

ANNUAL REPORT OF FOREST RESEARCH TECHNICIANS

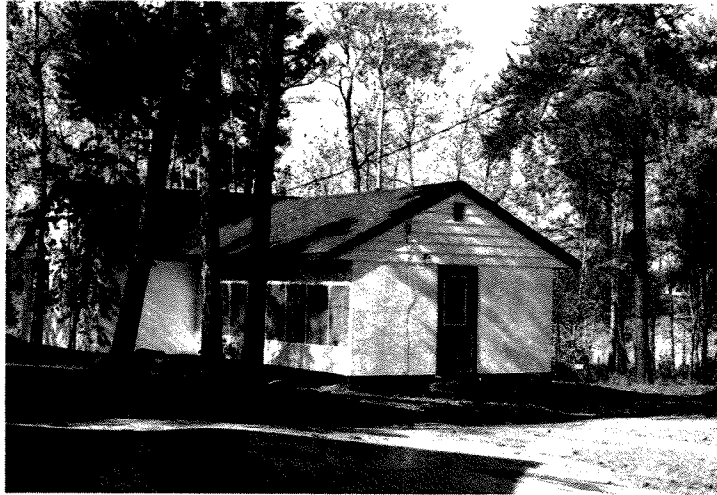
LARCH SAWFLY POPULATION DYNAMICS STUDIES

1966

by

J.A. Drouin, D.G.H. Ray, R.M. Smith, M.J. Pocatello

INTERNAL REPORT MS-40



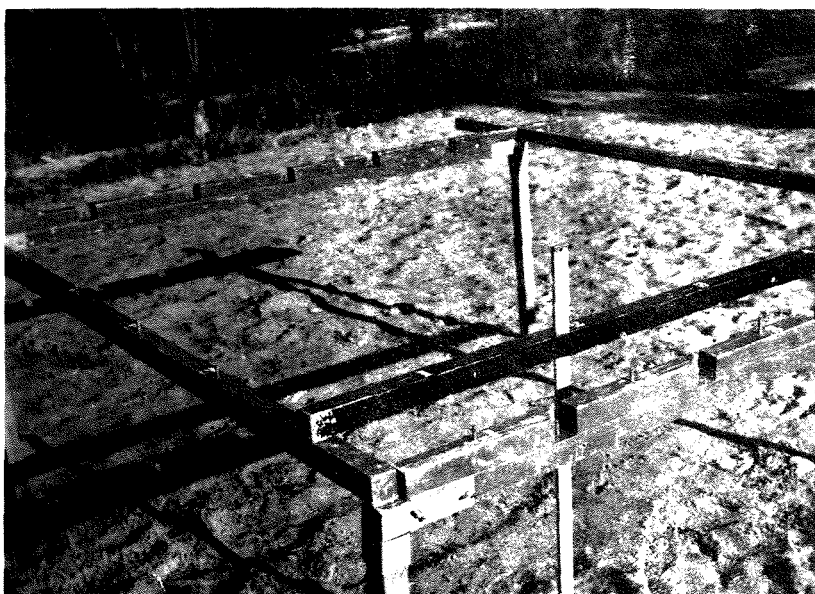
LABORATORY-INSECTARY, WHITESHELL FIELD STATION

Photo by J.A. Drouin



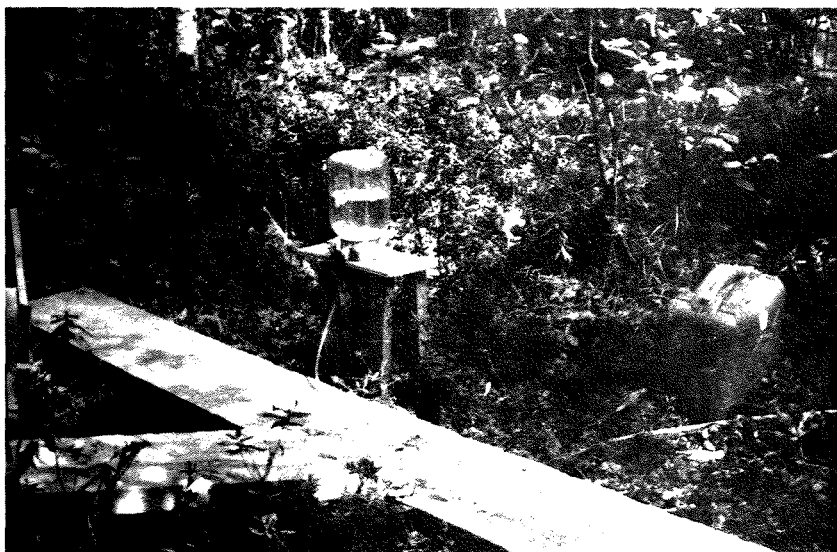
TRAILER, WHITESHELL FIELD STATION, UNIT 2

Photo by J.A. Drouin



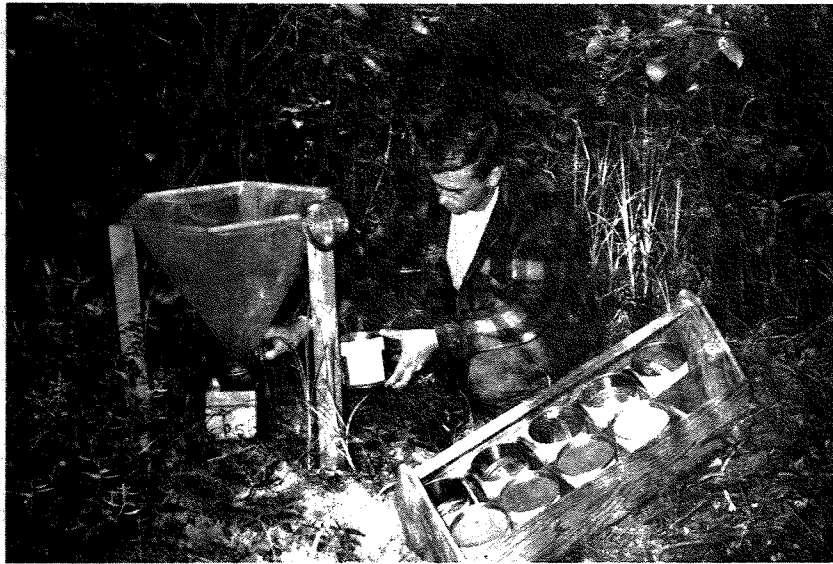
GAUGE USED IN TOPOGRAPHICAL MEASUREMENTS

Photo by C.H. Buckner



WATER FOUNT FOR ARTIFICIAL DATUM USED IN LEVELLING

Photo by J.A. Drouin



SERVICING OIL DROP TRAPS

Photo by C. Burdall



MANITOBA SHORT-TAILED SHREW,
Blarina brevicauda manitobensis (Anderson)

Photo by D.G.H. Ray

INTRODUCTION

This annual report deals with the technical and field aspects of the life table research projects being conducted by the Larch Sawfly Investigation group from the Whiteshell Field Station and the maintenance of the field station property.

During 1966, the collection of data was continued at six study plots for estimating the populations of the larch sawfly in all stages, parasites, vertebrate and invertebrate predators. Annual estimates were continued for mortality in the egg stage, in the larval instars and cocoon stage. Foliage sampling was completed at the remaining three life table plots. Topographical measurements of twenty-five six-foot grids were also completed at three plots. Records of meteorological events, water table fluctuations, defoliation and host tree mortality and phenology were continued. Recording instruments to measure solar radiation, wind gusts, miles of wind, rainfall, relative humidity and temperature were maintained at each plot. Magnetic tape recorders and a 24 point recorder were submitted to trials at the Rennie plot.

These projects were under the direction of the following research officers in their respective areas of program responsibilities:

W.J. Turnock - Project leader; co-ordination of program planning; advanced synthesis and interpretation and reporting of results of over-all project; parasitism by Bessa harveyi.

W.G.H. Ives - Collection and primary analysis of data from the life table system; the effects of weather on sawfly mortality; the impact on invertebrate predators.

C.H. Buckner - Vertebrate predators.

