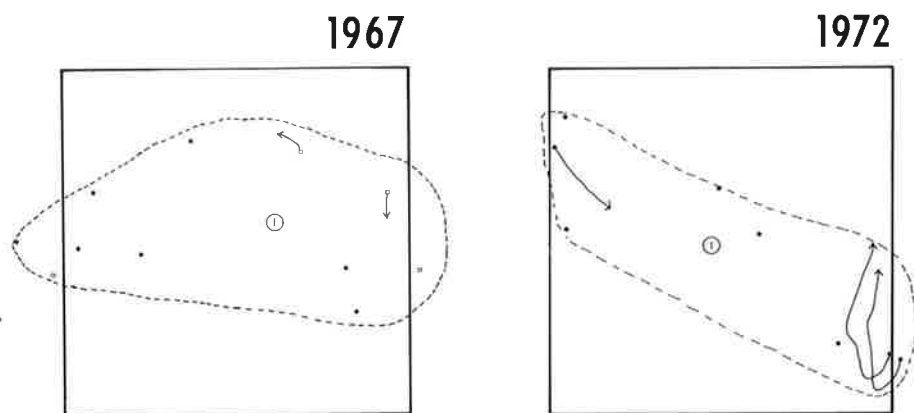
The robin is a typical species of jack pine stands and its territories are second in size only to the solitary vireo. In jack pine stands robins are seen foraging more in the lower crowns of trees and on the ground.

## 11. AMERICAN ROBIN

### STUDY AREA 04\*



### STUDY AREA 05\*\*



\* NO TERRITORIES 1968-1969

\*\* NO TERRITORIES 1964-1965, 1968-1971  
NO TERRITORIES, STUDY AREAS 02, 03



#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

12. Boreal Chickadee (Sp. 276) (Fig. 12).

Mean No. of Breeding Males/100 Hect.:  $0.99 \pm .55$

Mean Territory Size:  $8.0 \pm 2.6$  acres (3.2 hectares), N = 2

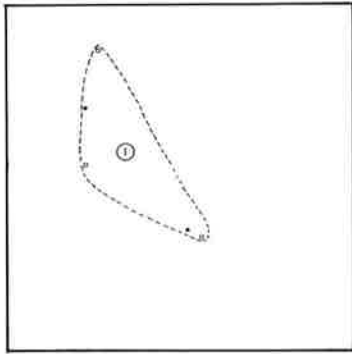
Remarks:

This species is probably more abundant than indicated by this census. It sings inconsistently and wanders at large throughout the jack pine stands so its territories are extremely difficult to delineate. Similar remarks apply to the brown creeper and the black-burnian warbler. The latter, although recorded consistently in jack pine stands, has never had a territory confirmed (Table 2). Black-burnian warblers are often observed posting for long periods at the top of tall jack pines. They will be heard for one day or at the most two days but then seemingly disappear from the area.

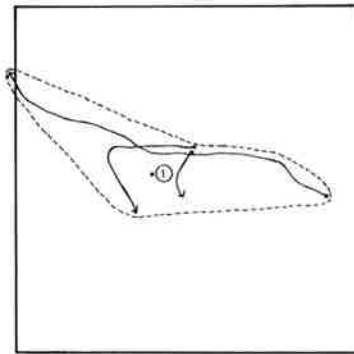
## 12. BOREAL CHICKADEE

### STUDY AREA 02\*

1965

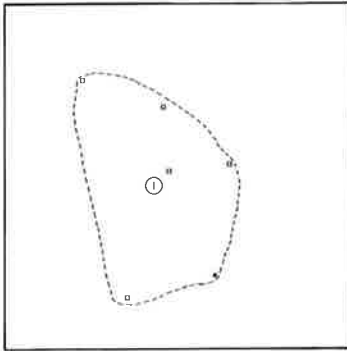


1966

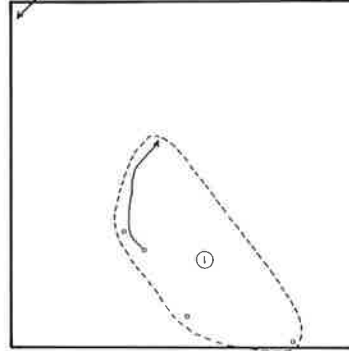


### STUDY AREA 05\*\*

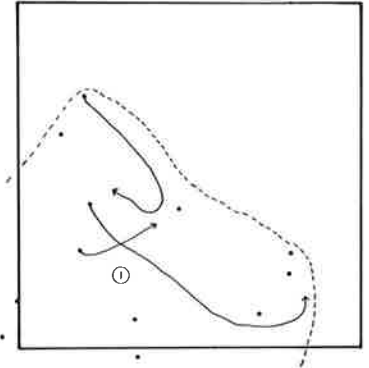
1964



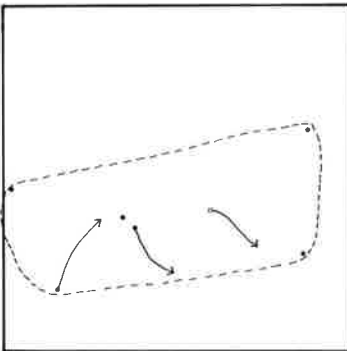
1966



1969



1972



\* NO TERRITORIES 1967-1972

\*\* NO TERRITORIES 1965, 1967, 1968, 1970, 1971  
NO TERRITORIES, STUDY AREAS 03, 04

#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Scale in metres





13. Magnolia Warbler (sp. 331) (Fig. 13)

Mean No. of Breeding Males/100 Hect.:  $1.66 \pm .82$

Mean Territory Size: No complete territories recorded

Remarks:

Most of the Magnolia warblers were found in edge area of the richest jack pine stands (study areas 3 and 4) where hardwoods and spruce are mixed with the jack pine.

14. Golden-Crowned Kinglet (Sp. 299) (Fig. 14)

No. of Breeding Males/100 Hect.:  $.66 \pm .46$

Mean Territory Size: 2.7 acres (1.1 hectares), N = 1

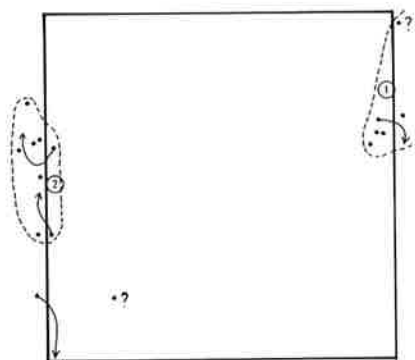
Remarks:

The golden crowned kinglet most often occurs in dense spruce-fir stands and is of incidental occurrence in jack pine stands. It was recorded only from the richest jack pine stand, study area 4.

### 13. MAGNOLIA WARBLER

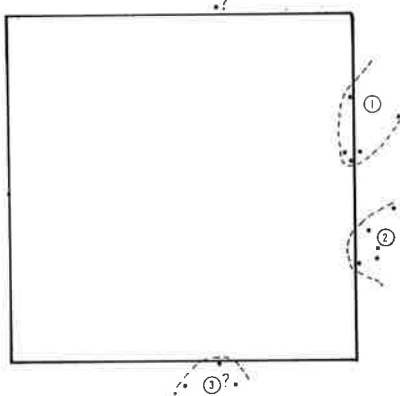
#### STUDY AREA 03

1966

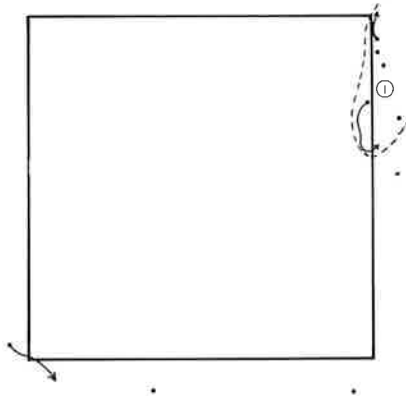


#### STUDY AREA 04

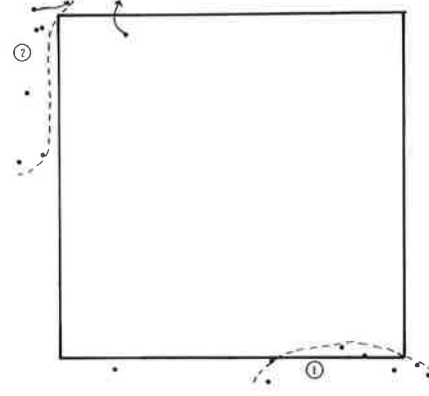
1968



1970



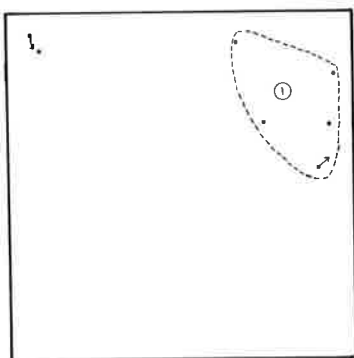
1972



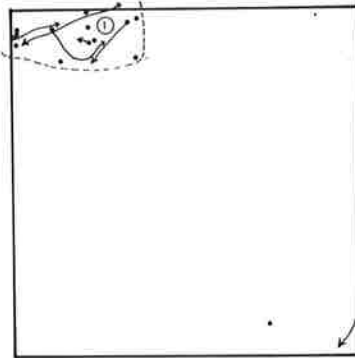
### 14. GOLDEN-CROWNED KINGLET

#### STUDY AREA 04

1968

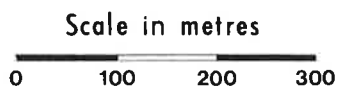


1972



#### Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest



15. Tennessee Warbler (Sp. 326) (Fig. 15)

Mean No. of Breeding Males/100 Hect.:  $2.32 \pm 1.22$

Mean Territory Size: No complete territories recorded

Remarks:

An ecotone species of richer jack pine stands.

