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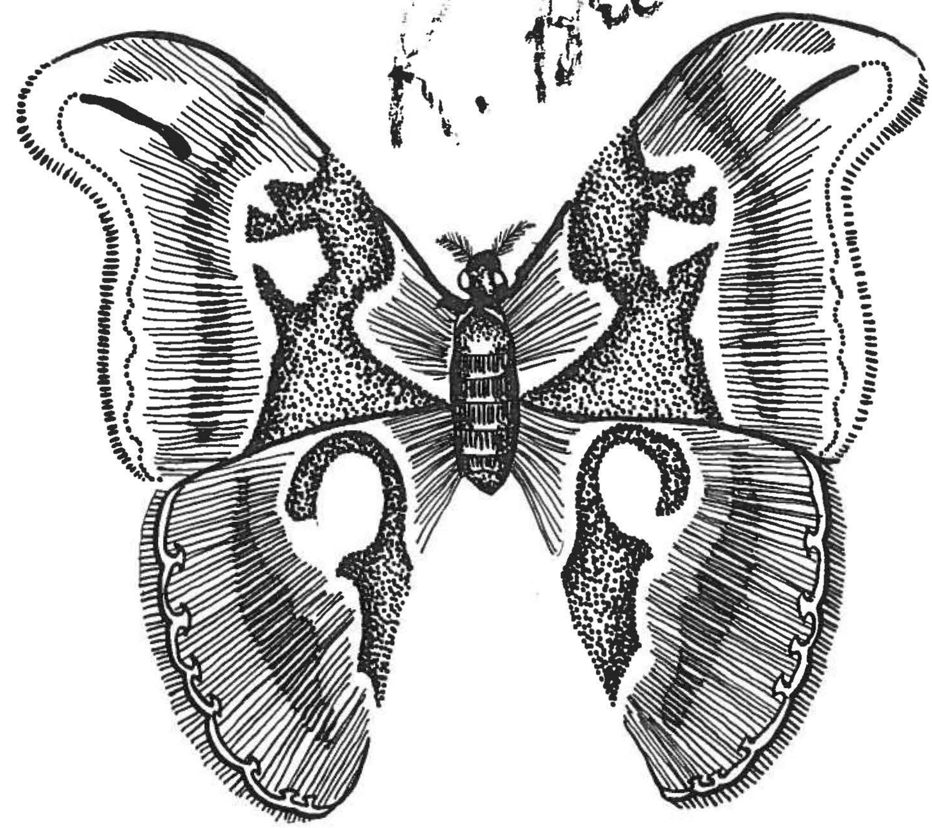
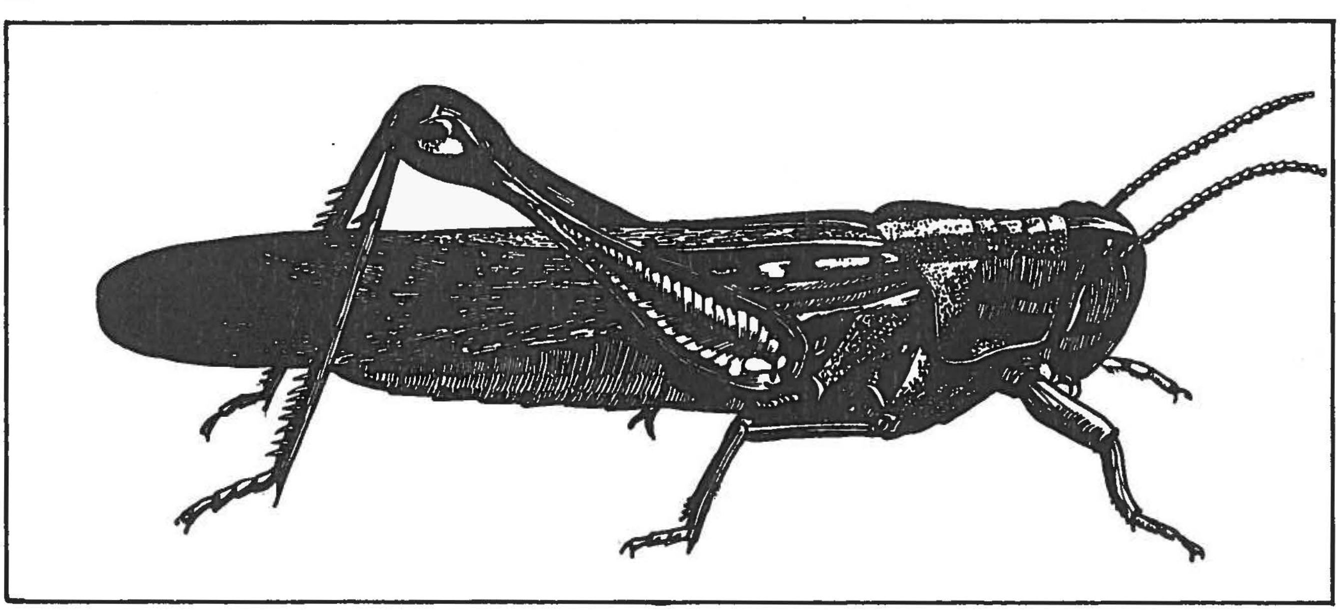


the manitoba ENTOMOLOGIST



THE MANITOBA ENTOMOLOGIST

VOLUME I

1967

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FOREWORD

The Entomological Society of Manitoba has come of age in 1967, this Centennial year of Canada. Our official publications, for we now have two, have continued to change with the times. You will notice, hopefully with approval, that your executive has considered our publication to have attained full journal status and, as a final Canada Centennial Project, have launched this Volume I of The Manitoba Entomologist. The Proceedings of the Entomological Society of Manitoba, now containing only the affairs of our society, will continue to be published but its distribution will be restricted to members in good standing.

Highlights of the year's events included a spring meeting consisting of a social evening of informal entomological and philosophical "shop-talk", and a well attended fall meeting which had "Radiation" as its theme. Scientific sessions were followed by a tour of the Whiteshell Nuclear Research Establishment at Pinawa, and a wine and cheese party at the University of Manitoba Faculty Club with President and Mrs. H.H. Saunderson present as honored guests.

Membership expanded during the year with the recruitment of new members and the reclaiming of some old ones. The executive appointed a Centennial Project Committee in anticipation of Manitoba's Centennial year in 1970, when our Society will play host to the Entomological Society of Canada. Another committee was appointed to examine, revise and improve our constitution.

We sincerely thank the members for their expressions of confidence in their executive and for their support during the past year. We trust that this will continue in the future.

S. R. Loschiavo, President, 1966

and

C. H. Buckner, Editor, 1967.

COVER DESIGN by John Wiens, artist with the Department of Forestry and Rural Development in Winnipeg. Mr. Wiens is accomplished in several fields relating to design and illustration, among them: photomicrography, publication planning, displays, visual aids, and photo processing.

His early training in art was acquired while attending a two-year fine arts course at the St. Cloud State College in Minnesota, and he has since produced material on a free-lance basis for several Canadian magazines and newspapers.

Before joining the Department of Forestry in February, 1967, Mr. Wiens was employed by the Department of National Defence. Winnipeg.

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THE MANITOBA ENTOMOLOGIST

Official publication of The Entomological Society of Manitoba, an organization to foster the advancement, exchange and dissemination of entomological knowledge.

CONTENTS

ENVIRONMENTAL RESEARCH AT THE WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT

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W.N.R.E. Pinawa

ABSTRACT

The program concerns micrometeorology, small mammal population dynamics and topics in insect ecology. The unifying theme of the program is the effect of chronic exposure to low dose-rates of ionizing radiation as an environmental stress on populations and communities.

INTRODUCTION

Nuclear research carried on at the various laboratories and establishments of Atomic Energy of Canada Limited (A.E.C.L.) is devoted to the peaceful applications of atomic energy (A.E.C.L. 1967). To date, the major effort of A.E.C.L., the Crown Corporation responsible for Federal Government nuclear research, has been directed to the development of the deuterium moderated, liquid cooled, natural uranium fuelled reactor. A significant part of the A.E.C.L. research effort during the past twenty years has been devoted to the biological sciences. It is this part of the effort which I wish to speak about, especially the work being pursued at Whiteshell Nuclear Research Establishment (W.N.R.E.) of interest to entomologists.

The life sciences program at W.N.R.E. is concerned with two aspects of biology: biophysics, and environmental studies including applied work which is specifically related to reactor operations. Pinawa is situated in an ecotone, a transition zone between two biomes, the eastern coniferous-deciduous and the western prairie. Consequently, our environmental studies program has been designed to utilize the rich flora and fauna which is available for study. We are establishing at Pinawa a small group of ecologists and biometeorologists who share an interest in the inter-action and effects of ionizing radiation and micro-climate on populations and communities of insects, mammals and plants.

ENVIRONMENTAL RADIATION SURVEILLANCE

Radiation surveillance is an operational responsibility. Its function is to assure A.E.C.L. Management and the general public that effluents from W.N.R.E. are not a hazard. The measurements accumulated by the surveillance part of the program are an important source of research data. The discovery of fallout Na-22 in certain species of Manitoba biota (Guthrie 1965) illustrates this point. Heretofore, Na-22 had been reported only in tundra food-chains (Perkins and Nielson 1965, Palmer et al 1965). Gamma spectrometric analysis of samples of biota taken as part of routine environmental surveillance in the W.N.R.E. Controlled Area, revealed the presence of this nuclide in Manitoba.

There is a two-way flow of information between environmental surveillance and research. A recent investigation of Cs-137 and Sr-90 concentrations in various species of fish and mammals led to the discovery that the amount of Sr-90 in the flesh of a fish or mammal may be calculated from the total-β activity of the animal's bone, if there has been no recent large scale testing of nuclear devices in the atmosphere (Grummit and Guthrie 1967). This finding reduced the number of radiochemical analyses required for effective radiation surveillance. It was the same study which provided the clue that Cs-137 might be a useful nuclide with which to investigate aquatic insect food-chains. Another major contribution of the environmental surveillance group to our research program is the provision of sampling and analytical experience and competence.

BIOMETEOROLOGY

Any effects observed in our irradiated animal populations must be viewed in the light of possible interaction between ionizing radiation and climate. Hence it is essential that the various meteorological parameters be measured accurately and continuously. Fortunately, the use of small digital computers as programmable data acquisition systems has done much to reduce the volume of paper charts, not to mention chart scaling, long a familiar part of micrometeorological measurements. The advantage of a programmable data acquisition system is flexibility. Many and frequent inputs can be handled, and the input-information from sensors can be treated in different ways. For example, the input signal from a particular anemometer may be recorded every second, while that from a soil temperature probe may be accepted once per hour. The core of our meteorological data acquisition system, not fully operational, is a PDP 8/S digital computer.