J.A. Muldrew - Biological control studies including the development of impact studies of introduced parasites.

R.J. Heron - Physiology and nutrition, with current emphasis on laboratory studies of the effects of temperature and humidity on development, fecundity and survival.

FIELD STATION OPERATION

In 1966, the Whiteshell Field Station, which serves as a field headquarters for the larch sawfly group, operated from May 2 to September 23. The only major station improvement was the addition of a porch to cottage 2 in late March which completed the program of cottage improvements begun in 1965.

Work outline for 1967 will consist mainly of painting, maintenance and upkeep of buildings and grounds and completion of clay-capping at the disposal field.

Due to the one year transfer of work for W.J. Turnock, some re-assignments occurred in the accommodations:

Cottage 1 - W.G.H. Ives

Cottage 2 - R.M. Smith

Cottage 3 - J. Arthurs

Trailer 1 - B.C. Sutton

Trailer 2 - J.A. Drouin

ASSIGNMENT OF PERSONNEL

In 1966, four Forest Research Technicians, six student assistants, one Insect Sampling and Rearing Aide and two hourly rate employees were assigned to life table studies. One student assistant resigned in mid-July and was replaced by an additional hourly rate employee, while another was assigned to the Winnipeg laboratory for rearings in early August. The personnel and hourly rate categories follow:

FR-260-8925	May	9 - Aug.	26	E. Rotstein	Student Assistant	20 weeks
FR-260-8912	May	2 - Sept.	15	R. Broeska	Student Assistant	20 weeks
FR-260-8917	May	2 - Sept.	15	W. Hominick	Student Assistant	20 weeks
FR-260-8916	May	2 - July	15	W. Mak	Student Assistant	20 weeks
FR-260-8902	April	20 - Sept.	9	G. Low	Student Assistant	20 weeks
FR-260-8903	May	2 - Aug.	22	D. Young	Student Assistant	20 weeks
FR-260-8931	June	27 - Sept.	2	J. Gray	I.S.R.A.	10 weeks
FR-260-8930	June	27 - Sept.	2	C. Christie	Casual	10 weeks
FR-260-8929	June	27 - Sept.	2	J. Price	Casual	10 weeks
FR-260-8933	July	18 - Sept.	2	J. Ramsay	Casual	10 weeks
FR-260-9095	May	2 - Sept.	20	M. McNarland	Maintenance	20 weeks
FR-260-9096	May	2 - Sept.	17	A. McNarland	Cook	20 weeks

TRANSPORTATION EQUIPMENT

One change occurred in the vehicle fleet operating from the field station. A Dodge Town and Country personnel carrier was acquired as a replacement unit for the older model International Travel-all.