16. Chipping Sparrow (Sp. 409) (Fig. 16)

Mean No. of Breeding Males/100 Hect.:  $.99 \pm .73$

Mean Territory Size:  $1.5 \pm .69$  acres (.62 hectares), N = 3

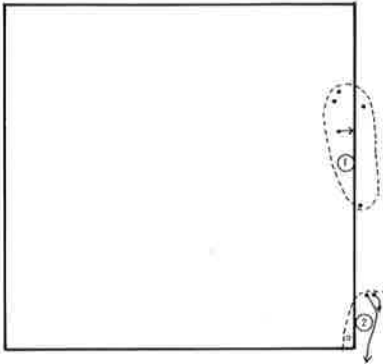
Remarks:

This species is not common in jack pine stands but has been noted increasingly in latter years.

# 15. TENNESSEE WARBLER

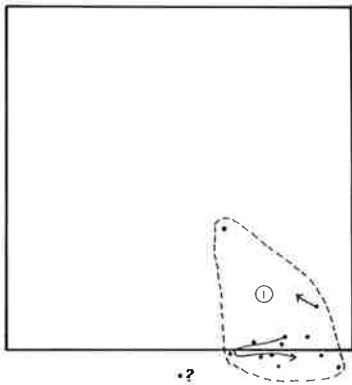
## STUDY AREA 03

1966

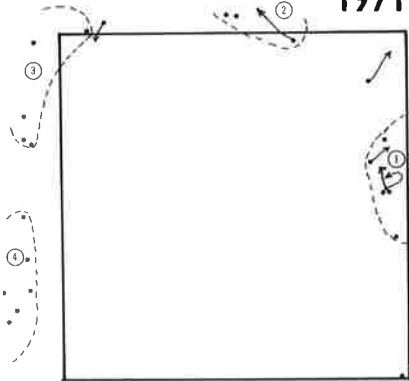


## STUDY AREA 04

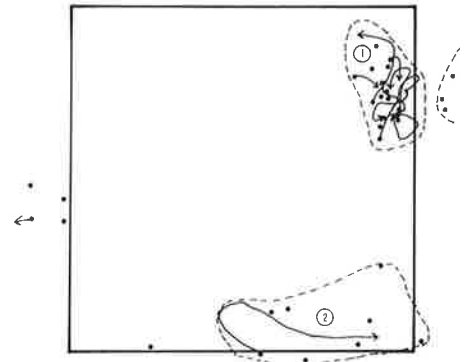
1970



1971



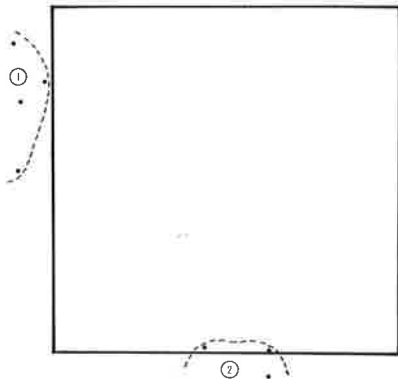
1972



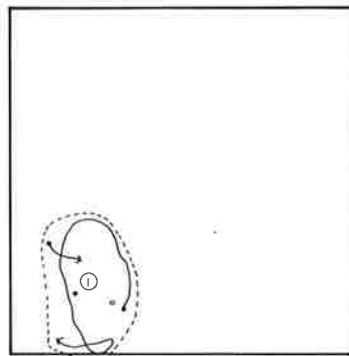
# 16. CHIPPING SPARROW

## STUDY AREA 04

1968

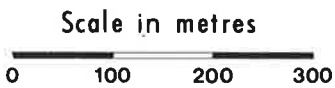
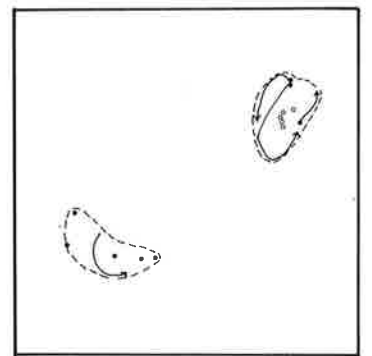


1972



## STUDY AREA 05

1972



### Legend

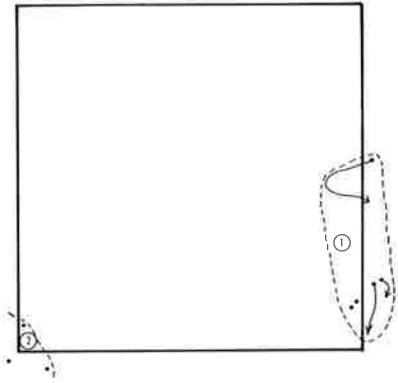
- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

Miscellaneous Species (Figs. 17 to 26 Inclusive)

The yellowthroat and northern waterthrush (Figs. 17, 18) occurred near swamps (study areas 3 and 5) or streambeds (study area 4). The ovenbird's territory (Fig. 19) recorded from study area 5 infringed on the jack pine stand from an aspen stand on the slope west of the stream on the northwest edge of the jack pine stand. The brown creeper (Fig. 20) occurs regularly in jack pine stands but its territories are difficult to delineate because of the inconsistency of its singing. The yellow-bellied flycatcher (Fig. 21) and other empidonax flycatchers have been recorded from jack pine stands but they are mostly invaders or wanderers from adjacent hardwood areas or swamps. The black-capped chickadee occurs rarely in jack pine stands (Fig. 22). Territories of the purple finch (Fig. 23) and the pine siskin (Fig. 24) were confirmed in the richest jack pine stand (study area 4), and have occurred sporadically in other study areas (Table 2). The arctic three-toed woodpecker is typical of jack pine stands but only one territory was located, in study area 3, where there were many trees killed by the sawfly (Fig. 25). Rusty blackbirds are very common in swamps adjacent to jack pine stands (Fig. 26) and are often seen as transients.