Measurements made by the wind and temperature sensors fixed to the 200 foot (61 m) meteorological tower have been published (Reimer 1966). The findings that inversion conditions occur almost 50% of the time, and inversions of 20°F (11°C) are not infrequent, are observations of considerable importance to insect ecologists.

Other micro-environmental parameters routinely measured and pertinent to ecological studies are: humidity, precipitation, wind speed, temperature and solar radiation. A soil-air temperature measuring network has been assembled. This network is designed to measure soil temperatures at various depths to 200 cm below the surface, and at several levels in the snow-cover on the ground. These measurements are important to our small mammal studies.

MAMMALOGY AND POPULATION DYNAMICS

There are two ways in which radionuclides may be used to study an animal population. The mammal or insect may be 'tagged' with a small piece of radioactive wire, and subsequently identified or followed. Secondly, ionizing radiation affords a means of applying an environmental stress to the individual animal or population. This stress is amenable to precise control. Stress is defined as any change in the environment of an organized unit which threatens its integrity or requires an increased expenditure of energy to maintain homeostasis.

The tagging method is one technique used to determine an animal's home range. A toe-clipped animal is live-trapped several times to establish that it is a resident. Its weight, approximate age and reproductive condition are noted. A small piece of activated tantalum (Ta-182) or cobalt (Co-60) wire is then inserted under the skin on the animal's back. The animal is released at its point of capture

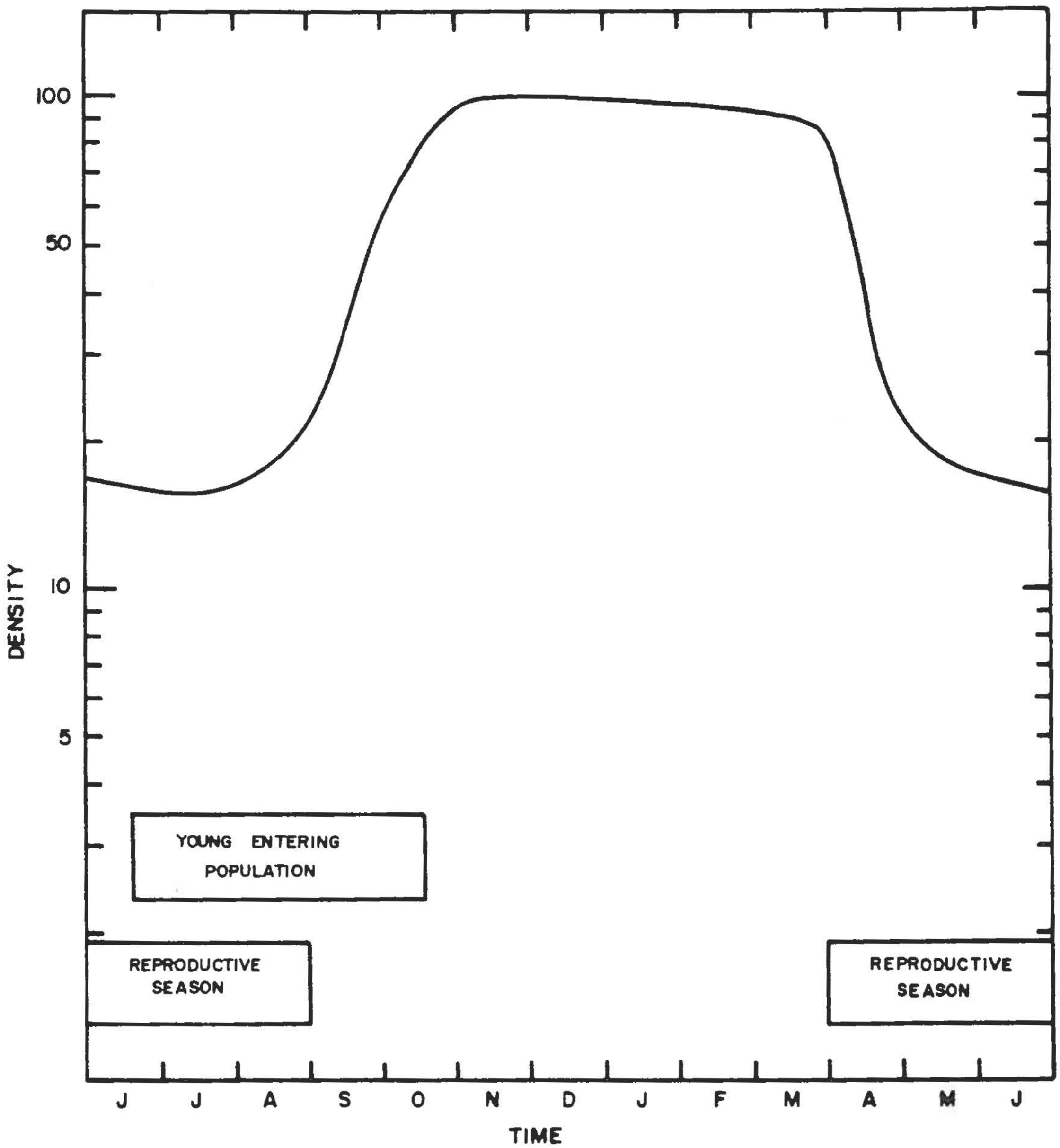

Fig. 1 Yearly Cycle In Numbers Often Seen In Small Mammal Populations

and can be subsequently located with a Geiger radiation instrument as many times as required. Finally, the animal is recaptured and the radioactive wire recovered.

Radiation in the role of an environmental stress affords one method of testing theories of population control. We hope to get this phase of our program under way as soon as the current population census is completed. One hypothesis suggests (Fig. 1) that the regulation of population size is achieved via socially induced mortality during the early part of the animal's reproductive season (Sadleir 1965). The finding that there is a significant correlation between high population numbers and high mortality supports this hypothesis (Healey 1967). Experimental proof, however, is incomplete. The socially induced mortality hypothesis also predicts that, above a certain minimum density, the population which has a history of higher mortality and, therefore, has lower numbers will have a lower spring mortality rate regardless of environmental conditions (Fig. 2). We shall test this hypothesis using radiation in the role of a controllable environmental stress.

INSECT ECOLOGY

We are interested in the distribution of Cs-137 in ecosystems, because this nuclide is a fission product of some biological importance. The entomological part of our program is concerned with two aspects of insect ecology: succession, and the distribution rates of Cs-137 in aquatic insect food-chains. Knowledge of radiocaesium uptake and elimination rates allow calculation of food-chain kinetics and energy transfer between trophic levels (Odum and Smalley 1959, Crossley 1966).

The succession study, begun in 1966, is a long term project from which we do not expect to get results for several years. Therefore I shall limit myself to a brief description of the study. In the fall of 1965, two pits were dug measuring about 50 feet (15m) in diameter, and six feet (2 m) in depth. Both pits were lined with heavy plastic sheeting, which was then covered with one foot (0.3 m) of the soil removed during excavation. The pits filled with snow during the ensuing winter and after the thaw in the spring of 1966 became permanent ponds. Two lines of stakes (Fig. 3) and two marked pre-stretched nylon ropes provide a satisfactory grid system for sampling bottom-dwelling organisms. The ponds were sampled at regular intervals during 1966 and immediately following the spring thaw in 1967. Whereupon, 0.5 Ci of Cs-137 was added to one of the ponds - the "active pond". The other pond contains only the Cs-137 which enters via fallout. At the time of contamination, the water in the active pond contained about 2 x 10^5 pCi/1 of radiocaesium. This amount is about 100 times the 168 hour maximum permissible concentration in water recommended by the International Commission on Radiological Protection. No plants or animals were introduced into the ponds, the present pond communities being the result of invasion from the surrounding terrain, that is, primary succession. The invasion of the pond community by aquatic insect species is being followed. The radiocaesium added to the active pond was rapidly sorbed onto the soil covering the pond bottom. We know from dosimetry measurements using lithium fluoride dosimeters that the organisms living at the water-mud interface are receiving a radiation dose of about 2 R/day. Thus, the radiocaesium in the active pond is serving as a radiation source, irradiating the benthic organisms with a dose 1000 times greater than the background radiation in the area.

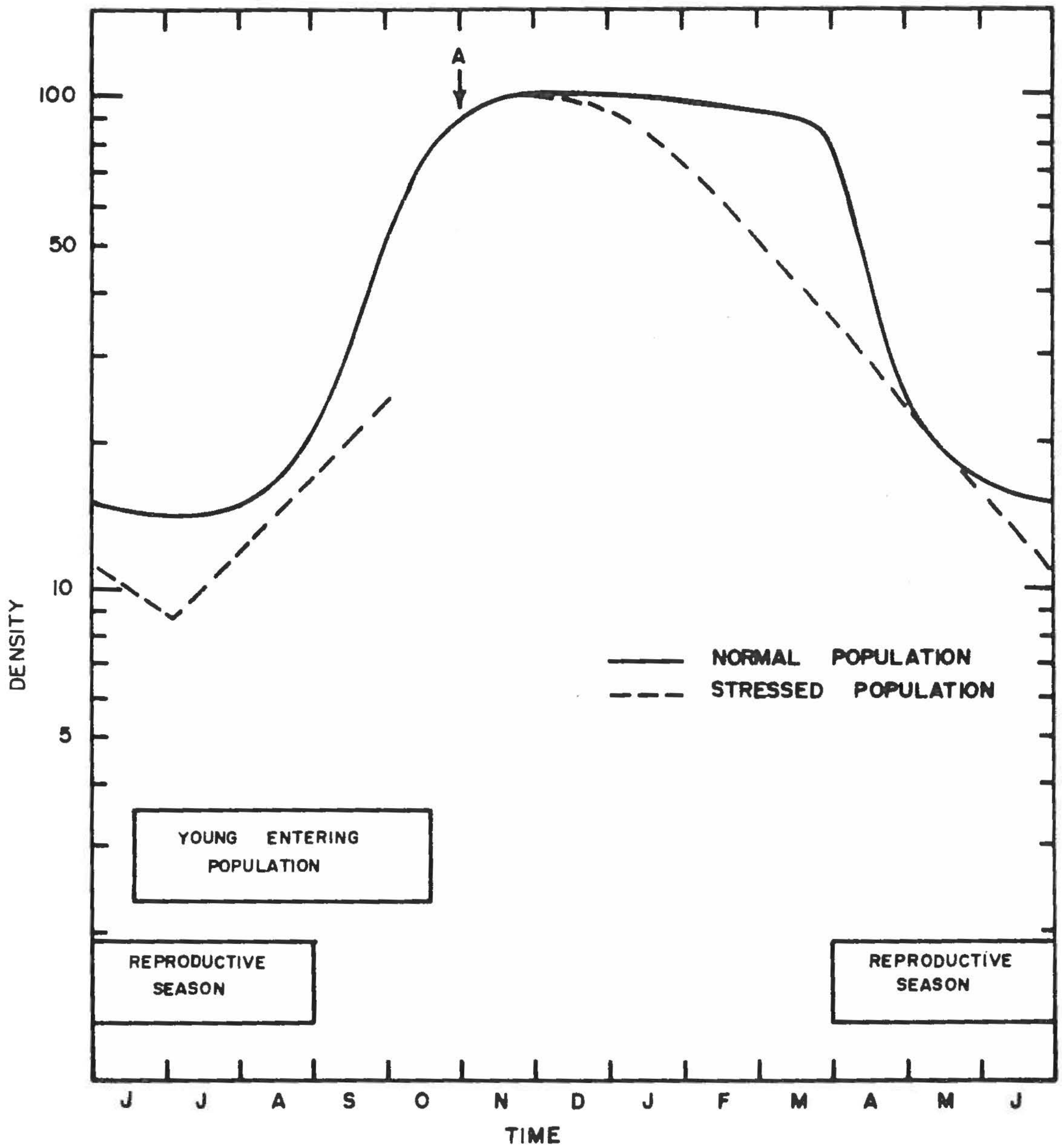

Fig. 2 Population Cycle As Predicted By Socially Induced Density Dependant Mortality Hypothesis. 'A' Is Time Of Application Radiation Stress.