POPULATION DYNAMICS STUDIES, LIFE TABLE PLOTS

Larch sawfly populations increased considerably at Rennie and Seddon's Corner. Slight increases were also noted at Telford and Darwin while populations continued to decline at Riverton and Pine Falls. The decline at Riverton was increased by flooding caused by the high water levels of Lake Winnipeg. Since the high water level on the lake is predicted to remain as such, collection of data from this plot may be minimal.

A seventh plot was established 13 miles west on the Hodgson road and 1.1 miles north of the junction of the Hodgson and Fish roads to partially replace the flooded plot. This new plot is located on a slight ridge, composed of strongly calcareous till, very stony, supporting regeneration black spruce, tamarack, black poplar and willow of fire origin. In this area, larch sawfly populations were high in 1966, causing 80 to 90 percent defoliation. The introduced parasite, Olesicampe sp. nr. nematorum, which was effectively established at the Riverton plot, reaching 87 percent parasitism in 1965, will be released at this Hodgson plot if sufficient numbers are available.

No further change in the status of the eastern larch beetle, Dendroctonus simplex (Lec.) was recorded at the Rennie plot.

Meteorological instruments, recorders and oil drop funnels were serviced at weekly intervals while emergence traps were changed every second week. Plot retallies to obtain tree mortality, growth in height, d.b.h., and measurements of crown depth were completed at the five remaining plots. This data is used in part to evaluate the effect of larch sawfly on the host, successional changes in stand composition resulting from these attacks and in randomization of trees for assessing certain aspects of the population dynamics

EFFECTS OF DEFOLIATION ON HOST STANDS

The adverse effects of continued larch sawfly defoliation and subsequent deterioration of the host stand is being evaluated in the six plots. Records are taken annually on the individual trees for defoliation, growth and mortality. Defoliation records are also maintained of each tree above all oil funnels. The average defoliation, diameters and mortality for the current year are shown in Table I.

TABLE I

Tamarack Mortality and Defoliation in Six Population Dynamics Plots
1966

PLOT		No. living trees re- maining in plot 1966	No. trees dying in 1966	% trees dying in 1966	Average DBH of dead trees	Living Trees **				Defoliation	
						DBH (Inches)		Height (Feet)		% Range	
						Mean	Range	Mean	Range	Mean	Range
Rennie [†]	1.	199	0	0	0	5.1	2.9-7.0	46	36-58	49.4	9-100
Telford [†]	2.	241	7	2.9	0.6	1.4	0.5-4.0	10	2-24	5.7	0-62
Seddon's [†] Corner	3.	495	2	0.4	2.3	3.7	1.7-5.4	36	19-46	26.7	3-100
Pine Falls	4.	570	0	0	0	1.5	0.5-4.0	16	7-32	9.6	0-52
Riverton [†]	5.	273	0	0	0	3.5	1.9-6.9	27	14-40	2.9	0-15
Darwin [†]	6.	111	0	0	0	7.3*	4.2-10.5*	43*	19-57*	13.4	0-40

** Calculations based on random sample of 40 trees

* Calculations based on random sample of 30 trees

† Plot retallied in 1966

DEVELOPMENT OF TECHNIQUES

The modified sampling technique for estimating populations of invertebrate predators on larch was used at all six plots in 1966, utilizing the two tables and hoods. The experimental phase of this project has been completed and the manuscript containing data on the abundance of the numerous invertebrate predators and prey has been submitted for publication. The sampling will be continued until sufficient data for final analysis has been collected.

The predator sampling sheets were changed from white to blue paper to separate the predator sampling vials from the mass collection vials and maintain the continuity of the data. In addition to the large label with the pertinent information on it, a small blue label with the branch level and date was included in the predator vial. During the preliminary sort at the field station the insects are sorted out from the debris and placed in 1/4 dram shell vials. The small label is included for the appropriate branch and the vials stored in 12 dram plastic vials. This modification makes the collection date visible in the shell vial without opening the larger vial. This procedure also speeds up identification in the laboratory during the winter as the vials can be easily set up in chronological order. The smaller blue labels also reduce the amount of mutilation of insect specimens through squashing. Egg shoots collected from the branch samples were also susceptible to loss during data transfer since the branch level designation could be omitted when egg and larval counts were entered in the field rearing records. To guard against this, the rearing tubes for these egg shoots were identified in the field with red plastic adhesive tape and the branch designation. For the past few years abnormal egg mortality was observed on egg shoots in rearing. As a corrective measure, the egg shoots and emergence traps, (which contain a toxic substance for killing emerging insects) collected during weekly servicing periods are now separated. The emergence traps are transported in a plywood carrier box which is mounted on the roof of the vehicle by car top carriers to prevent possible contamination. Similar mortality was observed at the field station when the emergence traps and egg shoots were housed in the same building. At present the emergence traps are sorted in a different building and stored there. Another possible source of mortality may have resulted from the fluctuations of temperatures within the insectary. In 1967 egg shoots will be reared in a specially constructed concrete, constant temperature room. It is hoped that these modifications will decrease egg mortality and bring rearing results closer to natural mortality.