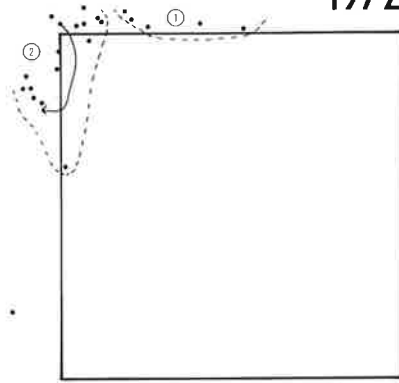
STUDY AREA 03

1966



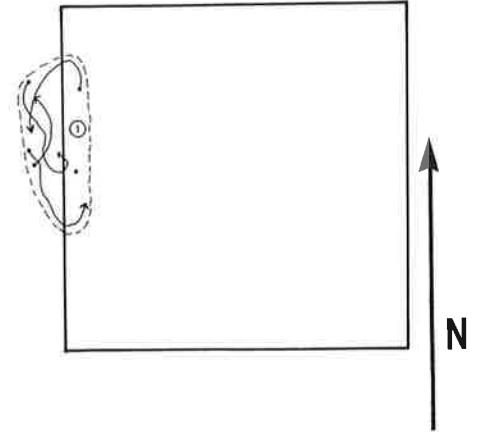
17. YELLOWTHROAT  
STUDY AREA 04

1972



STUDY AREA 05

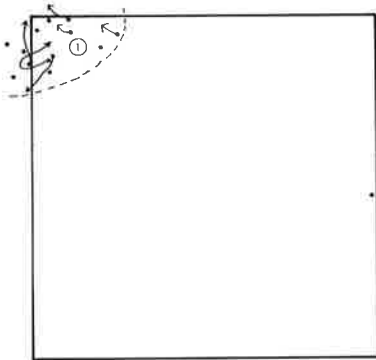
1971



18. NORTHERN WATER THRUSH

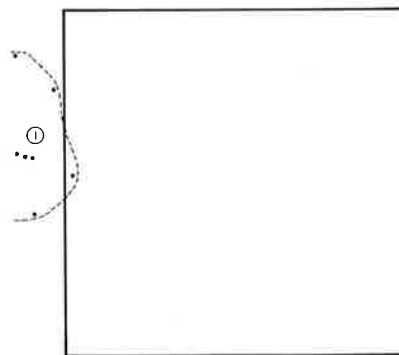
STUDY AREA 04

1970

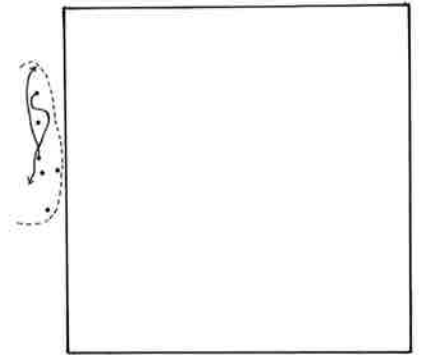


STUDY AREA 05

1967

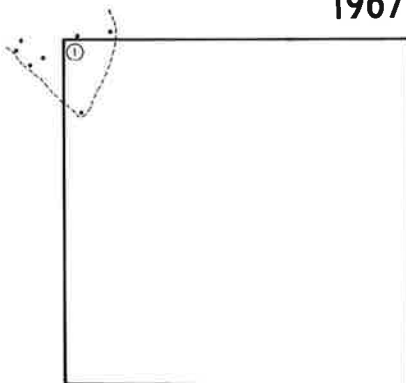


1968



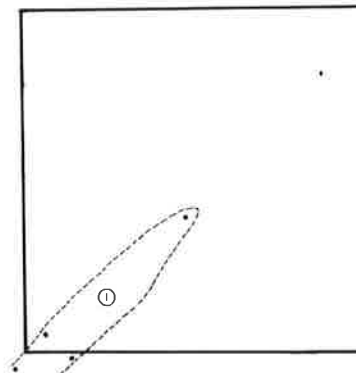
19. OVENBIRD  
STUDY AREA 05

1967



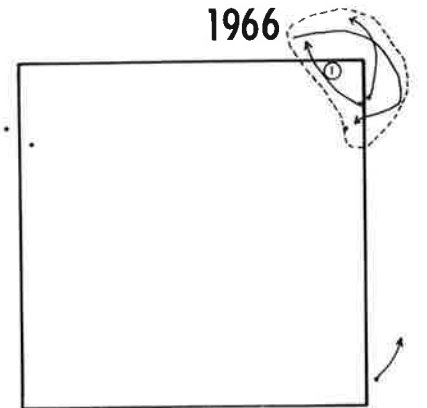
20. BROWN CREEPER  
STUDY AREA 05

1971



21. YELLOW-BELLIED  
FLYCATCHER  
STUDY AREA 05

1966



Scale in metres

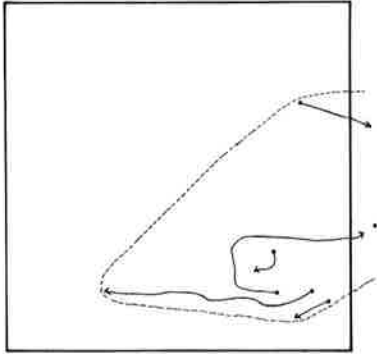


Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

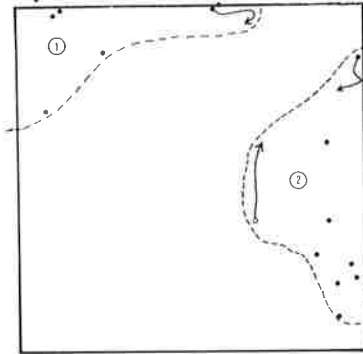
22. BLACK-CAPPED CHICKADEE

STUDY AREA 05  
1967



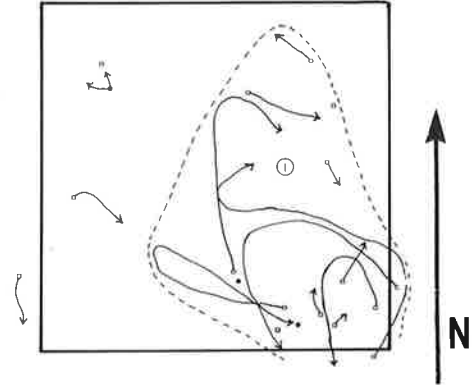
23. PURPLE FINCH

STUDY AREA 04  
1972



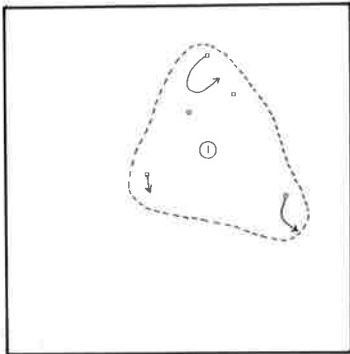
24. PINE SISKIN

STUDY AREA 04  
1971



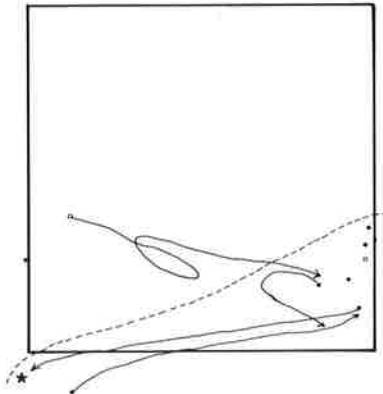
25. ARCTIC THREE-TOED WOODPECKER

STUDY AREA 03  
1966



26. RUSTY BLACKBIRD

STUDY AREA 03  
1966



Scale in metres  
0 100 200 300

Legend

- ① Assigned territory number (? = definition uncertain)
- Position of singing male (arrow = direction of movement)
- Position of observed bird (arrow = direction of movement)
- Estimated limit of territory
- ★ Position of nest

## TERRITORY SIZE

The average territory sizes vary considerably, from the slate-coloured junco at .67 hectares to the American robin at 3.9 hectares (Tables 3-7). The blue headed vireo, for which no complete territories were recorded, has the largest territory of all; the incomplete territories averaged 4.5 hectares. Mean territory size is precisely determined for only four species; the slate coloured junco, the hermit thrush, myrtle warbler, and white throated sparrow. For the remaining nine species (Table 7) the sample size is less than 5.



TABLE 3. AVERAGE TERRITORY SIZE (COMPLETE TERRITORIES); STUDY AREA 2

SPECIES CODE*	NO. OF TERRITORIES	TOTAL (UNITS)**	MEAN (UNITS)	S.E. MEAN	MEAN (HECTARES)
334	2	0.430000E 02	0.215000E 02	0.135000E 02	0.870074E 00
406	31	0.552000E 03	0.178064E 02	0.893729E 00	0.720601E 00
293	7	0.181000E 03	0.258571E 02	0.390011E 01	0.104640E 01
414	10	0.263000E 03	0.263000E 02	0.364250E 01	0.106432E 01
276	1	0.550000E 02	0.550000E 02	0.0	0.222577E 01
245	0	0.0	0.0	0.0	0.0
253	0	0.0	0.0	0.0	0.0
300	1	0.470000E 02	0.470000E 02	0.0	0.190202E 01
294	0	0.0	0.0	0.0	0.0
299	0	0.0	0.0	0.0	0.0
291	0	0.0	0.0	0.0	0.0
328	0	0.0	0.0	0.0	0.0
409	0	0.0	0.0	0.0	0.0

\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES

\*\* 1 UNIT = 0.10 ACRE

TABLE 4.

SPECIES NO. OF TERRITORIES		AVERAGE TERRITORY SIZE (COMPLETE TERRITORIES):		STUDY AREA 3	
CODE#	TERRITORIES	TOTAL (UNITS)**	MEAN (UNITS)	S.E. MEAN	MEAN (HECTARES)
334	1	0.200000E 02	0.200000E 02	0.0	0.809371E 00
406	3	0.330000E 02	0.110000E 02	0.360555E 01	0.445154E 00
293	1	0.460000E 02	0.460000E 02	0.0	0.186155E 01
414	0	0.0	0.0	0.0	0.0
276	0	0.0	0.0	0.0	0.0
245	1	0.590000E 02	0.590000E 02	0.0	0.238764E 01
253	1	0.520000E 02	0.520000E 02	0.0	0.210436E 01
300	1	0.210000E 02	0.210000E 02	0.0	0.849840E 00
294	0	0.0	0.0	0.0	0.0
299	0	0.0	0.0	0.0	0.0
291	0	0.0	0.0	0.0	0.0
328	0	0.0	0.0	0.0	0.0
409	0	0.0	0.0	0.0	0.0

\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\* 1 UNIT = 0.10 ACRE

TABLE 6. AVERAGE TERRITORY SIZE (COMPLETE TERRITORIES): STUDY AREA 5

SPECIES CODE*	NO. OF TERRITORIES	TOTAL (UNITS)**	MEAN (UNITS)	S.E. MEAN	MEAN (HECTARES)
334	9	0.329000E 03	0.365555E 02	0.456773E 01	0.147935E 01
406	46	0.727000E 03	0.158043E 02	0.764312E 00	0.639579E 00
293	12	0.315000E 03	0.262500E 02	0.326396E 01	0.106230E 01
414	8	0.151000E 03	0.188750E 02	0.249598E 01	0.763844E 00
276	1	0.106000E 03	0.106000E 03	0.0	0.428967E 01
245	0	0.0	0.0	0.0	0.0
253	0	0.0	0.0	0.0	0.0
300	1	0.900000E 01	0.900000E 01	0.0	0.364217E 00
294	2	0.440000E 02	0.220000E 02	0.100000E 02	0.890308E 00
299	0	0.0	0.0	0.0	0.0
291	0	0.0	0.0	0.0	0.0
328	1	0.290000E 02	0.290000E 02	0.0	0.117359E 01
409	2	0.170000E 02	0.850000E 01	0.150000E 01	0.343983E 00

\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES

\*\* 1 UNIT = 0.10 ACRE

TABLE 5. AVERAGE TERRITORY SIZE (COMPLETE TERRITORIES); STUDY AREA 4

SPECIES CODE*	NO. OF TERRITORIES	TOTAL (UNITS)**	MEAN (UNITS)	S.E. MEAN	MEAN (HECTARES)
334	7	0.209000E 03	0.298571E 02	0.527992E 01	0.120827E 01
406	13	0.240000E 03	0.184615E 02	0.125889E 01	0.747112E 00
293	6	0.165000E 03	0.275000E 02	0.269258E 01	0.111288E 01
414	12	0.306000E 03	0.255000E 02	0.266145E 01	0.103195E 01
276	0	0.0	0.0	0.0	0.0
245	0	0.0	0.0	0.0	0.0
253	0	0.0	0.0	0.0	0.0
300	0	0.0	0.0	0.0	0.0
294	1	0.250000E 02	0.250000E 02	0.0	0.101171E 01
299	1	0.270000E 02	0.270000E 02	0.0	0.109265E 01
291	2	0.194000E 03	0.970000E 02	0.370000E 02	0.392545E 01
328	1	0.340000E 02	0.340000E 02	0.0	0.137593E 01
409	1	0.290000E 02	0.290000E 02	0.0	0.117359E 01