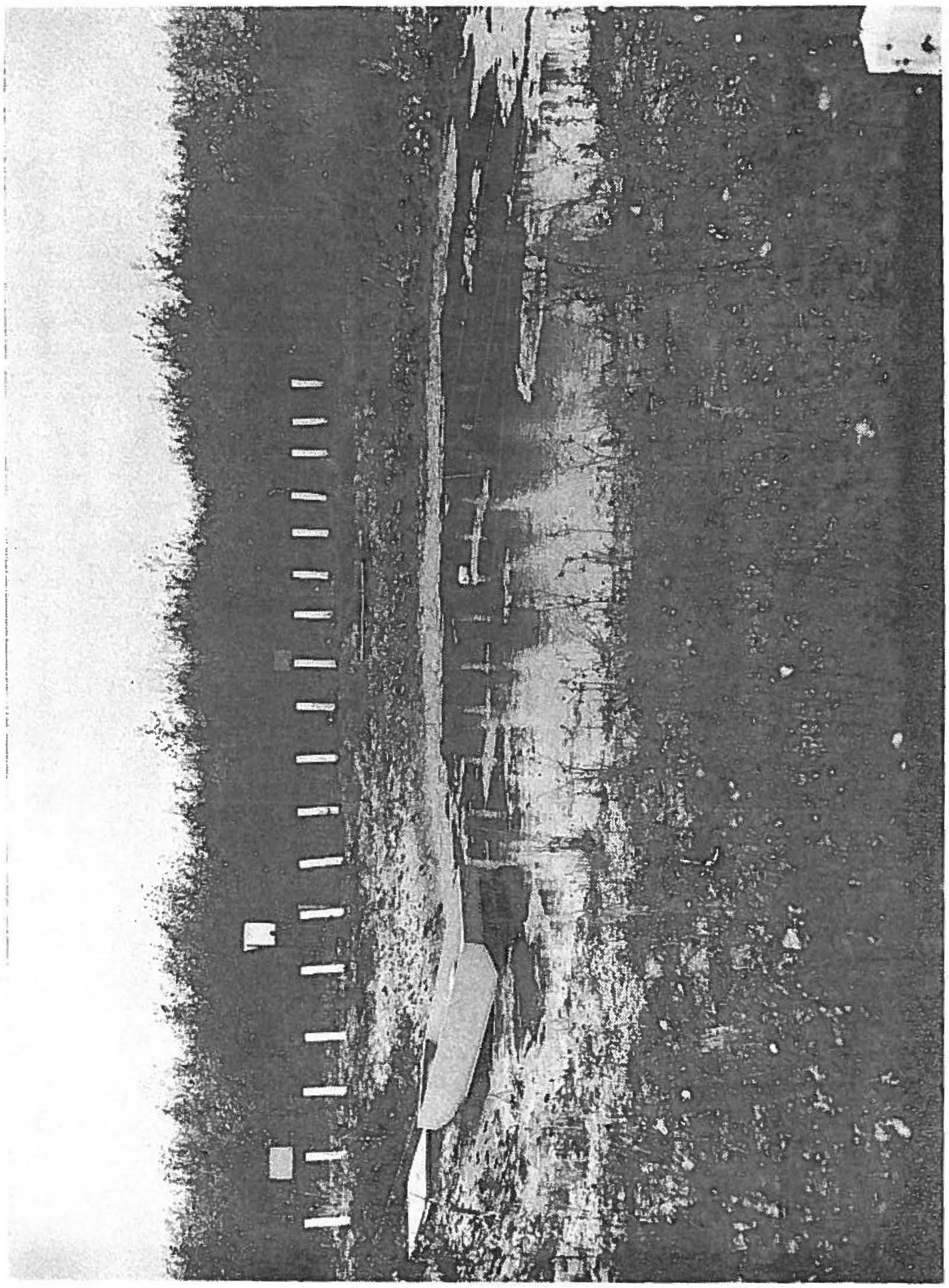

Fig. 3 Active Pond Showing Sampling Stakes and Grid Ropes

The Cs-137 in the active pond serves another purpose. In the role of a tracer, it is enabling us to work out the foodchain relationships between the insects of the pond community. This tracer function is of interest for two reasons. First, the fate of radionuclides, such as Cs-137, in the aquatic environment is of importance because the Canadian reactor concept emphasizes liquid cooled systems. Secondly, the determination of radiocaesium distribution in the pond, together with uptake and elimination rate measurements in the laboratory, will permit calculation of energy transfer taking place at each trophic level.

CONCLUSION

I have endeavoured to acquaint you with the major features of our environmental research program at W.N.R.E. We prefer to think in terms of the whole program and so not lose sight of our objective - the study of ionizing radiation as an environmental stress - amidst the detail of the component parts.

ACKNOWLEDGEMENT

I wish to thank my colleagues, O. E. Acres, S. L. Iverson and A. Reimer, for their generous contributions.

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THE PROBLEM OF INFERTILE AND NOSEMA-INFECTED QUEENS

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ABSTRACT

Surveys were made between 1963-1966 to ascertain how many queens had entered Manitoba as potential drone layers and how many of these queens and their attendant nurse bees had Nosema disease. An average of 11% per year of the queens had low sperm counts, 10% per year of the queens had Nosema disease, and 54% of the groups of attendant workers had Nosema disease. The significance of these data are discussed.

Over 200,000 packages of honey bees, each containing a caged queen, enter Canada from the southern United States annually. On arrival in Canada the bees are hived and the queen released; usually 5-10% of the queens are killed or lost at this time. Methods of reducing these losses have been studied (Butler and Simpson 1956, Jay 1965, Jay 1967). Beekeepers using packages in Western Canada report that an additional 5-10% of the queens are superseded, and an undetermined number become "drone layers", (i.e. all their eggs develop into drones) within the first month after hiving. Although Nosema disease probably accounts for some of the queen supersedures (Farrar 1947, Furgala 1962a, Jay 1966) few data are available concerning other possible reasons for queen replacement, such as lack of sufficient sperm in package bee queens.

To ascertain how many queens enter Manitoba as potential drone layers with low numbers of sperm (i.e. queens laying unfertilized eggs), a survey involving sperm counts of queens was made from 1963-1966 using queens from various queen producers. These queens, and their attendant nurse bees were examined at the same time for Nosema disease. The queens chosen for the survey in any one year came from those producers who sent the largest number of bees to Manitoba. Certain producers were unable to supply queens in some years. Consequently the source of the bees used differed somewhat from year to year.

Queens in small cages with their attendant worker bees were received directly from the various producers. Upon arrival the spermatheca of every queen was removed and the sperm counted with a blood cell counter; the gut was examined for Nosema spores. The attendant bees were killed, ground together with a known amount of water, and the "liquid" fraction examined for spores. Bees from packages entering Manitoba had been examined for Nosema spores previously (see Jay 1966). No attempt was made to determine the degree of Nosema infection in these queens, attendants, or packages.

The results are shown in Table I - IV. Between 1963 and 1966, an average of 10% per year of the queens, 54% of the groups of attendant workers, and 47% of the packages had Nosema disease. Both the bees in the packages and the attendant bees were potential sources of Nosema infection for the queens due to the possible transmission of spores to the queens during feedings (see L'Arrivee 1964). Supersedure is common among queens with Nosema disease (Farrar 1947, Furgala 1962a) although many with low levels of infection undoubtedly survive. Supersedure, due to injuries sustained by the queens during production, shipping, hiving, and colony management also occurs.

Table 1. Examination of queens, their attendants, and package bees for Nosema disease (1963-1966)*

Year	No. of queens examined	No. and % queens with Nosema	No. and % of queens with Nosema-infected attendants	No. of packages sampled for Nosema	No. and % of packages with Nosema
1963	124	10 (8.1)	62 (50.0)	272	95 (34.9)
1964	54	2 (3.7)	22 (40.7)	443	212 (47.9)
1965	127	22 (17.3)	66 (52.0)	410	217 (52.9)
1966	86	5 (5.8)	59 (68.6)	249	126 (50.6)
Totals	391	39 (10.0)	209 (53.5)	1,374	650 (47.3)

* See also Jay (1966).

Queens, with sperm counts of less than 3 million, are unable to head colonies satisfactorily for one season (Taber, personal communication). A high percentage of queens from several shippers were in this category, (Table 2).

Table 2. Sperm Counts of Queens from various shippers (1963-1966)

Shipper and home state	Years when sampled*	No. of queens examined	No. of queens with sperm (in millions)			
			0-.5	.5-3	3-5	over 5
1 - California	5,6	28	0	6	8	14
2	4,5,6	50	2	5	13	30
3 - Alabama	3,	20	0	3	13	4
4	3,	20	0	3	11	6
5	3,4,5,6	66	0	1	19	46
6	5,	8	1	0	5	2
7	3,4,5,	43	0	3	14	26
8 -Mississippi	3,4,5,6	68	0	8	11	49
9 - Georgia	3,4,5,6	68	0	7	10	51
10	3,	10	0	1	4	5
11 - Texas	4,	10	0	2	5	3
Totals		391	3	39	113	236

* 3 - 1963; 4 - 1964; 5 - 1965; 6 - 1966.