In a cooperative project to establish the parasite Olesicampe sp. nr. nematorum in the Maritimes and Maine, approximately 18,000 fourth and fifth instar larvae were collected in the vicinity of the plot at Pine Falls, ranging from 1/4 to 3/4 of a mile from the release point. To prevent any accidental release of the parasite at the field station, the rearing cages were set up over water-filled trays to kill any larvae escaping through the household screen. The principle proved sound but considerable numbers were lost by escaping through the screen and drowning. All cages were therefore converted to a fine mesh brass screen.

The replacement of the meteorological towers was undertaken this past year and the platform enlarged to six feet by six feet to permit easier servicing and to accomodate new instrumentation. The Eppley 180° pyranometer was installed at one plot to supplement the data gathered by the pyreheliometer. This instrument sits atop a three foot pipe stand and is wired to a recording instrument.

The close proximity of some meteorological towers to main arterial roads was a problem. Vandalism was encountered at some plots. As a corrective measure all the instrument boxes and all rain gauges were painted green to camouflage them from the road. The multiple contact anemometers at all plots needed periodic adjustments due to wear in the contacts. After a preliminary test the contacts were replaced by a micro-switch at one plot, using the one-tenth mile of wind gear unit. Tests were satisfactory but to lessen wear and increase legibility of the data on the charts, readings were decreased to the one-half mile of wind gear unit. All multiple contact anemometers have now been modified.

An attempt was made to ascertain whether megachilids, (leaf cutter wasps), some of which provision their nests with larvae, were present in life-table plots. Cardboard containers were dipped in wax to prevent weathering and filled with both plastic or paper fountain straws. Six of these containers were placed on six separate trees at eye level on the perimeter of each plot. These were checked at weekly intervals; however, no evidence of megachilids was found in the straws. For several years accuracy and range of hygrothermographs used at the plots have been erratic after installation, requiring adjustments and resulted in the loss of some data. To eliminate this problem, hygrothermographs were run in prior to installation at the plots. With further refinements in handling and transporting of these sensitive instruments, error in these data should become negligible.

Analog recorders were sent to a scientific instrument service centre for annual servicing in 1965 and 1966. After installation in 1966, all recorders were operating erratically. They were removed from the plots in June and re-examined by the same serviceman. After re-installation the recorders still malfunctioned. The drive mechanisms were therefore returned to the factory for servicing. This policy will become an annual practice.

Modifications were made to the data code cards numbers 1 to 10, clarifying the terms of reference of each card. In some cases, changes were made where problems arose during the transfer of data which were not anticipated nor allowed for, during the drafting of the card outlines.

LARCH SAWFLY POPULATION AND SURVIVAL ESTIMATES

Data from larch sawfly egg, larval and cocoon collections were coded and recorded on data sheets for punching on I.B.M. cards. The survival estimates for each larval instar collection period and confidence intervals for the six plots in operation during 1965 and 1966 are shown in Tables II to XIII.

Populations per acre are estimated annually for adults, eggs, and cocoons and confidence intervals for each state are calculated. Tables XIV and XV show the populations for 1965 and 1966.

MORTALITY FACTORS

Water Tables:

The larch sawfly is susceptible to mortality from flooding in the larval and cocoon stages. The purpose of water level measurements is to provide data from which to determine the effects of fluctuating water levels on the sawfly survival. During the field season, water levels are taken weekly at all six plots and monthly during the winter until the pipes freeze. Water levels in 1966 were generally lower. At the Rennie life table plot, beaver dams on a creek flowing along the west side caused a marked fluctuation in levels every three weeks; the time needed to rebuild the dam after its removal. At Darwin, a number of emergence cages were placed on higher ground due to high water throughout June. This condition persisted until late July before receding. At Seddon's Corner water level dropped steadily in late July after the construction of a drainage ditch on the northwest corner of the plot.

Lake Winnipeg flooding raised the water level of the Riverton plot to a far greater degree than indicated by the water level readings. Daily fluctuations were observable, with water levels rising by midday or late afternoon due to wind action forcing flood water inland via drainage channels. This flooding caused the loss of data from the oil traps in late August. The topographic datum is the highest hummock encountered when measuring a sample of the contours. Water levels for each plot are expressed as inches below this datum (Table XVI).

TABLE II

SURVIVAL ESTIMATES BY LARVAL INSTAR AND COLLECTION PERIOD WITH 95% CONFIDENCE INTERVALS FOR RENNIE PLOT 1965

COLLECTION DATE	EGGS		I		II		III		IV		V	
	n	%	n	%	n	%	n	%	n	%	n	%
15.6.65	-	-	-	-	-	-	-	-	-	-	-	-
22.6.65	15	87.4	3	87.9	1	93.4	1	73.3	-	-	-	-
29.6.65	61	73.8	-	-	4	62.2	-	-	-	-	-	-
6.7.65	56	79.7	13	84.8	8	74.8	-	-	1	78.9	-	-
13.7.65	33	80.3	33	83.1	22	80.4	12	76.5	8	80.6	-	-
20.7.65	15	96.0	12	83.4	22	82.8	23	77.3	24	76.8	4	53.1
27.7.65	7	75.2	16	79.5	14	73.8	3	76.6	18	65.9	11	59.8
3.8.65	-	-	1	76.0	1	78.2	7	71.2	14	72.7	10	64.4
10.8.65	-	-	-	-	4	38.2	6	83.4	7	69.8	5	66.6
Total	185	80.8	78	82.8	76	76.3	52	76.8	72	72.1	30	61.6
1d1	±2.9		±11.0		±5.4		±4.7		±11.2		±9.6	