\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\* 1 UNIT = .10 ACRE

TABLE 7. AVERAGE TERRITORY SIZE (COMPLETE TERRITORIES); ALL STUDY AREAS

SPECIES NO. OF CODE* TERRITORIES	TOTAL (UNITS)**	MEAN (UNITS)	S.E. MEAN	MEAN (HECTARES)
334	19	0.601000E 03	0.325272E 01	0.128008E 01
406	93	0.155200E 04	0.539461E 00	0.675346E 00
293	26	0.707000E 03	0.201534E 01	0.110043E 01
414	30	0.720000E 03	0.178371E 01	0.971245E 00
276	2	0.161000E 03	0.255000E 02	0.325772E 01
245	1	0.590000E 02	0.0	0.238764E 01
253	1	0.520000E 02	0.0	0.210436E 01
300	3	0.770000E 02	0.112151E 02	0.103869E 01
294	3	0.690000E 02	0.585946E 01	0.930777E 00
299	1	0.270000E 02	0.0	0.109265E 01
291	2	0.194000E 03	0.370000E 02	0.392545E 01
328	2	0.630000E 02	0.250000E 01	0.127476E 01
409	3	0.460000E 02	0.688799E 01	0.620518E 00

\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES

\*\* 1 UNIT = .10 ACRE

## POPULATION TRENDS

Breeding male populations varied little from year to year over the nine year period, but have shown a steady and statistically significant ( $P < .01$ ) increase from 69 males/100 hectares in 1964 to 193 males/100 hectares in 1972 (Fig. 27A). Each of the study areas showed similar increases. The average breeding male population of 130/100 hectares although considerably lower than in spruce-fir stands in the boreal forest, is comparable to population levels registered in other pine stands (Erskine, 1971) in the boreal forest. Estimates in the present report are lower than those given in previous reports (McLeod, 1967, 1968) for the same areas, because of the more rigorous definition of a confirmed territory defined in the present report (cf. page 4, and Appendix I).

Bird species diversity as defined by the Shannon index of diversity has also increased slightly ( $P < .05$ ) from 1964 to 1972 (Fig. 27B). Both the increase in numbers and diversity may be a function of stand maturity. In plot 2 the older stand, the increase in both numbers and diversity is slowest. Also, species diversity and numbers are higher in the rich stands, (study areas 3 and 4), than in the poor stands (study areas 2 and 5) (Tables 8-12).

Of the 25 breeding male species recorded from jack pine stands (Table 12) four ground nesters, the slate-coloured junco (406) hermit thrush (293), white throated sparrow (414) and olive-backed thrush (294) account for over 64 per cent of the total number of territories. The number of these ground nesters is proportionally higher (71 and 81 per cent respectively) in the poor stands plots 5 and 2 than in the richer sites 3 and 4 where the proportions are 42 and 47 per cent respectively.

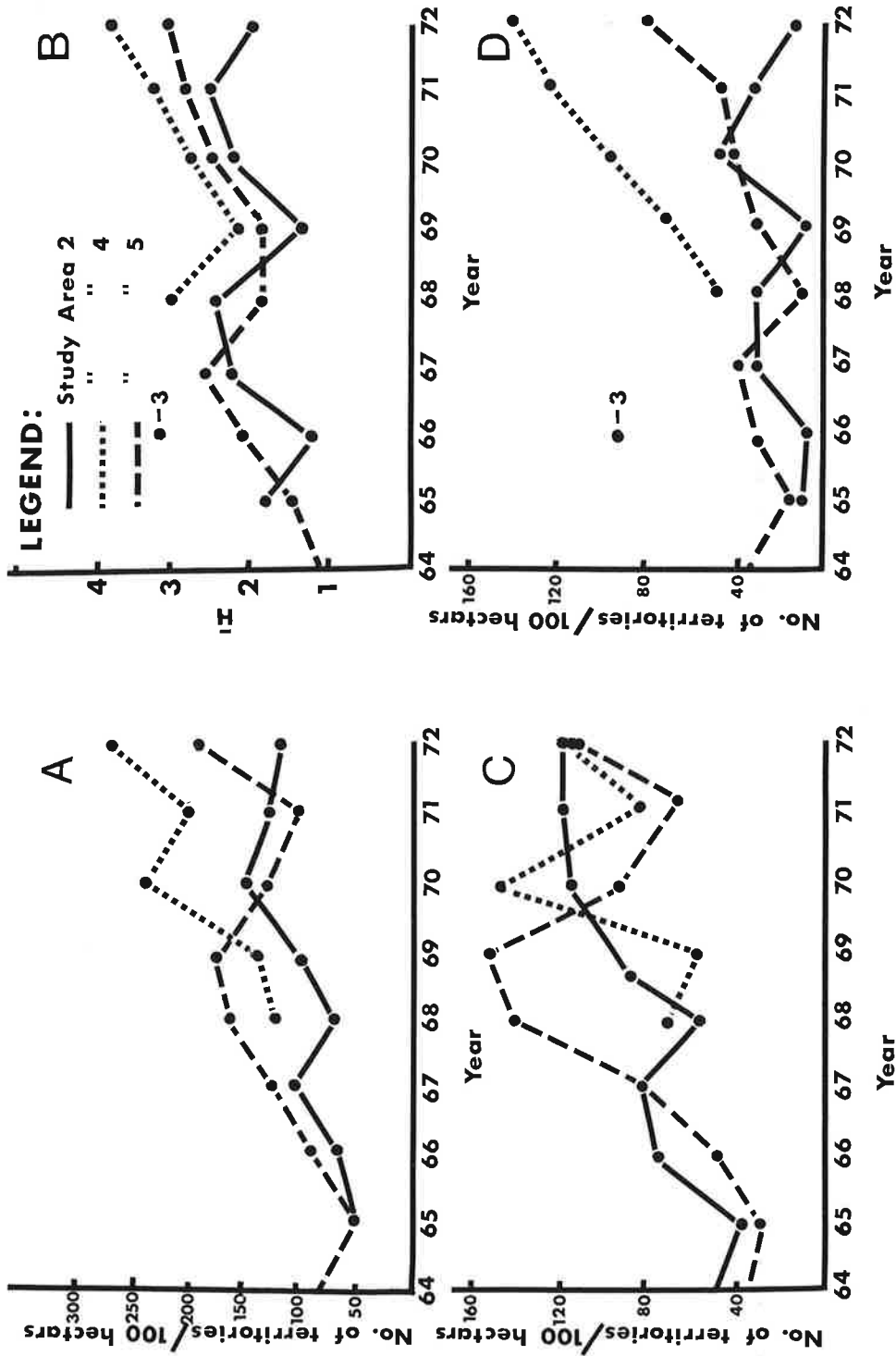


Fig. 27 A-D. Population trends of birds in jack pine stands in Quebec, 1964-1972. A. Total number of territories per 100 hectares. B. Shannon diversity index (H). C. Total number of territories per 100 hectares, terrestrial nesters. D. Total number of territories per 100 hectares, arboreal nesters.

The absolute number of ground nesting birds was similar in all study areas whereas the absolute numbers of arboreal nesters was much higher in the richer sites (Fig. 27 C,D). The ground-nesting species are dominant. The jack pine stands of central Quebec are monocultures. The canopy is one-storied, relatively open and narrow crowned. Thus, vertical stratification in the stand is low and the open crowns afford a clear view for aerial predators, probably accounting for the low numbers of arboreal nesters.

The ground cover on the other hand which averages about .75 metres in height is dense and rich in species, affording protection from predators and provides a diversified food supply. This probably explains the dominance of the ground nesting birds. Typical birds of jack pine stands include all the ground nesters plus only a few of the 18 species of arboreal nesters. These include the myrtle warbler, the dominant arboreal nester, which accounts for over half of the arboreal territories, and others include, in order of abundance, the blue-headed vireo, american robin, brown-capped chickadee, chipping sparrow, brown creeper, and purple finch. The other species occur only in ecotones where vertical stratification is augmented through additional trees and shrubs. In the example of combined territory distribution for all years for study area 4 shown in Fig. 4 of McLeod (1973) areas of high territory density are found; on the east side of the plot where alders, birches and trembling aspens along a roadside have increased vertical stratification; near the south west corner where the stand becomes mixed jack pine-black spruce, and in the northwest corner, a border area between a jack pine stand and a black spruce-tamarack stream bed. A more detailed analysis of bird distribution in each of the study areas will appear in a forthcoming publication.