The sperm counts varied from year to year, even within a given area. When the results are tabulated by years (Table 3) an average of 10.8% per year of the queens had low sperm counts, and a total of 5 of these also had Nosema disease. In 1961 Furgala (1962b) found that of 236 queens lost in the first month after hiving in Manitoba, 34 (14%) had few or no sperm. It is possible that of the queens with sperm counts close to 3 million (Table 2), many would not be drone

Table 3. Sperm counts and incidence of Nosema disease of queens by years (1963-1966)

Year	No. of queens examined for sperm	No. and % of queens with sperm (in millions) 0-.5	.5-3	3-5	over 5	Total no. queens with Nosema
1963	124	0 (0%)	19 (15.3) (2)**	46 (37.1) (4)	59 (47.6) (4)	(10)
1964	54	1 (1.9)	7 (13.0) (1)	16 (29.6)	30 (55.6) (1)	(2)
1965	127	2 (1.6)*	8 (6.3)	36 (28.3) (6)	81 (63.8) (14)	(22)
1966	86	0 (0)	5 (5.8)	15 (17.4) (1)	66 (76.7) (4)	(5)
Totals	391	3 (0.8)	39 (10.0) (5)	113 (28.9) (11)	236 (60.4) (23)	(39)

* No sperm present.
**Second set of brackets indicate queens with Nosema disease.

layers in the first month but would become so later in the season. It is also possible that a direct correlation exists between drone laying and supersedure. Little, if any, information is available about this.

Table 4 shows that as the spring progresses a larger percentage of the queens have more sperm; this may provide one argument for shipping packages to Canada late in the spring. One reason for this may be that improvement in weather conditions as spring advances results in better flight conditions for both virgin queens and drones. Queens usually mature and mate when they are 8-12 days old with aerial mating usually occurring over a 2-3 day period during the warmest 3-4 hours of the day (Grout 1963). Drones mature and mate when they are 15-20 days old; between 4 and 17 drones mate with each queen (Peer 1956, Triasko 1956, Taber and Wendel 1958, Woyke 1962). Therefore, not only must good flying weather prevail when the queens and drones are mature enough to mate but large numbers of drones must be available, particularly where mating yards contain large numbers of virgin queens. Queens must also be left in the mating yard for a sufficient length of time to mate, particularly if poor flying weather persists.

Table 4. Sperm counts of queens by arrival date of packages

Time period used in comparisons	No. queens examined	No. and % of queens with sperm (in millions) 0-.5	.5-3	3-5	over 5
April 16 - 23	114	1 (0.9)	15 (13.2)	43 (37.7)	55 (48.2)
April 24 - May 1	99	1 (1.0)	14 (14.1)	26 (26.3)	58 (58.6)
May 2 - 9	81		4 (4.9)	19 (23.5)	58 (71.6)
Totals	294	2 (0.7)	33 (11.2)	88 (29.9)	171 (58.2)

Other factors, as yet unknown, may influence the number of sperm present in a queen. Sterility can be caused in a few cases by such factors as congenital malformations, tumours, infectious and metabolic diseases (Fyg 1961) and oviduct blockage (Kohler 1956).

ACKNOWLEDGEMENTS

I thank the Manitoba Co-operative Honey Producers Ltd. and the beekeepers of Manitoba for making this study possible.

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OCCURRENCE OF THE EASTERN LARCH BEETLE IN MANITOBA AND SASKATCHEWAN

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ABSTRACT

The presence of the eastern larch beetle, Dendroctonus simplex Lec., in Manitoba and Saskatchewan is established. An outbreak of this species on tamarack, Larix laricina (Du Roi) K. Koch, on trees previously attacked by the larch sawfly, Pristiphora erichsonii (Hartig) began on a single tree with damaged roots and within 6 years had spread to over 30 adjacent trees. Tree death occurred in summer one year after attack by the beetles.

The eastern larch beetle, Dendroctonus simplex Lec., normally attacks weakened or severely damaged tamarack, Larix laricina (Du Roi) K. Koch (Wood 1963). Since this beetle had been collected in Minnesota and Alberta, its distribution was considered to extend across the forested areas of Manitoba and Saskatchewan (Wood 1963). Its presence in this area has been confirmed by specimens collected by the Forest Insect and Disease Survey at the following locations: Manitoba-Rennie, Darwin, Riverton, Hodgson and Riding Mountain National Park; Saskatchewan - Dumble, Prince Albert. Pierceland, Loon Lake, Buffalo Narrows, Meadow Lake Provincial Forest and at Prince Albert National Park (Fig. 1).

These collections were made in tamarack stands that had been defoliated during the recent widespread outbreak (1938 to date) of the larch sawfly, Pristiphora erichsonii (Hartig) (Nairn et al 1962). Cumulative effects of defoliation include reduced tree vigour and wood production but little mortality directly attributable to larch sawfly defoliation has been observed (Graham 1956, Drooz 1960, Turnock 1954, 1955, 1960). This reduced vigour may have predisposed the trees to attacks by the eastern larch beetle.

Observations on the progress of an attack by this beetle were made from 1962 to 1967 on trees in a near-mature tamarack stand adjacent to the Whiteshell Central Road near Rennie, Manitoba. The trees in this stand were moderately to severely defoliated by the larch sawfly from 1949 to 1956 and have suffered light to moderate defoliation annually since that time. The first tree apparently was attacked by the eastern larch beetle in 1961 and died in 1962. This tree was large (10 inches in diameter) and had suffered some root injury due to road construction and a human path as well as that due to sawfly defoliation. From this focus the infestation has spread to adjacent trees and covers an area of about 200 x 300 ft (Table 1). Within this area all except a few smaller trees ($<$ 5 inches diameter) have been attacked.

Attack on individual trees began about 20 ft. above ground and spread both up and down. Profuse resin flow marked the location of the initial attacks. Most

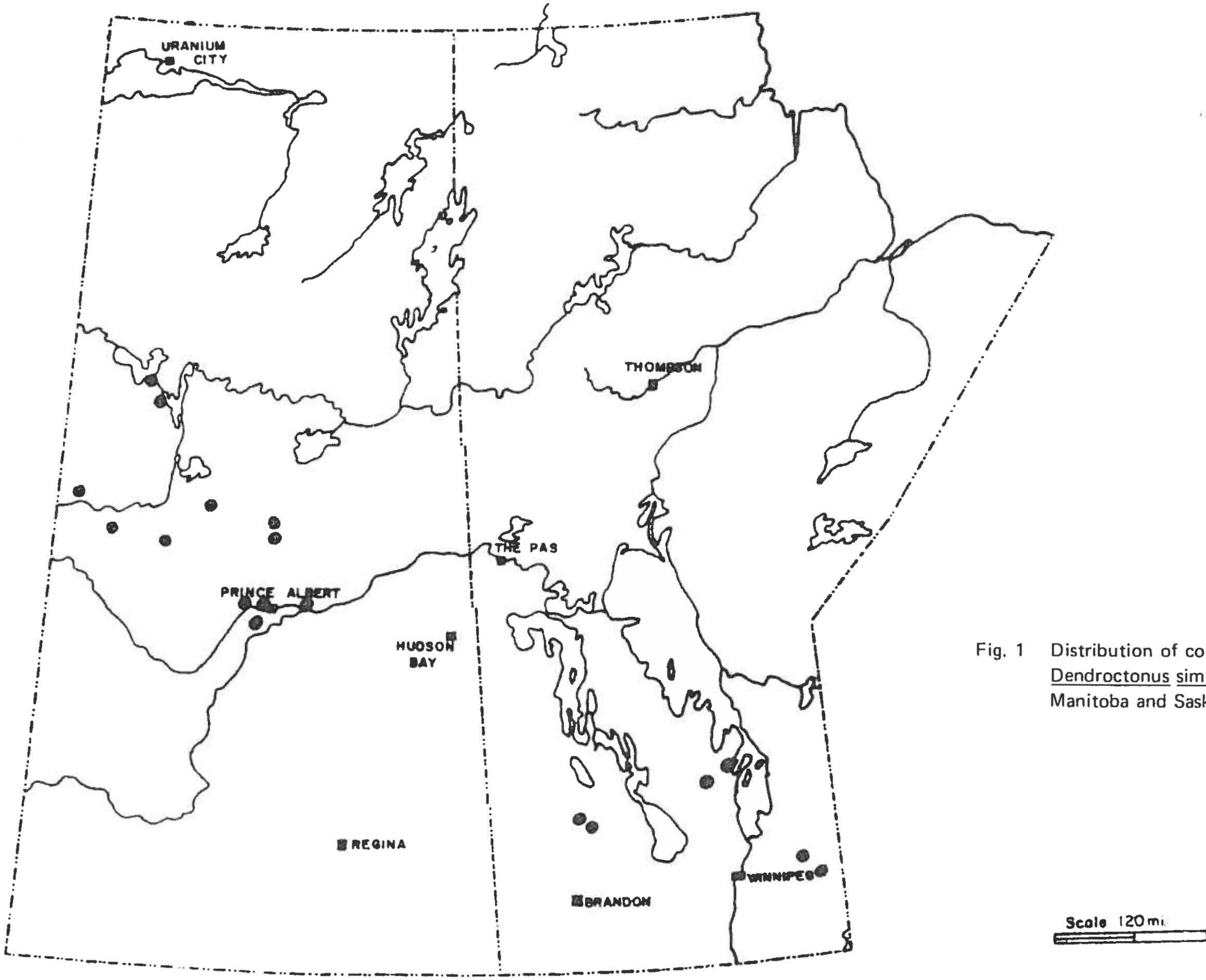

Fig. 1 Distribution of collection points of Dendroctonus simplex Leconte in Manitoba and Saskatchewan.

trees leafed out the year following attack but the foliage yellowed by late July. Some narrow bands of living cambium, on the west-facing side of the boles, were found at this time but the trees failed to survive.

Infested trees were marked, and then cut and burned during the winters of 1964-65 and 1965-66 but there is no evidence that these sanitation measures have influenced the spread of the infestation. Since sanitation cutting in winter appears ineffectual for controlling outbreaks of this species, summer cutting or chemical control should be considered where it is desirable to eliminate the focus of infestation.

Other outbreaks of the eastern larch beetle have been recorded at MacDowall, near English Cabin in the Fort à la Corne Provincial Forest, and in the Nisbet Block of the Nisbet Provincial Forest by the Annual Reports of the Forest Insect and Disease Survey (1955 to 1959).

Table 1. Tamarack trees attacked by eastern larch beetle near Rennie, Manitoba, 1964 to 1967

	Number of trees			
	Dead	With yellow foliage	With green foliage	Total
1964-65	22 (8.0)[1]	8	4	34
1966	4 (6.2)	4	0	8
1967	4 (7.2)	3	1	8

[1] Average tree diameter in inches, at breast height shown in parentheses.