n = number of colonies or clusters examined

% = per cent survival of eggs or larvae

1d1 = $\frac{1}{2}$ 95% confidence interval width

TABLE III

SURVIVAL ESTIMATES BY LARVAL INSTAR AND COLLECTION PERIOD WITH 95% CONFIDENCE INTERVALS FOR TELFORD PLOT 1965

COLLECTION	EGGS		I		II		III		IV		V	
DATE	n	%	n	%	n	%	n	%	n	%	n	%
18.6.65	4	82.5	-	-	-	-	-	-	-	-	-	-
23.6.65	17	78.2	-	-	-	-	-	-	-	-	-	-
30.6.65	46	77.4	1	85.7	1	66.6	1	57.1	-	-	-	-
7.7.65	37	77.8	11	70.2	4	38.0	6	60.0	1	97.7	-	-
14.7.65	44	71.5	24	80.3	22	68.2	14	70.4	4	51.3	-	-
21.7.65	11	89.6	13	75.2	22	60.7	16	56.8	8	55.3	4	49.1
28.7.65	4	84.3	7	96.9	10	45.8	18	60.6	22	59.0	6	62.4
4.8.65	-	-	1	100.0	9	81.0	20	74.2	14	67.1	19	50.2
Total	163	76.2	57	80.5	68	62.6	75	65.0	49	61.6	29	53.7
1d/	± 3.8		± 5.3		± 6.4		± 10.3		± 8.0		± 12.7	

n = number of colonies or clusters examined

% = per cent survival of eggs or larvae

1d/ = $\frac{1}{2}$ 95% confidence interval width

TABLE IV

Survival Estimates by Larval Instar and Collection Period with
95% Confidence Interval for Seddon's Corner Plot 1965

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
15.6.65	8	75.0	-	-	-	-	-	-	-	-	-	-
22.6.65	20	82.0	3	62.9	4	77.0	4	65.3	-	-	-	-
29.6.65	25	92.4	5	81.1	9	64.5	5	63.7	-	-	-	-
6.7.65	43	90.3	11	71.6	8	69.0	1	68.4	1	78.7	-	-
13.7.65	16	84.3	21	76.6	11	59.4	11	62.7	7	37.6	7	64.9
20.7.65	13	91.5	9	80.0	26	66.8	14	80.9	10	75.0	4	63.3
27.7.65	-	-	1	100.0	5	83.8	5	91.4	21	60.8	21	56.4
3.8.65	-	-	-	-	-	-	-	-	-	-	3	51.8
Total	125	88.2	50	76.4	63	67.0	40	75.0	39	62.4	35	59.4
/d/	± 3.0		± 4.9		± 9.8		± 6.6		± 9.4		± 7.1	

N = Number of Colonies or Clusters examined

% = Percent survival of eggs or larvae

/d/ = $\frac{1}{2}$ 95% confidence interval width

TABLE V

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Pine Falls Plot 1965

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
17.6.65	11	81.4	-	-	-	-	-	-	-	-	-	-
24.6.65	37	71.7	3	53.6	-	-	-	-	-	-	-	-
1.7.65	41	70.5	12	71.3	2	65.9	1	64.7	-	-	-	-
8.7.65	50	73.0	30	70.6	17	62.2	6	56.8	6	70.2	2	30.7
15.7.65	45	74.0	11	85.0	29	86.7	17	59.3	3	32.0	3	36.9
22.7.65	32	77.5	23	77.8	18	60.0	15	58.6	19	47.4	5	68.1
29.7.65	15	76.7	12	75.7	23	67.8	10	68.1	9	71.2	10	57.8
5.8.65	-	-	3	83.7	13	71.6	20	75.2	19	83.5	5	60.9
12.8.65	-	-	1	66.6	1	05.0	14	76.0	9	69.3	12	71.7
19.8.65	-	-	-	-	-	-	1	75.0	-	-	18	52.2
Total	231	73.1	95	75.1	103	70.9	84	66.9	65	67.3	55	60.0
/d/	± 3.2		± 4.8		± 16.5		± 6.4		± 6.6		± 7.9	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = $\frac{1}{2}$ 95% confidence interval width

TABLE VII

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Intervals for Darwin Plot 1965

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
16.6.65	8	93.8	2	92.1	1	70.5	-	-	-	-	-	-
23.6.65	35	92.7	-	-	3	96.8	1	100.0	-	-	-	-
30.6.65	57	89.0	9	81.6	7	56.3	6	74.5	3	53.2	5	70.2
7.7.65	34	89.7	25	62.8	9	67.8	30	65.4	14	53.4	2	31.1
14.7.65	14	81.6	11	59.9	15	74.4	13	63.3	10	68.3	8	72.6
21.7.65	1	100.0	1	43.2	9	72.1	11	58.4	15	68.9	19	49.5
28.7.65	-	-	-	-	1	41.6	7	71.7	14	60.4	19	69.0
4.8.65	-	-	1	90.9	2	45.7	-	-	2	85.7	1	46.1
Total	149	90.1	49	66.1	47	70.1	68	65.9	58	61.2	54	60.0
/d/	± 2.4		± 7.3		± 1.9		± 5.8		± 6.2		± 8.7	