TABLE 8. BIRD POPULATION TRENDS; STUDY AREA 2

SPECIES	ADJUSTED NUMBER OF TERRITORIES BY YEARS *													TOTAL	MEAN
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1973	1973			
334	0	0	0	1	1	1	4	2	1	0	0	10	1.2500		
406	0	3	7	5	4	9	8	6	8	0	0	50	6.2500		
293	0	1	2	2	1	2	5	3	2	0	0	18	2.2500		
414	0	1	0	4	2	1	1	4	4	0	0	17	2.1250		
276	0	0	1	0	0	0	0	0	0	0	0	1	0.1250		
245	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
253	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
300	0	0	0	1	1	0	1	1	1	0	0	5	0.6250		
294	0	0	0	0	0	0	0	1	0	0	0	1	0.1250		
299	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
291	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
328	0	1	0	1	0	0	0	0	0	0	0	2	0.2500		
409	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
326	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
331	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
340	0	0	0	0	1	0	0	0	0	0	0	1	0.1250		
352	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
367	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
314	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
274	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
312	0	0	0	0	0	0	1	0	0	0	0	1	0.1250		
347	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
387	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
281	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
382	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
TOTAL	0	6	10	14	10	13	20	17	16	0	0	106	13.2500		
NO OF SPECIES	0	4	3	6	6	4	6	6	5	0	0	10	5.0000		
H***	0.0	1.792	1.157	2.264	2.322	1.352	2.141	2.307	1.875	0.0	0.0		2.260		

\* COMPLETE AND ACCEPTED PARTIAL TERRITORIES  
 \*\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\*\* SHANNON INDEX OF DIVERSITY

TABLE 9. BIRD POPULATION TRENDS; STUDY AREA 3

SPECIES	ADJUSTED NUMBER OF TERRITORIES BY YEARS *											TOTAL	MEAN
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1973		
334	0	0	2	0	0	0	0	0	0	0	0	2	2.0000
406	0	0	5	0	0	0	0	0	0	0	0	5	5.0000
293	0	0	2	0	0	0	0	0	0	0	0	2	2.0000
414	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
276	0	0	0	0	0	0	0	0	0	0	0	0	0.0
245	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
253	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
300	0	0	3	0	0	0	0	0	0	0	0	3	3.0000
294	0	0	2	0	0	0	0	0	0	0	0	2	2.0000
299	0	0	0	0	0	0	0	0	0	0	0	0	0.0
291	0	0	0	0	0	0	0	0	0	0	0	0	0.0
328	0	0	0	0	0	0	0	0	0	0	0	0	0.0
409	0	0	0	0	0	0	0	0	0	0	0	0	0.0
326	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
331	0	0	2	0	0	0	0	0	0	0	0	2	2.0000
340	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
352	0	0	2	0	0	0	0	0	0	0	0	2	2.0000
367	0	0	1	0	0	0	0	0	0	0	0	1	1.0000
314	0	0	0	0	0	0	0	0	0	0	0	0	0.0
274	0	0	0	0	0	0	0	0	0	0	0	0	0.0
312	0	0	0	0	0	0	0	0	0	0	0	0	0.0
347	0	0	0	0	0	0	0	0	0	0	0	0	0.0
387	0	0	0	0	0	0	0	0	0	0	0	0	0.0
281	0	0	0	0	0	0	0	0	0	0	0	0	0.0
382	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	0	0	24	0	0	0	0	0	0	0	0	24	24.0000
NO OF SPECIES	0	0	13	0	0	0	0	0	0	0	0	13	13.0000
H***	0.0	0.0	3.486	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.486	

\* COMPLETE AND ACCEPTED PARTIAL TERRITORIES

\*\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES

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TABLE 10. BIRD POPULATION TRENDS; STUDY AREA 4

SPECIES CODE **	ADJUSTED NUMBER OF TERRITORIES BY YEARS *											TOTAL	MEAN
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1973		
334	0	0	0	0	1	6	6	2	6	0	21	4.2000	
406	0	0	0	0	4	2	5	5	6	0	22	4.4000	
293	0	0	0	0	1	2	4	3	3	0	13	2.6000	
414	0	0	0	0	3	3	7	3	3	0	19	3.8000	
276	0	0	0	0	0	0	0	0	0	0	0	0.0	
245	0	0	0	0	0	0	0	0	0	0	0	0.0	
253	0	0	0	0	0	0	0	0	0	0	0	0.0	
300	0	0	0	0	1	0	0	2	2	0	5	1.0000	
294	0	0	0	0	1	0	2	0	1	0	4	0.8000	
299	0	0	0	0	1	0	0	0	1	0	2	0.4000	
291	0	0	0	0	0	0	1	1	1	0	3	0.6000	
328	0	0	0	0	2	0	0	3	3	0	8	1.6000	
409	0	0	0	0	0	0	0	0	1	0	1	0.2000	
326	0	0	0	0	0	0	1	3	2	0	6	1.2000	
331	0	0	0	0	1	0	1	0	1	0	3	0.6000	
340	0	0	0	0	0	3	0	2	1	0	6	1.2000	
352	0	0	0	0	0	0	0	0	1	0	1	0.2000	
367	0	0	0	0	0	0	0	0	0	0	0	0.0	
314	0	0	0	0	1	1	1	0	1	0	4	0.8000	
274	0	0	0	0	0	0	0	0	0	0	0	0.0	
312	0	0	0	0	0	0	0	1	0	0	1	0.2000	
347	0	0	0	0	0	0	1	0	0	0	1	0.2000	
387	0	0	0	0	0	0	0	1	0	0	1	0.2000	
281	0	0	0	0	0	0	0	0	0	0	0	0.0	
382	0	0	0	0	0	0	0	0	2	0	2	0.4000	
TOTAL	0	0	0	0	16	17	29	26	35	0	123	24.6000	
NO OF SPECIES	0	0	0	0	10	6	10	11	16	0	19	10.6000	
H***	0.0	0.0	0.0	0.0	3.078	2.380	2.900	3.292	3.664	0.0		3.566	

\* COMPLETE AND ACCEPTED PARTIAL TERRITORIES  
 \*\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\*\* SHANNON INDEX OF DIVERSITY

TABLE 11. BIRD POPULATION TRENDS; STUDY AREA 5

SPECIES	ADJUSTED NUMBER OF TERRITORIES BY YEARS *													TOTAL	MEAN
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1973	1973			
334	3	2	2	2	1	1	3	1	3	0	0	18	2.0000		
406	5	3	5	5	11	14	6	4	7	0	0	60	6.6667		
293	1	1	1	1	2	3	5	1	4	0	0	19	2.1111		
414	0	0	1	3	4	1	1	3	3	0	0	16	1.7778		
276	0	0	0	0	0	1	0	0	1	0	0	2	0.2222		
245	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
253	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
300	0	0	0	0	0	0	1	1	1	0	0	3	0.3333		
294	0	0	0	2	1	1	0	0	0	0	0	4	0.4444		
299	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
291	0	0	0	1	0	0	0	0	1	0	0	2	0.2222		
328	0	0	0	1	0	0	0	0	1	0	0	2	0.2222		
409	0	0	0	0	0	0	0	0	2	0	0	2	0.2222		
326	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
331	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
340	0	0	1	0	0	0	0	0	0	0	0	1	0.1111		
352	0	0	0	0	0	0	0	1	0	0	0	1	0.1111		
367	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
314	0	0	1	0	0	0	0	0	0	0	0	1	0.1111		
274	0	0	0	1	0	0	0	0	0	0	0	1	0.1111		
312	0	0	0	0	1	1	1	2	2	0	0	7	0.7778		
347	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
387	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
281	0	0	0	0	0	0	0	1	0	0	0	1	0.1111		
382	0	0	0	0	0	0	0	0	0	0	0	0	0.0		
TOTAL	9	6	11	16	20	22	17	14	25	0	0	140	15.5556		
NO OF SPECIES	3	3	6	8	6	7	6	8	10	0	0	16	6.3333		
H***	1.352	1.459	2.222	2.727	1.919	1.820	2.213	2.753	2.997	0.0	0.0		2.739		

\* COMPLETE AND ACCEPTED PARTIAL TERRITORIES  
 \*\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\*\* SHANNON INDEX OF DIVERSITY

TABLE 12. BIRD POPULATION TRENDS; ALL STUDY AREAS

SPECIES	ADJUSTED NUMBER OF TERRITORIES BY YEARS *											TOTAL	MEAN
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1973		
406	5	6	17	10	19	25	19	15	21	0	137	5.9565	
414	0	1	2	7	9	5	9	10	10	0	53	2.3043	
293	1	2	5	3	4	7	14	7	9	0	52	2.2609	
334	3	2	4	3	3	8	13	5	10	0	51	2.2174	
300	0	0	3	1	2	0	2	4	4	0	16	0.6957	
328	0	1	0	2	2	0	0	3	4	0	12	0.5217	
294	0	0	2	2	2	1	2	1	1	0	11	0.4783	
312	0	0	0	0	1	1	2	3	2	0	9	0.3913	
340	0	0	2	0	1	3	0	2	1	0	9	0.3913	
326	0	0	1	0	0	0	1	3	2	0	7	0.3043	
314	0	0	1	0	1	1	1	0	1	0	5	0.2174	
331	0	0	2	0	1	0	1	0	1	0	5	0.2174	
291	0	0	0	1	0	0	1	1	2	0	5	0.2174	
352	0	0	2	0	0	0	0	1	1	0	4	0.1739	
409	0	0	0	0	0	0	0	0	3	0	3	0.1304	
276	0	0	1	0	0	1	0	0	1	0	3	0.1304	
382	0	0	0	0	0	0	0	0	2	0	2	0.0870	
299	0	0	0	0	1	0	0	0	1	0	2	0.0870	
281	0	0	0	0	0	0	0	1	0	0	1	0.0435	
387	0	0	0	0	0	0	0	1	0	0	1	0.0435	
347	0	0	0	0	0	0	0	1	0	0	1	0.0435	
274	0	0	0	1	0	0	1	0	0	0	1	0.0435	
367	0	0	1	0	0	0	0	0	0	0	1	0.0435	
253	0	0	1	0	0	0	0	0	0	0	1	0.0435	
245	0	0	1	0	0	0	0	0	0	0	1	0.0435	
TOTAL	9	12	45	30	46	52	66	57	76	0	393	17.0869	
NO OF SPECIES	3	5	15	9	12	9	12	14	18	0	25	10.7778	
H***	1.352	1.959	3.184	2.694	2.741	2.314	2.762	3.248	3.406	0.0		<b>3.173</b>	