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AERIAL SPRAYING FOR CONTROL OF THE JACK PINE BUDWORM IN MANITOBA

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ABSTRACT

Experimental aerial applications of insecticides for control of the jack-pine budworm, Choristoneura pinus pinus Freeman, were made for the first time in Manitoba during 1967. Three chemicals were tested for efficacy in reducing larval populations and, hence, protecting the foliage of planted and natural pines from serious injury. DDT was used in formulations of 0.25 lb., 0.50 lb., and 0.75 lb. (actual)/acre, and Matacil and Sumithion at rates of 0.20 lb. and 0.50 lb./acre, respectively. Results showed that all formulations of DDT substantially reduced populations of fourth-instar larvae of the jack-pine budworm, but superior control was attained with the higher rates (0.50 lb. and 0.75 lb./acre) of application. Matacil and Sumithion at the rates applied gave control equivalent to applications of DDT at 0.50 lb./acre.

INTRODUCTION

The jack-pine budworm, Choristoneura pinus pinus Freeman (Lepidoptera: Tortricidae) (Freeman 1953, 1967), is one of the most important defoliators of pines in central Canada and the Lake States Region of the United States (MacAloney and Drooz 1956). Sustained attack by this insect pest usually results in extensive branch-killing in the upper crown levels of attacked trees, and occasionally whole-tree mortality, particularly in stands of low vigor. Budworm infestations are normally of short duration, lasting for intervals ranging from one to four years. After population collapse, five or more years usually elapse before the recurrence of subsequent damaging infestations. However, 50% or more of all trees attacked during an outbreak may suffer crown top-killing.

Chemical control studies were initiated in Manitoba during 1967 to determine the efficacy of conventional aerial applications of DDT, Matacil and Sumithion (= Accothion) for control of the budworm in severely infested stands of jack pine (Pinus banksiana Lamb.) and Scots pine (P. sylvestris L.). The objectives of the control program were (1) to demonstrate a method of preventing serious budworm injury to plantations and natural stands in southern Manitoba; (2) to determine control levels on budworm larval populations using various formulations of insecticides; and (3) to evaluate and compare the effectiveness of the insecticides Matacil and Sumithion (not previously tested for budworm control) with DDT, a material which is known to be effective in the Lake States.

MATERIALS AND SPRAY-APPLICATION METHODS

Plantations and natural stands for aerial treatment were selected at three locations:

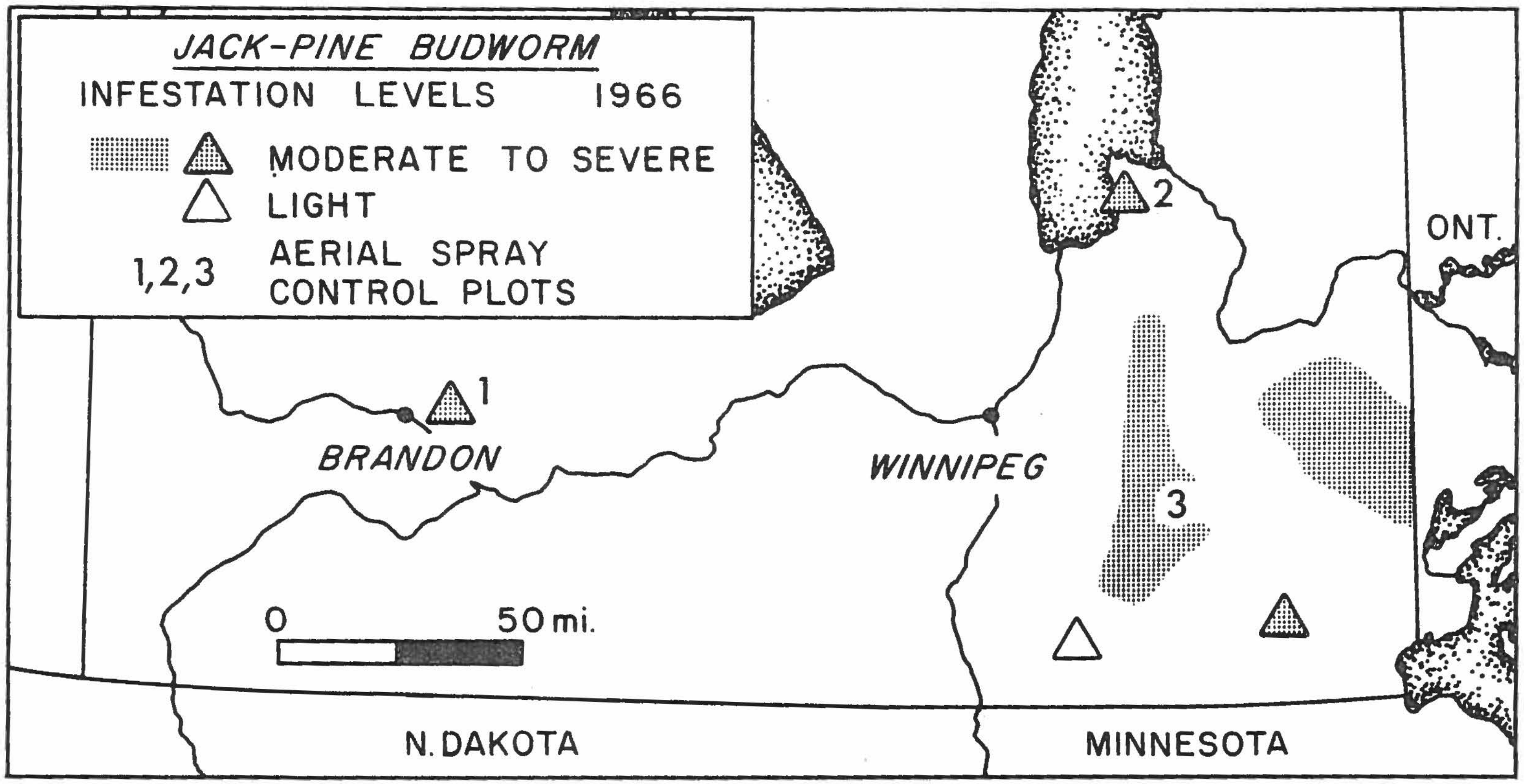

Fig. 1 Location of treatment areas and jack-pine budworm infestations in 1966:
1 – Spruce Woods Provincial Forest;
2 – Belair Provincial Forest;
3 – Sandilands Provincial Forest.

1. Spruce Woods Provincial Forest -- 1,400 acres of planted jack and Scots pine (all treated).

2. Sandilands Provincial Forest -- 200 acres of natural jack pine (three 50-acre treated plots, one 50-acre untreated check plot).

3. Belair Provincial Forest -- 100 acres of natural jack pine (one 50-acre treated plot and one 50-acre check plot).

Tree heights in all areas ranged from 15 to 60 feet and averaged approximately 35 feet. Trees in treatment and check plots (Fig. 1) were moderately to severely defoliated during 1966 (50% or more defoliation in top half of tree crowns), and fall and winter egg mass sampling had indicated continued severe attack in 1967.

The aircraft used for application of the insecticides was a Piper Pawnee 235B (Fig. 2) specifically designed for aerial control work. The aircraft was furnished with a 150 gallon spray mixture tank and conventional emission equipment, and was capable of covering an effective swath width of 50 feet flying at a height of 6 to 15 feet above tree tops.

Swath lines were marked by aluminum poles (length adjustments were made according to tree height - usually 30-35 feet). Bright red flags and/or red helium-filled weather balloons supplied by the Meteorological Branch, Department of Transport, were attached to pole extremities for swath-line sighting by the pilot. Two or three pole crews were located along each swath line; the crews moving 50 feet to the next line after each pass of the aircraft. The maximum length of swath lines was slightly more than one mile.

Fig. 2 Piper Pawnee 235B During Application of DDT in the Spruce Woods Provincial Forest.

Oil- and water-sensitive cards (prepared by the Chemical Control Research Institute, Ottawa) were distributed in openings near permanent sample trees to assess spray deposit pattern and droplet size. Three rates of DDT (0.25, 0.50 and 0.75 lb./acre) were applied for control assessment of early to peak levels of fourth-instar larvae (June 21-29). Second- and third-instar larvae are protected by feeding under immature needles and in staminate flower clusters, thereby making earlier applications of insecticides ineffective. In addition to treatments with the insecticide DDT, applications of Matacil at the rate of 0.20 lb./acre and Sumithion at the rate of 0.50 lb./acre were made in the Sandilands Provincial Forest. According to technical literature provided by the manufacturers and unpublished reports of control results on other forest insects by the Department of Forestry and Rural Development, these latter insecticides have short residual activity but have been shown to be as effective as DDT for control of certain insect species.

Treatments were formulated as follows:

1. DDT -- 0.25, 0.50, 0.75 lb. actual in one U.S. gallon of No. 2 fuel oil.
2. Matacil -- 0.20 lb. actual in one U.S. gallon of water.
3. Sumithion -- 0.50 lb. actual in one U.S. gallon of water.

All insecticide mixtures were emitted from the aircraft at the rate of one U.S. gallon per acre. Spraying was not conducted with wind velocity in excess of 10 m.p.h.

POPULATION ASSESSMENT METHODS

Budworm population levels were assessed using procedures outlined by Fettes (1952), but modified slightly to incorporate necessary changes and developments in recent years. The sample unit for population assessment consisted of two 15-inch branch samples collected from mid-crown regions of permanent sample trees, which were located at two- to five-chain intervals along predetermined sampling lines running perpendicular to flight paths of the spray-aircraft. Three sampling lines were established for each independent spray plot.

Spray applications in treatment areas took place from June 21-29. To determine the control exerted by the insecticides, larval counts were taken twice before and twice following application in both the sprayed areas and check plots. Prespray counts were made during periods of 10-14 days and again 1-5 days before the actual spray date; postspray counts were taken 1-5 days and 7-15 days following treatments. The budworm population levels calculated from the branch samples taken before and after treatment were used to determine population reduction due to the effect of the insecticide.

No check plots were available in the Spruce Woods for comparison between treated and untreated populations. However, the projection of natural mortality curves from the prespray sampling in the Spruce Woods gave close approximation of normal larval population declines in check plots in the Sandilands and Belair Provincial forests. Thus, population levels after spray treatment for this area was compared with corresponding chronological points on the projected natural decline curve. Deviations from normal mortality then were expressed as % reduction due to treatment. At Sandilands and Belair, population levels after spraying were compared with both population levels in untreated check plots and with corresponding points on the curve projections of population trends for individual treatment plots.