N = Number of colonies or clusters examined
 % = Percent survival of eggs or larvae
 /d/ = 1/2 95% confidence interval width

TABLE VIII

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Rennie Plot 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
14.6.66	-	-	-	-	-	-	-	-	-	-	-	-
21.6.66	41	86.4	-	-	1	100.0	-	-	-	-	-	-
28.6.66	55	71.2	-	-	-	-	1	100.0	-	-	-	-
5.7.66	39	55.5	5	90.3	11	86.9	15	54.5	3	74.0	5	56.5
12.7.66	22	45.2	1	92.6	6	76.6	20	55.0	25	60.4	9	61.5
19.7.66	7	84.8	6	74.2	5	69.9	7	74.4	12	49.7	21	43.0
26.7.66	2	60.3	1	20.8	1	77.7	-	-	1	78.0	3	63.5
Total	166	65.3	13	77.4	24	79.0	43	58.2	41	58.4	38	50.7
/d/	± 4.8		± 14.9		± 6.4		± 8.0		± 8.1		± 10.4	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = 1/2 95% confidence interval width

TABLE IX

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Telford Plot 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
15.6.66	-	-	-	-	-	-	-	-	-	-	-	-
22.6.66	48	82.7	-	-	-	-	-	-	-	-	-	-
29.6.66	51	61.4	6	100.0	10	90.9	-	-	-	-	-	-
6.7.66	29	54.3	4	75.0	16	70.9	26	57.6	6	66.4	1	40.0
13.7.66	5	63.6	4	79.6	4	52.4	25	46.1	15	44.9	14	57.9
20.7.66	1	85.5	-	-	-	-	2	25.0	11	55.8	32	52.5
27.7.66	-	-	-	-	-	-	-	-	-	-	22	48.6
Total	134	67.4	14	89.6	30	75.7	53	53.2	32	54.7	69	52.7
/d/	± 5.0		± 9.2		± 8.7		± 7.2		± 9.1		± 6.1	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = $\frac{1}{2}$ 95% confidence interval width

TABLE X

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Seddon's Corner Plot 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
15.6.66	14	90.4	-	-	-	-	-	-	-	-	-	-
22.6.66	38	81.0	2	86.6	1	60.0	2	66.6	-	-	-	-
29.6.66	45	69.4	19	77.3	5	87.7	8	79.4	2	58.6	2	69.0
6.7.66	39	64.2	31	68.4	25	52.3	27	67.6	24	58.2	2	61.5
13.7.66	27	62.7	15	72.2	6	64.1	32	66.1	20	69.1	37	56.5
20.7.66	1	100.0	1	07.1	1	23.5	9	69.9	14	68.4	44	60.8
27.7.66	-	-	-	-	2	85.0	4	65.8	7	67.9	23	58.4
Total	164	70.6	68	71.8	40	60.1	82	68.1	67	63.3	108	59.2
/d/	± 4.2		± 5.8		± 10.5		± 4.8		± 3.0		± 4.5	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = 1/2 95% confidence interval width

TABLE XI

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Pine Falls 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
16.6.66	5	94.6	-	-	-	-	-	-	-	-	-	-
23.6.66	56	76.4	-	-	-	-	-	-	-	-	-	-
30.6.66	43	76.8	14	64.6	9	62.6	6	68.6	3	87.0	-	-
7.7.66	44	65.5	9	61.3	16	57.4	20	50.8	8	25.4	3	45.1
14.7.66	29	73.2	19	72.2	7	48.7	12	61.7	18	44.5	6	21.4
21.7.66	17	68.5	1	36.3	5	70.0	13	58.7	19	53.6	20	38.1
28.7.66	4	92.0	4	53.4	8	83.9	12	55.8	3	80.5	12	53.1
4.8.66	-	-	-	-	1	100.0	-	-	-	-	2	81.1
11.8.66	-	-	-	-	-	-	1	91.6	-	-	-	-
Total	198	73.2	47	65.2	46	62.8	64	56.0	51	48.8	43	41.6
/d/	± 3.4		± 6.8		± 7.2		± 5.8		± 8.3		± 8.3	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = 1/2 95% confidence interval width

TABLE XII

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Riverton Plot 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
14.6.66	-	-	-	-	-	-	-	-	-	-	-	-
21.6.66	3	76.6	-	-	-	-	-	-	-	-	-	-
28.6.66	53	69.7	1	30.5	2	100.0	-	-	-	-	-	-
5.7.66	43	65.9	10	81.3	9	59.5	10	46.7	6	50.0	-	-
12.7.66	13	69.4	5	63.6	7	58.7	19	52.0	14	46.9	11	38.3
19.7.66	-	-	1	45.4	2	40.0	6	60.0	5	67.0	37	44.0
26.7.66	-	-	-	-	1	76.4	5	75.7	9	68.8	20	54.0
2.8.66	-	-	-	-	-	-	-	-	1	53.5	-	-
Total	112	68.4	17	66.9	21	59.9	40	53.9	35	53.8	68	45.3
/d/	± 4.6		± 14.2		± 16.9		± 9.7		± 10.1		± 5.5	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = 1/2 95% confidence interval width