\* COMPLETE AND ACCEPTED PARTIAL TERRITORIES  
 \*\* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES  
 \*\*\* SHANNON INDEX OF DIVERSITY

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## REFERENCES

- Erskine, A.J. 1970. A preliminary catalogue of bird census studies in Canada. Can. Wildl. Serv. Prog. Notes. 20. 77 p.
- Kendeigh, S.C. 1944. Measurement of bird populations. Ecol. Monog. 14:67-106
- Kendeigh, S.C. 1947. Bird population studies in the coniferous forest biome during a spruce budworm outbreak. Ont. Dept. Lands For., Div. Res., Biol. Bull. No.1.
- Margalef, R. 1968. Perspectives in ecological theory. University of Chicago Press, Chicago, Ill. 111 p.
- McLeod, J.M. 1967. The effect of Phosphamidon on bird populations in jack pine stands in Quebec. Can. Field Nat. 81:102-106.
- McLeod, J.M. 1968. Results of an aerial spraying operation against the Swaine jack pine sawfly, *Neodirpion swainei* Middleton in Quebec utilizing the insecticide Phosphamidon. For. Chron. 44:14-20.
- McLeod, J.M. 1973. Information retrieval for the Swaine jack pine sawfly life system: a manual of coded sampling forms. Serv. Canad. des Forêts. Rapp. d'Inform. LAU-X-2:95 pp.

- McLeod, J.M. and D. Brochu. 1973. Fortran IV data summaries for the Swaine jack pine sawfly life system. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-3. 59 p.
- McLeod, J.M. and R. Lagüe. 1973. APL/360 programs for the-development and analysis of life tables for the Swaine jack pine sawfly. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-4; 73 pp.
- Plonski, W.L. 1960. Normal yield tables. Ont. Dep. Lands For. (Silvic. Ser.) Bull. No.2:16-19.





Appendix I



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MCLEOD

CACUL FOR BIRDS TERRITORIES

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REAL SOMME(4,10)/40*0./,TAREA(30)/30*0./,VMOYE(30)/30*0./,XRESU(30
1)/30*0./,ADDIT(10)/10*0./,VRESU(30,10)/300*0./,ANNE(30)/30*0./,AND
2RE(30,10)/300*0./,RESUL(4,30,10)/1200*0./,CABA(4,10)/40*0./,VVV(10
3)/10*0./,TMOYE(30,4)/120*0./,CACUL(30,4)/120*0./,POS I(4,30,10)/120
40*0./,TRESU(30,4)/120*0./
INTEGER NREFE(30)/30*0/,NCONT(4,30,10)/1200*0/,NC(10)/10*0/,IANV
1(10)/10*0/,NESPE(30,4)/120*0/,LVV(10)/10*0/,LCC(10)/10*0/,LCOMP(4,
210)/40*0/,ICOMP(4,10)/40*0/,LCESP(4,10)/40*0/,LVCES(4,10)/40*0/,MA
3REA(30)/30*0/,MCONT(30)/30*0/,KCONT(30,10)/300*0/,KAREA(30,10)/300
4*0/,ICORR(18)/18*0/,JXARE(30)/30*0/,JAREA(30)/30*0/,NAREA(4,30,10)
5/1200*0/,IXARE(30,4)/120*0/,NXARE(30,4)/120*0/,LLLL(10)/10*0/,LVLV
6(10)/10*0/,MMM(10)/10*0/,MMA(30,10)/300*0/,NNA(30)/30*0/,IAREA(4,3
70,10)/1200*0/
IHECT=0
LL=0
KK=1
JJ=1
II=1
IND=0
M=1
3 FORMAT(2I2,6X,I2,I3,I2,I1,7X,9(I4,I2),I1)
25 READ(1,3,END=4) ICAT,IAN,LOCAL,IBIRD,ITERR,ICLAS,ICORR,ICART
WRITE(4) ICAT,IAN,LOCAL,IBIRD,ITERR,ICLAS,ICORR,ICART
GO TO 25
4 REWIND 4
1 READ(4,END=100) ICAT,IAN,LOCAL,IBIRD,ITERR,ICLAS,ICORR,ICART

C
C
C
FILTER

IF(ICAT.NE.5) GO TO 1
IF(IAN.LT.64.OR.IAN.GT.73) GO TO 1
IF(LOCAL.LT.2.OR.LOCAL.GT.5) GO TO 1
IF(ICART.GT.2) GO TO 1
IF(IND.EQ.1) GO TO 7
IF(ICLAS.GT.1) GO TO 1
IF(IBIRD.LT.100.OR.IBIRD.GT.424) GO TO 1
GO TO 6
7 IF(ICLAS.NE.2) GO TO 1
IF(ICART.GT.2) GO TO 1
6 IF(ICART.GT.1) GO TO 150
IF(IND.EQ.1) GO TO 8
IAREA(II,KK,JJ)=IAREA(II,KK,JJ)+IHECT
NAREA(II,KK,JJ)=NAREA(II,KK,JJ)+IHECT**2
GO TO 140
8 DC 130 NN=1,30
IF(NREFE(NN).NE.NNREF) GO TO 130
IF(IHECT.EQ.0) GO TO 130
IF(IHECT.GE.81) GO TO 131
IF(TAREA(NN).EQ.0.) TAREA(NN)=DIVIS
IF(TAREA(NN).GE.81) GO TO 131
UVW=.5*TAREA(NN)
IF(IHECT.LT.UVW) GO TO 130

```

```

131 NCONT(II, KK, JJ)=NCONT(II, KK, JJ)+1
130 CONTINUE
140 IHECT=0
    IF( IBIRD.EQ.424) GO TO 1
    I=LOCAL-1
    J=IAN-63
    N=1
    DO 50 K=1, M
    IF(NREFE(K).NE.IBIRD) GO TO 15
    N=0
    IF(IND.EQ.1) GO TO 15
    NCONT(I, K, J)=NCONT(I, K, J)+1
15 IF(K.NE.M) GO TO 50
    IF(N.NE.1) GO TO 50
    NREFE(K)=NREFE(K)+IBIRD
    IF(IND.EQ.1) GO TO 50
    NCONT(I, K, J)=NCONT(I, K, J)+1
50 CONTINUE
    NO=IBIRD
    IF(N.EQ.0) GO TO 150
    M=M+1
150 IF(NO.NE.IBIRD) GO TO 132
    DO 120 MO=1, 18, 2
    IF( ICORR(MO).EQ.0) GO TO 120
    IHECT=IHECT+1
120 CONTINUE
    DO 121 L=2, 18, 2
121 IHECT=IHECT+ICORR(L)
    II=I
    JJ=J
    DO 132 MM=1, 30
    IF(NREFE(MM).NE.IBIRD) GO TO 132
    KK=MM
    NNREF=NREFE(MM)
    LL=ICLAS
132 CONTINUE
    GO TO 1

```

C  
C  
C

```

100 IF(IND.EQ.1) GO TO 161
    DO 160 K=1, 30
    DO 160 J=1, 10
    DO 160 I=1, 4
    KAREA(K, J)=KAREA(K, J)+IAREA(I, K, J)
160 KCONT(K, J)=KCONT(K, J)+NCONT(I, K, J)
    DO 170 K=1, 30
    DO 170 J=1, 10
    MAREA(K)=MAREA(K)+KAREA(K, J)
170 MCONT(K)=MCONT(K)+KCONT(K, J)
    DO 180 K=1, 30
    NOMBR=NOMBR+MAREA(K)
    NUMER=NUMER+MCONT(K)
    IF(MCONT(K).EQ.0) GO TO 180
    TAREA(K)=MAREA(K)/FLOAT(MCONT(K))
180 CONTINUE
    DIVIS=NOMBR/FLOAT(NUMER)
    IND=1

```

```

DO 54 I=1,4
DO 30 K=1,30
DO 29 J=1,10
29 NESPE(K,I)=NESPE(K,I)+NCONT(I,K,J)
NW=NESPE(K,I)
30 NNA(K)=NNA(K)+NW
54 CONTINUE

```

C  
C  
C

STATISTICS