Threeweeks after completion of spraying operations and budworm population sampling, random shoot collections, taken along sampling lines provided information on foliage consumption by larvae in sprayed and unsprayed areas. Counts were made of the numbers of living and dead needles from several hundred current year shoots. Comparisons of actual defoliation then served as indices for protection levels attained. Finally, colour photographs were taken from the air in August during the period of optimum foliage discoloration for visual verification of spray results in the Spruce Woods plantations.

RESULTS

All of the materials and rates of application tested substantially reduced larval population levels (Table 1). The experiments indicated, however, that applications of DDT at dosages of 0.50 and 0.75 lb. per acre are more effective than at 0.25 lb. per acre. Treatments of Matacil and Sumithion applied at rates of 0.20 and 0.50 lb. per acre, respectively, resulted in population reductions equivalent to the 0.50 lb. application of DDT.

Table 1. Results of aerial applications of DDT, Matacil, and Sumithion for control of jack-pine budworm.

Treatment	Rate of application (lb./acre)	Location and no. acres treated		% Reduction (4th-instar larvae)	% Defoliation of infested shoots	
					Treated	Untreated
DDT	0.25	Sandilands -	50	74	34	71
DDT	0.50	Spruce Woods -	1,300	87	21	- *
DDT	0.50	Belair -	50	97	18	80
DDT	0.75	Spruce Woods -	80	99	10	- *
Matacil	0.20	Sandilands -	50	87	20	71
Sumithion	0.50	Sandilands -	50	90	16	71

* No untreated check plots available for comparison.

Feeding injury by budworm larvae was reduced by all treatments to less than 35% defoliation on new shoots. These levels of defoliation did not appear to cause branch mortality. In contrast, 71 to 80% of the current year's foliage of trees in the untreated plots was consumed, and many of the shoots and branches on these trees were either dead or in poor condition.

In the pine plantations of the Spruce Woods Provincial Forest, a few narrow swaths of trees apparently did not receive spray coverage during the treatment, due to unexpected wind gusts and an early morning temperature inversion which severely impeded droplet descent. Spray deposit cards that had been set out prior to spray operations showed either no spray deposit or only a few droplets 400 μ or larger in diameter. At other locations 8 to 12 droplets per cm^2 and 100-250 μ in diameter were collected. Trees in these untreated swaths had red crowns which stood out vividly against the green foliage of the treated areas in aerial photographs taken in early August. This additional severe defoliation was expected to result in branch and tree top mortality in these areas.

No immediate evidence of detrimental effects on wildlife or natural enemies of the jack-pine budworm were observed throughout the treatment areas.

DISCUSSION AND CONCLUSIONS

The aerial spray program conducted in 1967 successfully demonstrated the suitability of this method in reducing the severity of an outbreak of the jack-pine budworm. The application of DDT at 0.25 lb. per acre gave some protection to the foliage and reduction in budworm numbers. However, in view of the relatively small area treated, further tests would be desirable before accepting this dosage in preference to the well-tested and more effective application of 0.50 lb. per acre.

Results also indicated that Matacil and Sumithion may be used as substitutes for budworm control by aerial application. These materials would be most suitable for use in parks or in areas where watershed contamination by an insecticide such as DDT is undesirable. Again, however, more extensive testing is necessary to fully evaluate their effectiveness.

The significant reductions in population levels and prevention of serious feeding injury achieved by the aerial spray program were enhanced by: (1) good coverage of treatment areas due to careful guiding and low flying height of the aircraft, and (2) the thinned tree crowns caused by budworm defoliation in the years prior to treatment which allowed better penetration of the spray formulation.

The manoeuverability and carrying capacity of the Pawnee 235B aircraft was suitable for small-scale applications for control of jack-pine budworm. Larger aircraft with greater capacity may be necessary to make operations more practical in large or inaccessible natural stands.

ACKNOWLEDGEMENTS

Our thanks are extended to Cyanamid of Canada Ltd., Rexdale, Ontario, and Chemagro Corporation, Kansas City, Missouri, for providing quantities of insecticides, to Aerial Spray and Charter Ltd., Neepawa, Manitoba, for their contribution in skilled aerial applications, and to H. C. Phillips and A. E. Campbell, Forest Research Technicians, Canada Department of Forestry and Rural Development, Winnipeg, Manitoba, for their assistance in field and laboratory sampling.

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BIOLOGICAL NOTES ON Saperda Concolor LEC. IN MANITOBA AND SASKATCHEWAN (COLEOPTERA: CERAMBYCIDAE)

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ABSTRACT

The life history of Saperda concolor Lec. was studied in Manitoba and Saskatchewan from 1962 to 1967. The insect requires two years to complete its life cycle in the southern areas; sometimes three years in far northern areas. Two winters are passed in the larval stage; pupation and adult activity occur from late spring to mid-summer. Willow is the preferred host, but trembling aspen is occasionally attacked. Ten species of larval parasites were recovered and an avian predator was tentatively identified. Mortality attributable to these factors was higher in populations from the southern areas of Manitoba and Saskatchewan than from the far north. Egg mortality and total larval mortality, however, were higher in populations from the far north.

INTRODUCTION

Galls caused by Saperda concolor Lec. are frequently encountered in annual forest insect surveys in Manitoba and Saskatchewan. Wong and McLeod (1965) have indicated that host and gall shape separate this species from the closely related species S. populnea moesta Lec. The purpose of this paper is to provide information on the life history, distribution, and natural color of S. concolor in Manitoba and Saskatchewan. The published reports on the life history of this insect by Felt and Joutel (1904), Craighead (1949), Graham et al (1963), and McAloney and Ewan (1964) differ in many respects from our observations.

METHODS

Information on seasonal development and gall formation was obtained by observing the development of caged hosts bearing fresh oviposition scars of S. concolor and by gall dissections from late March to mid-October from 1962 to 1967. This information was supplemented by storing galls containing immature insects in polyethylene bags at 34°C for three months, and then placing each gall in a separate jar at room temperature for adult emergence. The overwintering stages were determined by examining galls collected in late November and March. Estimates of mortality caused by parasites and avian predation were obtained by dissecting fresh and mature galls in the spring and fall from widely separated areas in Manitoba and Saskatchewan.

DISTRIBUTION AND HOSTS

Saperda concolor has been collected throughout Manitoba and Saskatchewan from the Turtle Mountains (Latitude 49°N) in the south to around Nueltin Lake and Uranium City (approximate Latitude 60°N) in the north. This distribution in Manitoba and Saskatchewan is shown on the accompanying map (Fig. 1) and includes nearly all the forest sections described by Rowe (1959) in this area.

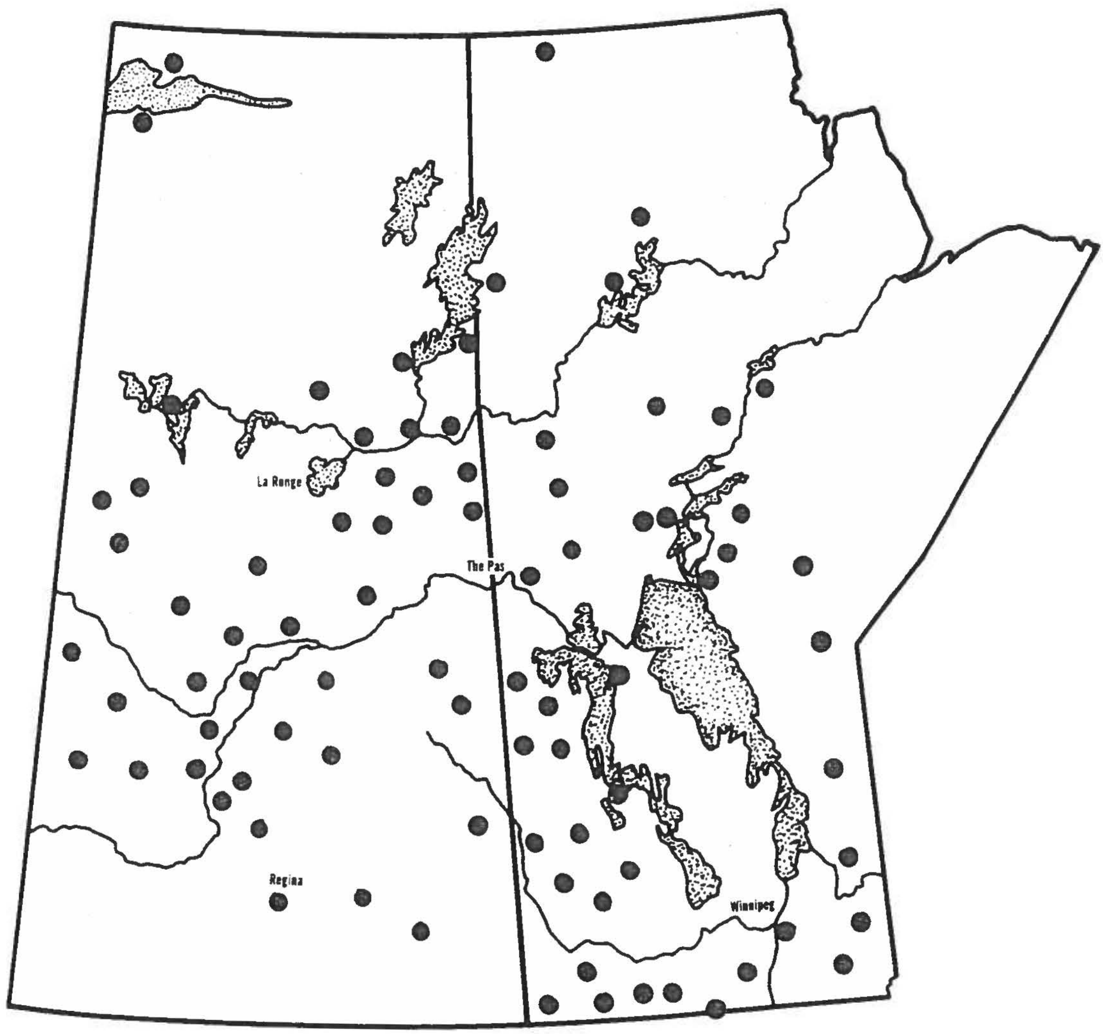


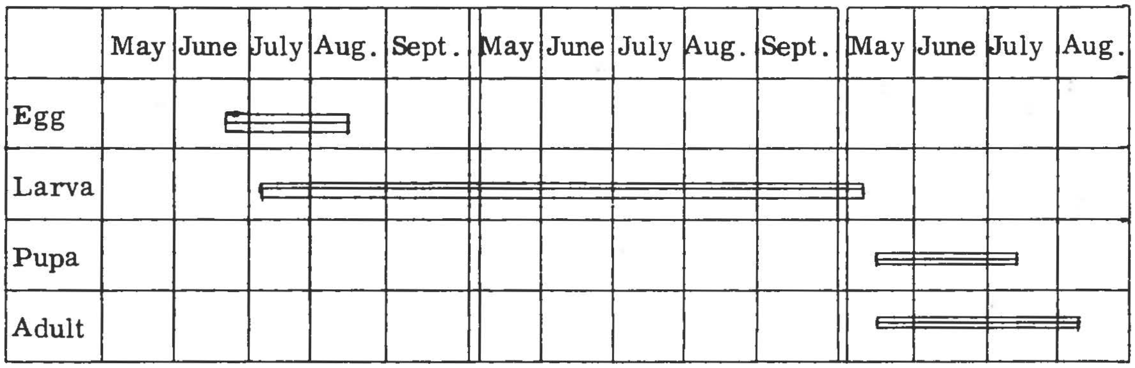
Fig. 1 Map of Manitoba and Saskatchewan showing the Distribution of Saperda concolor Recorded from 1962 to 1967.