TABLE XIII

Survival Estimates by Larval Instar and Collection Period
with 95% Confidence Interval for Darwin Plot 1966

Collection Date	Eggs		I		II		III		IV		V	
	N	%	N	%	N	%	N	%	N	%	N	%
16.6.66	24	89.3	-	-	-	-	-	-	-	-	-	-
23.6.66	55	83.3	5	91.9	5	85.3	9	90.0	3	47.0	-	-
30.6.66	53	71.4	5	54.6	22	66.3	10	58.7	4	56.3	5	66.6
7.7.66	21	54.0	18	63.5	19	56.5	21	53.5	21	52.8	14	56.8
14.7.66	4	58.3	6	67.7	6	39.4	9	44.9	39	64.0	29	44.2
21.7.66	-	-	-	-	1	100.0	5	83.9	7	48.5	21	43.3
28.7.66	-	-	-	-	-	-	-	-	1	71.4	8	56.7
Total	157	75.3	34	64.8	53	60.2	54	58.2	75	58.2	77	48.9
/d/	± 1.4		± 9.1		± 8.7		± 10.4		± 5.3		± 5.8	

N = Number of colonies or clusters examined

% = Percent survival of eggs or larvae

/d/ = 1/2 95% confidence interval width

TABLE XIV

Adult, Egg, Larval and Cocoon Populations per Acre and Their One-half 95% Confidence Intervals (/d/) in 1965

	Rennie		Telford		Seddon's Corner		Pine Falls		Riverton		Darwin	
	No.	/d/	No.	/d/	No.	/d/	No.	/d/	No.	/d/	No.	/d/
Adults	2,831	1,448	218	4,086	2,831	1,448	45,738	11,078	218	4,265	*	-
Eggs	686,715	157,820	22,195	14,866	421,990	177,985	416,898	77,633	347,044	16,444	206,563	78,125
Larval I	548,686	-	17,512	-	308,897	-	321,428	-	267,918	-	146,866	-
Instars II	541,132	-	16,136	-	302,989	-	309,338	-	250,566	-	139,017	-
Instars III	523,964	-	14,449	-	295,815	-	288,493	-	230,784	-	132,820	-
Instars IV	501,342	-	13,828	-	286,531	-	278,904	-	216,902	-	129,928	-
Instars V	473,873	-	13,406	-	273,871	-	273,901	-	206,144	-	127,243	-
Cocoons	375,487	68,909	6,535	2,977	143,748	23,782	395,089	77,962	114,563	36,674	49,223	18,728

* No adults collected in 1965

The American water shrew, Sorex palustris palustris Richardson, trapped only once previously on these plots (Rennie Plot, 1955) appeared on both the Darwin and Riverton plots in 1966. Two specimens were taken at Darwin and one at Riverton. All specimens were taken in the most moist areas of the plots, but none had access to running water. Two of these 1966 specimens were placed in the small mammal collection of this laboratory along with the 1955 specimen. The data on these four specimens of S. palustris are in Table XIX.

The home range for S. palustris was determined as 0.5 acres with a calculated cruising radius of 83.2 feet for specimen #603 which was captured at four locations before its death. The four captures of this specimen are plotted in figure 1, page 31.

COCOON PREDATION BY SMALL MAMMALS

The cocoon planting technique is used in determining mortality of the larch sawfly in the cocoon stage caused by small mammal predators. The estimates of small mammal predation of the 1964-65 generation of larch sawfly cocoons are given in Table XX.

Bird Populations

Bird populations were assessed at the six larch sawfly study sites, and populations per acre are recorded in Table XXI. Populations on all plots except Seddon's Corner (#3) were lower in 1966 than recorded in 1964 and 1965. For a comparison of total populations per acre and number of species for the three years, see Table XXII.

TABLE XVII

Populations per acre, age, sex, breeding condition, parasitism and mortality of the small mammals in 1966.
(Percent parasitism is given in parentheses)

Species	Plot No.	Pop/ Acre	Total caught	Sex ♂♂-♀♀	Age-No. (%)			No. in breeding condition	Parasites	Mortality
					J	S	A			
<u>Spring Census</u> -- (May 8-22, 1966)										
<u>S. cinereus</u>	1	.40	5	2 - 3	0	0	5(100)	2♂, 2♀	-	60%
	4	.40	5	3 - 2	0	0	5(100)	3♂, 2♀	-	40%
<u>S. arcticus</u>	1	.08	1	0 - 1	0	0	1(100)	1♀	-	0
<u>S. cooperi</u>	3	.08	1	0 - 1	0	0	1(100)	1♀	-	100%
<u>C. gapperi</u>	1	.43	4	3 - 1	0	0	4(100)	3♂	-	0
	4	.53	5	4 - 1	0	0	5(100)	3♂	M(20)	20%
	5	.09	1	1 - 0	0	0	1(100)	1♂	-	0
<u>Fall Census</u> -- (Sept. 12 - Oct. 20, 1966)										
<u>S. cinereus</u>	1	6.80	85*	32 - 50	3(4)	77 (94)	2(2)	0	-	20%
	2	1.36	17	7 - 10	0	17(100)	0	0	-	29%
	3	1.57	23	9 - 14	0	23(100)	0	0	F(4)	48%
	4	1.04	13	9 - 4	0	9(69)	4(31)	0	F(8)	61%
	5	2.74	40	24 - 16	0	31(77)	9(23)	0	0	23%
	6	6.32	79*	34 - 44	0	69(88)	9(12)	0	-	58%

Abbreviations: J = juvenile; S = sub-adult; A = adult; M = mites; F = fleas; T = ticks; B = bots.