```

20 FORMAT(1H1,29X,'TABLE ',I2,',',13X,'AVERAGE TERRITORY SIZE (COMPLE
1TE TERRITORIES); ALL STUDY AREAS',//30X,'SPECIES NO. OF ',5X,'TJ
2TAL ',12X,'MEAN ',15X,'S.E. ',16X,'MEAN',/30X,'CODE* TERRITORIES (U
3NITS)**',8X,'(UNITS) ',13X,'MEAN ',13X,'(HECTARES)',//)
219 FORMAT(1H1,29X,'TABLE ',I2,',',13X,'AVERAGE TERRITORY SIZE (COMPLE
1TE TERRITORIES); STUDY AREA ',I2, '//30X,'SPECIES NO. OF ',5X,'TOTA
2L ',12X,'MEAN ',15X,'S.E. ',16X,'MEAN',/30X,'CODE* TERRITORIES (UNI
3TS)**',8X,'(UNITS) ',13X,'MEAN ',13X,'(HECTARES)',//)
DO 230 I=1,4
LOCAL=I+1
ITABL=I+2
WRITE(3,219) ITABL,LOCAL
DO 221 K=1,30
DO 220 J=1,10
MMA(K,J)=MMA(K,J)+NCONT(I,K,J)
IXARE(K,I)=IXARE(K,I)+IAREA(I,K,J)
220 NXARE(K,I)=NXARE(K,I)+NAREA(I,K,J)
NT=NESPE(K,I)
SX=IXARE(K,I)
SXX=NXARE(K,I)
CALL STAT(NT,SX,SXX,VAR,ECA,ECM,XM)
SXCUN=(.40468564224*XM)/10.
224 FORMAT(32X,I3,6X,I3,4(4X,E14.6))
IF(NREFE(K).EQ.0) GO TO 221
WRITE(3,224) NREFE(K),NT,SX,XM,ECM,SXCUN
225 FORMAT(//,32X,'* SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES',
2/32X,'** 1 UNIT =.10 ACRE')
221 CONTINUE
WRITE(3,225)
230 CONTINUE

```

C  
C  
C

STATISTICS FOR ALL PLOTS

```

ITABL=ITABL+1
WRITE(3,20) ITABL
DO 240 I=1,4
DO 226 K=1,30
JXARE(K)=JXARE(K)+IXARE(K,I)
226 JAREA(K)=JAREA(K)+NXARE(K,I)
240 CONTINUE
DO 227 K=1,30
NT=NNA(K)
SX=JXARE(K)
SXX=JAREA(K)
CALL STAT(NT,SX,SXX,VAR,ECA,ECM,XM)
SXCUN=(.40468564224*XM)/10.
IF(NREFE(K).EQ.0) GO TO 227
WRITE(3,224) NREFE(K),NT,SX,XM,ECM,SXCUN

```

```

227 CONTINUE
  WRITE(3,225)
  GO TO 4
161 CONTINUE
  DO 75 I=1,4
  DO 75 K=1,30
  DO 75 J=1,10
  NESPE(K,I)=0
  MMA(K,J)=0
 75 NNA(K)=0
  NTPOI=0
  LLTOT=0
  DO 110 I=1,4
  LCESH=0
  NPOIN=0
  DO 40 K=1,30
  DO 39 J=1,10
  LCOMP(I,J)=LCOMP(I,J)+NCONT(I,K,J)
39 NESPE(K,I)=NESPE(K,I)+NCONT(I,K,J)
  NW=NESPE(K,I)
  NNA(K)=NNA(K)+NW
  IF(NW.EQ.0) GO TO 40
  LCESH=LCESH+1
40 CONTINUE
  DO 56 J=1,10
  IF(LCOMP(I,J).EQ.0) GO TO 56
  ICOMP(I,J)=ICOMP(I,J)+1
  NPOIN=NPOIN+ICOMP(I,J)
56 CONTINUE
  NTPOI=NTPOI+NPOIN
  IF(NPOIN.EQ.0) GO TO 67
  DO 58 K=1,30
  DO 59 J=1,10
  LCESP(I,J)=0
  LCESP(I,J)=LCESP(I,J)+NCONT(I,K,J)
  IF(LCESP(I,J).EQ.0) GO TO 59
  LVCES(I,J)=LVCES(I,J)+1
59 CONTINUE
  TMOYE(K,I)=NESPE(K,I)/FLOAT(NPOIN)
58 CONTINUE
  LADDI=0
  LTOTH=0
  TMESP=0.
  TSPE S=0.
  DO 63 J=1,10
  LTOTH=LTOTH+LCOMP(I,J)
63 LADDI=LADDI+LVCES(I,J)
  LLTOT=LLTOT+LTOTH
  TMESP=LTOTH/FLOAT(NPOIN)
  TSPE S=LADDI/FLOAT(NPOIN)
  IF(TMESP.EQ.0.) GO TO 67
  DO 31 K=1,30
  DO 11 J=1,10
  IF(LCOMP(I,J).EQ.0) GO TO 11
  IF(NREFS(K).EQ.0) GO TO 31
  CACUL(K,I)=TMOYE(K,I)/TMESP
  POSI(I,K,J)=NCONT(I,K,J)/FLOAT(LCOMP(I,J))
11 CONTINUE

```

```

31 CONTINUE
C
C   SHANNON
C
DO 33 K=1,30
DO 35 J=1,10
CABA(I,J)=POSI(I,K,J)
IF(CABA(I,J).LE.0.0) GO TO 35
RESUL(I,K,J)=(-1.*POSI(I,K,J))*(ALOG(POSI(I,K,J))/ALOG(2.))
IF(CACUL(K,I).LE.0.0) GO TO 33
TRESU(K,I)=(-1.*CACUL(K,I))*(ALOG(CACUL(K,I))/ALOG(2.))
35 CONTINUE
33 CONTINUE
TSOME=0.
DO 34 K=1,30
DO 84 J=1,10
84 SOMME(I,J)=SOMME(I,J)+RESUL(I,K,J)
COW=TRESU(K,I)
34 TSOME=TSOME+COW
67 LOCAL=I+1
ITABL=ITABL+1
C
C   PRINT
C
70 FORMAT(1H1,29X,'TABLE ',I3,','. BIRD POPULATION TRENDS; STUDY AREA'
1,I2)
WRITE(3,70) ITABL,LOCAL
DO 99 J=1,10
LCC(J)=LCOMP(I,J)
LLLL(J)=LLLL(J)+LCC(J)
LVV(J)=LVCE S(I,J)
VVV(J)=SOMME(I,J)
99 IANN(J)=J+63
72 FORMAT(/,30X,'SPECIES',15X,'ADJUSTED NUMBER OF TERRITORIES BY YEA
IRS *',//30X,'CODE ** ',10('19',I2,2X),'TOTAL MEAN'/)
WRITE(3,72) IANN
DO 16 K=1,30
DO 17 J=1,10
17 NC(J)=NCNT(I,K,J)
91 FORMAT(32X,I3,11(3X,I3),3X,F7.4)
IF(NREFE(K).EQ.0) GO TO 16
WRITE(3,91) NREFE(K),NC,NE SPE(K,I),TMOYE(K,I)
16 CONTINUE
92 FORMAT(/,31X,'TOTAL ',2X,I3,10(3X,I3),3X,F7.4,//30X,'NO OF',/30X,'S
1PECIES',2X,I2,10(4X,I2),3X,F7.4)
WRITE(3,92) LCC,LTOTH,TMESP,LVV,LCESH,TSPE S
47 FORMAT(/,33X,'H***',1X,10(F5.3,1X),oX,F5.3)
WRITE(3,47) VVV,TSOME
14 FORMAT(/,42X,'* COMPLETE AND ACCEPTED PARTIAL TERRITORIES',/42X,
1'** SEE APPENDIX II FOR COMMON AND SCIENTIFIC NAMES',/42X,'*** S
2HANNON INDEX OF DIVERSITY')
WRITE(3,14)
110 CONTINUE
C
C   PRINT FOR ALL PLOTS
C
LLCES=0
NNPOI=0

```

```

TMESS=0.
TSPEE=0.
DO 2 I=1,4
DO 9 K=1,30
DO 24 J=1,10
24 MMA(K,J)=MMA(K,J)+NCONT(I,K,J)
9 CONTINUE
2 CONTINUE
DO 36 K=1,30
DO 28 J=1,10
IF(MMA(K,J).EQ.0) GO TO 28
LVLV(J)=LVLV(J)+1
28 CONTINUE
36 CONTINUE
DO 10 J=1,10
IF(LVLV(J).EQ.0) GO TO 10
NNPOI=NNPOI+1
10 CONTINUE
IPLACE=0
DO 77 J=1,10
77 IPLACE=IPLACE+LVLV(J)
TMESS=LLTOT/FLOAT(NTPOI)
TSPEE=IPLACE/FLOAT(NNPOI)
ITABL=ITABL+1
18 FORMAT(1H1,29X,'TABLE ',I3,','. BIRD POPULATION TRENDS; ALL STUDY A
1REAS')
WRITE(3,18) ITABL
WRITE(3,72) IANN
DO 57 K=1,30
VMOYE(K)=NNA(K)/FLOAT(NTPOI)
IF(NNA(K).EQ.0) GO TO 57
LLCES=LLCES+1
57 CONTINUE
DO 22 K=1,30
DO 21 J=1,10
MMM(J)=MMA(K,J)
ANNE(K)=VMOYE(K)/TMESS
IF(LLLL(J).EQ.0) GO TO 21
ANDRE(K,J)=MMA(K,J)/FLOAT(LLLL(J))
21 CONTINUE
22 CONTINUE
C
C * SHANNON FOR ALL PLOTS
C
DO 43 K=1,30
DO 44 J=1,10
IF(ANDRE(K,J).EQ.0.) GO TO 44
VRESU(K,J)=(-1.*ANDRE(K,J))*(ALOG(ANDRE(K,J))/ALOG(2.))
IF(ANNE(K).EQ.0.) GO TO 43
XRESU(K)=(-1.*ANNE(K))*(ALOG(ANNE(K))/ALOG(2.))
44 CONTINUE
43 CONTINUE
DO 19 K=1,30
J=K+1
93 IF(J.GE.31) GO TO 19
IF(NNA(K).GT.NNA(J)) GO TO 27
NNA=NNA(K)
NNA(K)=NNA(J)