Willow is the preferred host in Manitoba and Saskatchewan and S. concolor has been reared from the following species: Salix amygdaloides Anderss., S. bebbiana Sarg., S. discolor Mulh., S. humilis Marsh., S. interior Rowlee, S. petiolaris Smith, S. petiolaris var. rosmarinoides (Anderss.) Schneid. Galls of this insect were most numerous on willows growing in farm woodlots, pastures, around prairie pot holes and along fence rows in the Aspen Grove and Aspen-Oak sections as defined by Rowe (1959). It has been collected occasionally on young trembling aspen, Populus tremuloides Michx.

LIFE HISTORY AND HABITS

In Manitoba and Saskatchewan, S. concolor generally requires two years to complete its development (Fig. 2). A portion of the far northern populations, however, may require up to three years. The female gouges a U shaped egg scar (averaging 6 x 4 mm) with her mandibles on the smooth bark of stems and

Fig. 2. Seasonal Cycle of Saperda concolor in Manitoba and Saskatchewan



branches that are at least three years old and drills a small hole at the base with her ovipositor (Fig. 3). A creamy white spindle-shaped egg (averaging 3.4 x 100 mm) is forced through the hole into the cambium under the undamaged bark within the egg scar, and the wound is sealed with a brownish liquid. The
bark within the egg scar, and the wound is sealed with a brownish liquid. The
number of egg scars around a stem varies from 1 to 9, the average being 3 in southern areas and 2.4 in northern areas. The egg scars lose their U-shape in mature galls, becoming irregular and ragged in appearance.

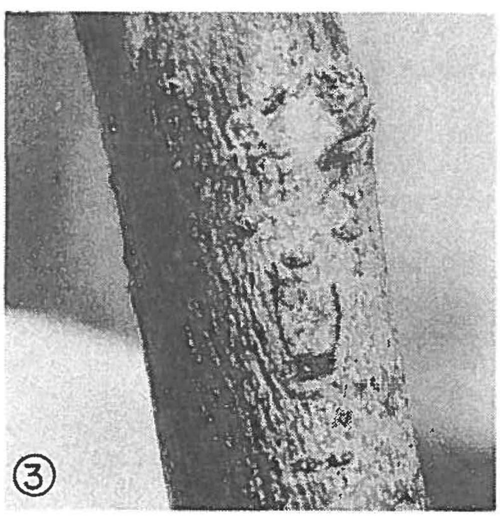


Fig. 3 S. concolor oviposition scar on willow stem.

The eggs hatch in ten to fifteen days and the first-instar larvae initially mine the outer sapwood under the egg scar. The larvae then tunnel into the heartwood, extending and enlarging the tunnel along the grain. The frass and debris produced are ejected through the egg scar. By the end of the first season, the tunnel may extend for about 40 mm above or below the egg scar. Larval tunnels generally do not extend in the same direction when more than one larva occupies the same oviposition site. The larva spends the first winter behind a plug of wood fibres constructed near the apical end of the tunnel. The plug is ejected through an enlarged hole under the egg scar the following spring and the gallery is further enlarged and extended as in the previous year. By the end of the second season, the larval tunnel measures about 110 mm in length. The mature larva overwinters behind another fibrous plug in the pupal cell, which is constructed close to the bark. Measurement of 276 head capsules failed to establish definitely the number of larval instars of S. concolor. Pupation occurs the following spring, and the adult emerges in two to three weeks by chewing its way out of the pupal cell.

The mature gall of S. concolor are characterized by alternating ridges and depressions (Fig. 4). They may measure up to four inches in length and are

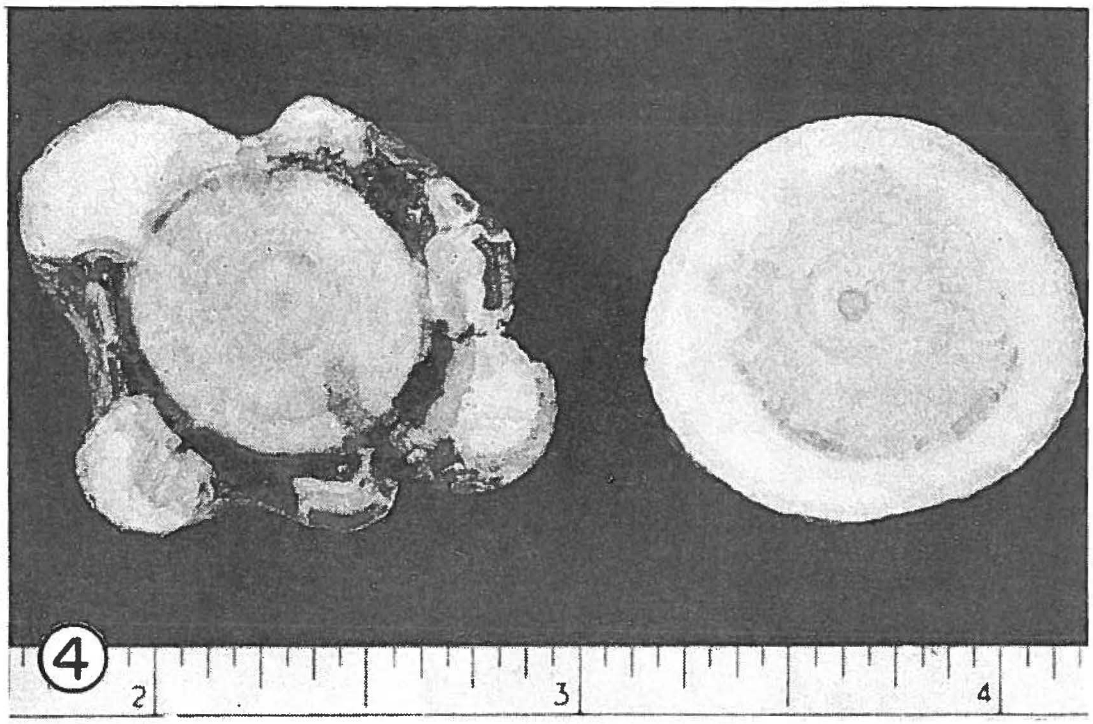


Fig. 4 Cross sections of infested and normal willow stems.

frequently twice the diameter of the infested stem. In very heavily infested stems, the galls become contiguous and are riddled with larval galleries (Fig. 5). Stems weakened by the larval activity of S. concolor are frequently broken off by the wind (Fig. 6).

NATURAL CONTROL

A number of galls were collected and examined prior to the second winter, from locations south of the latitude 53°N and north of the latitude 59°N in Manitoba and Saskatchewan from 1962 to 1967. Ten species of larval parasites were recovered (Table 1). The most common species collected were Dolichomitis messor perlongus (Cress.) and Odinia boletina (Zett.)

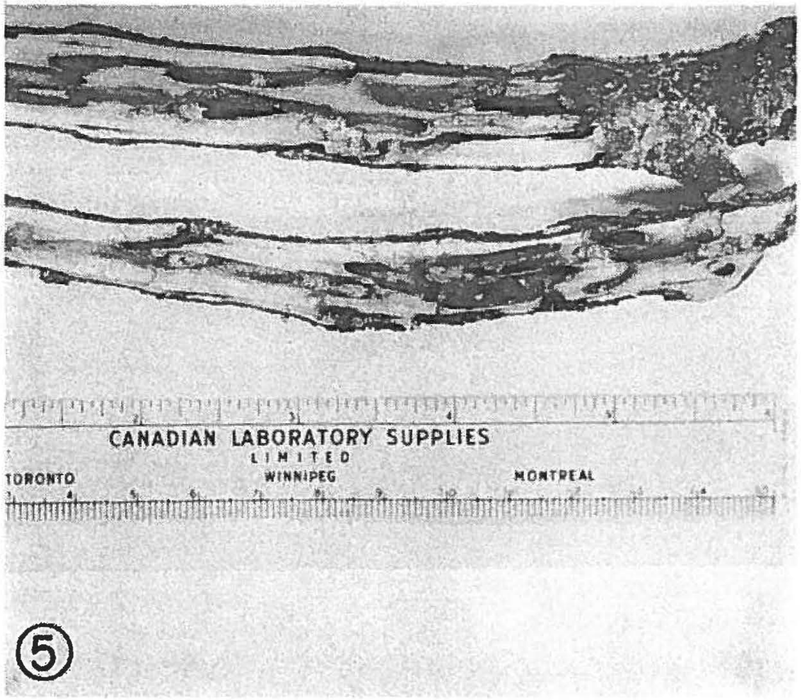


Fig. 5 Severely infested willow stem showing larval tunnels.

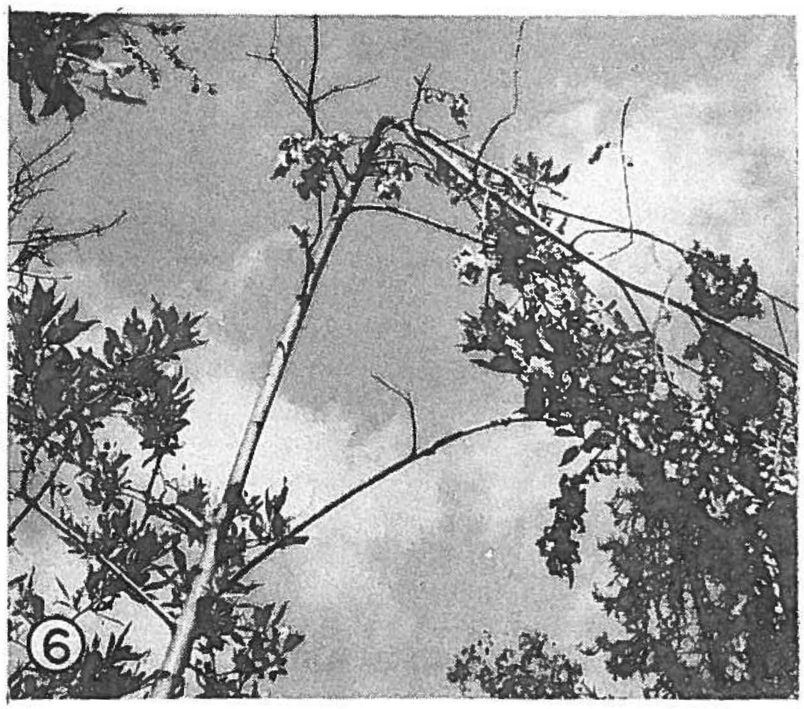


Fig. 6 Wind breakage of infested willow stem.