1 = Rennie; 2 = Telford; 3 = Seddon's Corner; 4 = Pine Falls; 5 = Riverton 6 = Darwin

* Total includes specimens which were eaten beyond recognition or which escaped before examination.

TABLE XVIII

Number of Small Mammals Other than Mice, Voles and Shrews Caught During the Fall 1966 Census.

	Plot #1	2	3	4	5	6
<u>T. hudsonius</u>	3	0	0	1	3	0
<u>M. erminea</u>	1	0	2	1	1	0

TABLE XIX

Data on Four Specimens of Sorex palustris palustris Richardson Captured in Tamarack Stands near Larch Sawfly Life Table Study Plots.

Collection Number	Location	Date	Measurements	Remarks
101	Rennie	Aug. 27, 1955	137, 62, 19; 9.0gm♂	skull & skin
602	Riverton	Oct. 11, 1966	150, 66, 17, 9; 11.5gm♂	in formalin
603	Darwin*	Sept. 16, 1966	152, 67, 18, 8 10.7gm♂	skull, skin & carcass.
	Darwin	Sept. 18, 1966	sub-adult ♂	released

* Near Whitemouth, Manitoba.

TABLE XX

Percent of Larch Sawfly Cocoons of the 1965-66 Generation Destroyed by Small Mammals.

	Rennie	Telford	Seddon's Corner	Pine Falls	Riverton	Darwin
Insectivoria	50	33	42	42	43	42
Rodents	11	26	5	19	5	16
Total	61	59	47	61	48	58

TABLE XXI (Cont'd)

Bird Populations per Acre in 1966

	Rennie	Telford	Seddon's Corner	Pine Falls	River- ton	Darwin
Canada Warbler				+	.24	
Unidentified Warblers					.13	.08
Cowbird			+			
Rose-breasted Grosbeak				.18		
Purple Finch			.17			
American Goldfinch	+		.07		.03	+
Slate-coloured Junco	.18			.33		
Chipping Sparrow		.24	.27	.15	.29	.17
White-throated Sparrow	.81	.25	.20	.63	.23	.46
Lincoln's Sparrow		.36				.23
Swamp Sparrow					.14	.68
Song Sparrow	.16	+		.16	.17	+
Unidentified Sparrows						.08

TABLE XXII

Total population per acre and number of species (in parentheses) of birds at the larch sawfly study sites from 1964 to 1966.

	Plot #1	2	3	4	5	6
1964	11.43(29)	5.93(15)	3.25(12)	9.74(34)	9.00(31)	8.73(29)
1965	-	-	4.09(14)	-	-	8.15(22)
1966	9.01(16)	3.64(13)	5.19(16)	5.81(22)	5.74(26)	7.08(20)

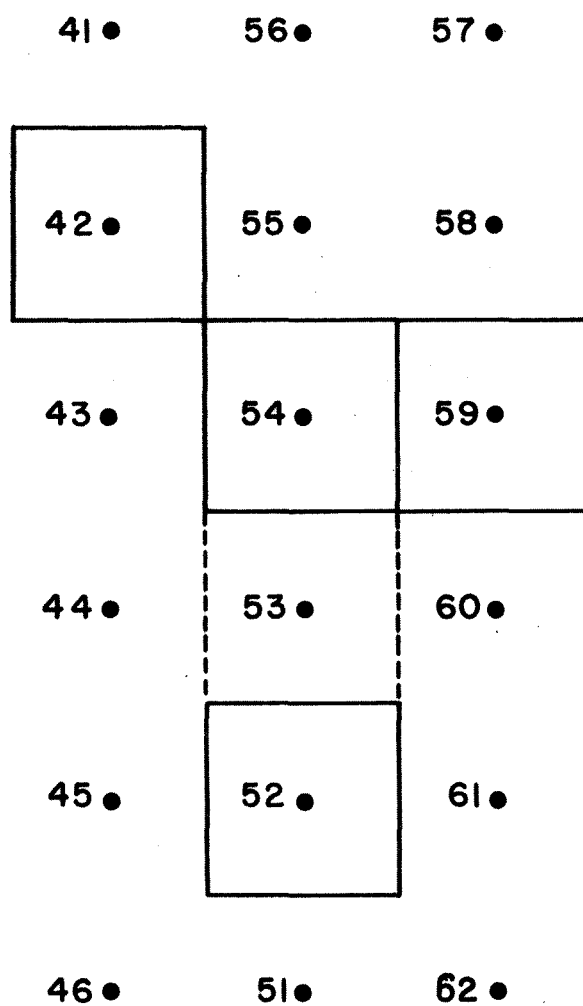


FIG. 1 Home range of *Sorex palustris palustris* Richardson trapped at Darwin, Manitoba, September 1966. Trap positions are at one-chain (66-foot) intervals.