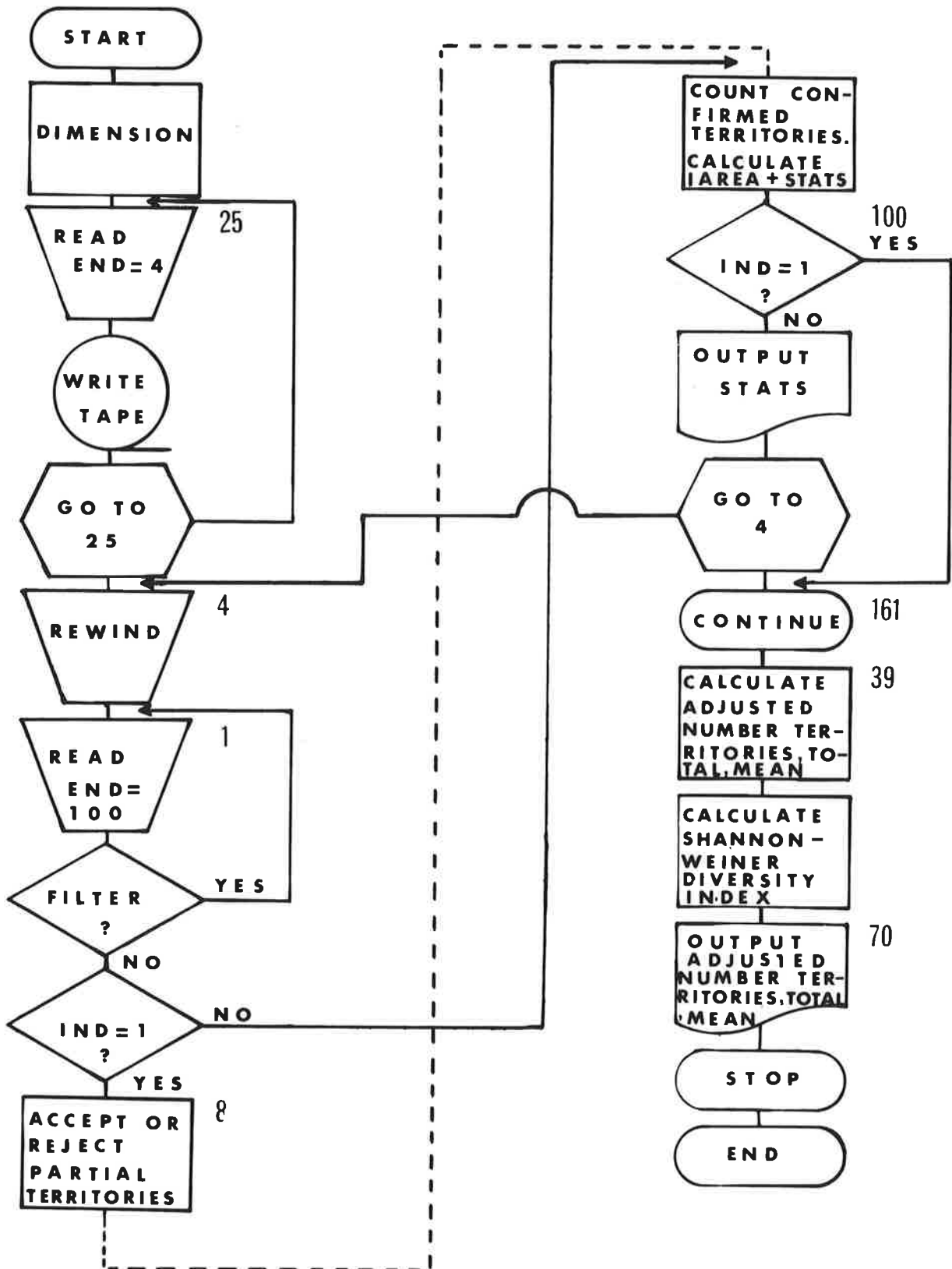
```



```
NNA(J)=NNA
NREF=NREFE(K)
NREFE(K)=NREFE(J)
NREFE(J)=NREF
VMO=VMOYE(K)
VMOYE(K)=VMOYE(J)
VMOYE(J)=VMO
DO 71 JU=1,10
MMA=MMA(K,JU)
MMA(K,JU)=MMA(J,JU)
71 MMA(J,JU)=MMA
27 J=J+1
GO TO 93
19 CONTINUE
DO 55 K=1,30
DO 45 J=1,10
45 ADDIT(J)=ADDIT(J)+VRESU(K,J)
BULL=XRESU(K)
AJOUT=AJOUT+BULL
55 CONTINUE
DO 23 K=1,30
DO 26 J=1,10
26 MMM(J)=MMA(K,J)
IF(NREFE(K).EQ.0) GO TO 23
WRITE(3,91) NREFE(K),MMM,NNA(K),VMOYE(K)
23 CONTINUE
WRITE(3,92) LLLL,LLTOT,TMESS,LVLV,LLCES,TSPEE
WRITE(3,47) ADDIT,AJOUT
WRITE(3,14)
STOP
END
```

```
SUBROUTINE STAT(NT,SX,SXX,VAR,ECA,ECM,XM)
VAR=0.
ECA=0.
ECM=0.
XM=0.
IF(SX.LE.0.) GO TO 34
IF(NT.LE.1) GO TO 32
VAR=(NT*SXX-SX**2)/(NT*(NT-1))
33 ECA=SQRT(VAR)
ECM=ECA/SQRT(FLOAT(NT))
32 IF(NT.EQ.0) GO TO 34
XM=SX/NT
34 RETURN
END
```

# Program BIGBIRD Flow Chart





Appendix II. List of common names, scientific names, and code designations of birds of jack pine stands in Quebec, in order of frequency of occurrence (1964-1972).

<u>Common Names</u>	<u>Scientific Names</u>	<u>Code Designation</u>
Slate-coloured junco	<i>Junco hyemalis</i>	406
Hermit thrush	<i>Hylocichla guttata faxoni</i>	293
White-throated sparrow	<i>Zonotrichia albicollis</i>	414
Myrtle warbler	<i>Dendroica coronata coronata</i>	334
Ruby-crowned kinglet	<i>Regulus calendula calendula</i>	300
Nashville warbler	<i>Vermivora ruficapilla ruficapilla</i>	328
Olive-backed thrush	<i>Hylocichla ustulata</i>	294
Brown-capped chickadee	<i>Parus hudsonicus</i>	276
Brown creeper	<i>Certhia familiaris</i>	281
Bay-breasted warbler	<i>Dendroica castanea</i>	340
American robin	<i>Turdus migratorius</i>	291
Blackburnian warbler	<i>Dendroica fusca</i>	337
Solitary vireo	<i>Vireo solitarius</i>	312
Red-eyed vireo	<i>Vireo olivaceus</i>	314
Red-breasted nuthatch	<i>Sitta canadensis</i>	279
Tennessee warbler	<i>Vermivora peregrina</i>	326
Purple finch	<i>Carpodacus purpureus purpureus</i>	382
Evening grosbeak	<i>Hesperiphona vespertina vespertina</i>	381
Canada jay	<i>Perisoreus canadensis</i>	267
Northern water thrush	<i>Seiurus noveboracensis</i>	347
Golden-crowned kinglet	<i>Regulus satrapa satrapa</i>	299
Chipping sparrow	<i>Spizella passerina passerina</i>	409
Rusty blackbird	<i>Euphagus carolinus</i>	367
Yellowthroat	<i>Geothlypis trichas</i>	352

## Appendix II (Cont'd)

<u>Common Names</u>	<u>Scientific Names</u>	<u>Code Designation</u>
Swamp sparrow	<i>Melospiza georgiana</i>	417
Ovenbird	<i>Seiurus aurocapillus</i>	346
Magnolia warbler	<i>Dendroica magnolia</i>	331
Yellow-bellied flycatcher	<i>Empidonax flaviventris</i>	253
Flicker	<i>Colaptes auratus</i>	236
Arctic three-toed woodpecker	<i>Picoides arcticus</i>	245
Black-capped chickadee	<i>Parus atricapillus</i>	274
Pine siskin	<i>Spinus pinus pinus</i>	387
Spruce grouse	<i>Canachites canadensis</i>	107
Hairy woodpecker	<i>Dendrocopos villosus</i>	242
Cape-may warbler	<i>Dendroica tigrina</i>	332
Alder flycatcher	<i>Empidonax traillii traillii</i>	255
Cedar waxwing	<i>Bombycilla cedrorum</i>	304
Black duck	<i>Anas rubripes</i>	53
Yellow-bellied sapsucker	<i>Sphyrapicus varius varius</i>	241
Least flycatcher	<i>Empidonax minimus</i>	256
Mourning warbler	<i>Oporornis philadelphia</i>	351
Canada warbler	<i>Wilsonia canadensis</i>	356
American redstart	<i>Setophaga ruticilla</i>	357
Philadelphia vireo	<i>Vireo philadelphicus</i>	315
Bronzed grackle	<i>Quiscalus versicolor</i>	371
Green-winged teal	<i>Anas carolinensis</i>	60
Ruffed grouse	<i>Bonasa umbellus</i>	108
Wood pewee	<i>Contopus virens</i>	257
Black throated green warbler	<i>Dendroica virens</i>	335
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>	339
Red wing	<i>Agelaius phoeniceus</i>	364
Black and white warbler	<i>Mniotilta varia</i>	317