Table 1. Parasites reared from the larvae of Saperda concolor in Manitoba and Saskatchewan.

Order	Family	Species
Hymenoptera	Ichneumonidae	Cubucephalus contatus Tow. & Gupta
		Cubucephalus prolixus Tow.
		Dolichomitus messor perlongus (Cress.)
		Dolichomitus populneus (Ratz.)
		Dolichomitus sp. nr. messor (Gr.)
		Xylophrurus bicolor bicolor (Cush.)
	Braconidae	Bracon n. sp.
		Meteorus n. sp.
		Meteorus tibialis Mues.
Diptera	Odiniidae	Odinia boletina (Zett.)

A number of galls were opened by an avian predator, which Dr. C. H. Buckner tentatively identified as the black-backed three-toed woodpecker, Picoides articus (Swainson). A comparison of a number of one-year-old galls and two-year-old galls of S. concolor from four separate locations in southern Saskatchewan indicated that avian predation was confined to two-year-old galls (Table 2).

Table 2. Avian predation of Saperda concolor at four separate populations south of the latitude 53^{o}N in southern Saskatchewan, 1967.

	Number of Galls		Avian Predation (%)	
Location	one-year-old	two-year-old	one-year-old	two-year-old
Hagen	14	34	0.0	21.4
Kinistino	14	42	0.0	74.4
Melfort	16	57	0.0	3.2
Redfield	60	34	0.0	28.8

Mortality of eggs and larvae was higher in populations from the far north (Table 3) but mortality caused by parasites, avian predators and diseases was higher in the southern population. The galls in far northern areas were closer to the ground than in southern areas and this may have resulted in more protection from avian predation by snow cover. The factors responsible for egg mortality and the diseases causing larval mortality are not known. The percentage of larvae surviving the first winter and second summer was higher in the south than in the far north, suggesting that other mortality factors, possibly weather, are operative in the north.

Table 3. Comparison of mortality factors in far northern and southern populations prior to the second winter in Manitoba and Saskatchewan, 1962 to 1966

Location of populations	No. of galls	No. of egg scars	Per cent mortality					Per cent survival prior to second winter
				Larval				
			egg stage	diseases	parasites	avian pred.	other causes	
South of the lat. 53°N	158	461	25.8	16.7	7.6	4.3	14.2	31.4
North of the lat. 59°N	110	259	44.8	12.8	0.8	0.0	32.4	9.2

ACKNOWLEDGEMENTS

We greatly appreciate the assistance of the officers of the Entomology Research Institute, Ottawa, for identification services and to Mr. C.B. Gill of the Manitoba Department of Mines and Natural Resources and the late J.S. Jameson of the Canada Department of Forestry and Rural Development, Winnipeg for identification of the willows. Thanks are extended to the rangers of the Forest Insect and Disease Survey of the Manitoba-Saskatchewan Region for their assistance in mapping the distribution of S. concolor and J. C. E. Melvin for assistance in the rearing programs.

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DUST BAGS FOR HORN FLY CONTROL ON BEEF CATTLE

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INTRODUCTION

Difficulties in control of horn fly, Haematobia irritans (L.) on beef cattle are due to lack of suitable methods of application of insecticides, rather than lack of effective materials. Protection of dairy cattle from horn flies is facilitated because the animals are milked 2-3 times daily, and insecticides may be applied at these times. Insecticides with a short residual action are normally applied to dairy cattle. With beef cattle, however, the animals are not handled daily and protection from horn flies depends on the use of insecticides with longer residual action, or some "self-treatment" method of application. The use of insecticides with longer residual action presents problems of possible residues in the meat when animals are slaughtered. Therefore, a satisfactory application technique using insecticides with shorter residual action, is urgently needed for beef cattle.

Several methods of controlling horn flies and other biting flies on range cattle have been used, with varying degrees of success. Backrubbers of various types have been tested, but recent studies indicate that only a small percentage of the cattle will use them. Also, they require constant maintenance, which many farmers neglect. Low volume applications of various insecticides have been shown to be effective when applied by aircraft over rangeland or pastures, but this method may not be economical or even available at the present time to the average livestock producer in Manitoba. Dipping cattle in vats or troughs requires special installations, and considerable time and expense are required. The use of systemic insecticides or medicated feeds are costly and do not always accommodate to normal management of cattle on pasture or range. The average livestock producer is prepared to control insects on cattle only if the method used requires very little time, effort or cost.

A new method of fly control on range cattle has recently been devised, and this paper presents the results of our tests of this technique in Manitoba.

METHODS AND MATERIALS

The method tested was the use of a dust formulation of insecticides applied from special bag dispensers under "forced-use" conditions to control horn flies and other livestock insects. Co-Ral 5% Dust (Chemagro Corporation Limited) was placed in three double-lined, burlap bags which were suspended in an arch in a gateway leading to a water trough. The cattle were thus forced to pass through the barrier of bags on their way to the water. Since the daily high temperatures during the period of treatment would range from 70-85^{o}F., it was estimated that the animals would use the drinking facilities at least twice per day, and would therefore be in contact with the dust bags at least four times daily. The average amount of dust used per animal per day was calculated at 1.6 ounces. This figure is probably slightly high, because some dust is lost by falling on the ground, rather than adhering to the animal. The cost of installing and maintaining the bags was considered negligible in both time and money).

Assessment of the value of the treatment was made by counting flies on mature animals at intervals of 2-3 days. There were twelve animals in the treated herd. Fly counts were also made on the same days on a herd of nine untreated animals on similar pasture two miles distant.

RESULTS

Results are shown in Table 1. It is obvious that on every day on which counts were made the treated animals were relatively free from horn flies.

Table 1. Effectiveness of burlap bag applications of 5% Co-Ral Dust for horn fly control on beef cattle in Manitoba, August 18- September 11, 1967.

No. of days from beginning of treatment	Mean no. of flies per one side of animal: Co-Ral Range	Co-Ral Mean	Untreated Range	Untreated Mean	Per cent control
Immediately prior to treatment	220-420	303	150-240	201	
3	5-20	11	50-190	124	91.1
5	2-13	7	40-270	106	93.4
7	2-25	7	40-600	106	93.4
9	0-4	1.6	15-500	125	98.7
12	2-12	7	25-750	168	95.8
14*	-	-	-	-	-
18	1-8	3	28-750	176	98.3
20	2-8	4.5	35-500	103	95.6
23	4-18	10	15-450	88	88.6

* Dust bags removed.

An interesting observation was that, on the treated herd, horn flies prior to commencement of the test were almost entirely concentrated on the backs of the animals behind the shoulders, whereas after treatment commenced the few horn flies found were nearly always on the lower portions of either the front or hind legs. This observation is consistent with the fact that the legs of the animals were not in contact with the bags as the animals passed through the barrier. Also, on the untreated herd the main concentrations of flies were counted on the backs behind the shoulders.

Face flies, Musca autumnalis (De Geer), and stable flies, Stomoxys calcitrans (L.), also appeared to be controlled by the dust bags, but no actual counts were made. The animals in the treated herd quickly became accustomed to passing through amongst the three bags. As early as three days after the test began the treated animals were noticeably less disturbed by flies, than were those animals in the untreated herd.

CONCLUSIONS

Co-Ral 5% Dust applied from ordinary burlap double-lined bags in a force-use system was highly effective in controlling populations of horn fly on beef cattle. The method of application is effective, economical, and requires little time or labor to install or maintain. The method could also be used against horn fly on dairy cattle, and should be considered in tests against other livestock pests.

IMPRESSIONS OF ENTOMOLOGY IN JAPAN[1]

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ABSTRACT

Impressions of Japan gathered by the author during a threeweek visit, which began August 19, 1967 are presented. Some general, agricultural, and entomological aspects of life in Japan are mentioned. A brief description of the silk industry is included, which shows how the industry benefitted from research.

INTRODUCTION

It was my good fortune to attend the Seventh International Congress of Biochemistry in Tokyo from August 19 to 25, 1967. During the two weeks immediately following the Congress I had the privilege of visiting a number of Japanese research institutions concerned with entomology. Our post Congress tour was arranged for us by the Japanese scientists with whom we visited (Table 1). During the first week we travelled south and west of Tokyo visiting Kanaya, Nagoya, and Kyoto. We returned to Tokyo on the weekend and spent the first three days of the second week visiting Universities and Institutes in Tokyo. The last three days of the week we travelled by rail and automobile north-east of Tokyo and visited one of the major silk producing areas in Japan.

Dr. R. Kasting[2] and I travelled together throughout our stay in Japan. Being with someone who had similar interests and who also spoke English was a great advantage. First it partially relieved the strain of visiting and travelling in a country where English was not the major language. Second, through discussion we were able to benefit from the other person's impressions as we sifted and organized the information received.

Throughout our stay in Japan we were accorded the very warmest of hospitality and kindness. We were met at Tokyo airport upon our arrival by three Japanese scientists who drove us to our hotel and finalized arrangements for our visit. One of them, Dr. T. Yushima, took time from his own duties at the National Institute of Agricultural Sciences to serve as our guide and interpreter during our travels outside of Tokyo. With his assistance we were able to see and do things that would otherwise have been impossible.

My impressions were gathered while spending 12 days in Tokyo and nine days in other areas, all on the main island of Honshu. Conditions are so different from those in North America that it is difficult to draw comparisons.

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Table 1. Research Institutions Visited While in Japan.

Date	Institution	Location	Scientists Visited	Research Interests
Aug. 28	Tea Research Station	Kanaya Shizuoka-Ken	Dr. T. Kaneko	Ecology and physiology of insects attacking tea plants
Aug. 29-30	Laboratory of Applied Entomology	Nagoya University	Dr. K. Iyatomi Dr. T. Saito	Insect toxicology and physiology
Aug. 31	Pesticide Research Institute	Kyoto University	Dr. S. Ishii	Insect pheromones
Aug. 31	Dept. of Zoology	Kyoto University	Dr. M. Kato	Nutrition and Physiology of silkworms
Aug. 31	Faculty of Textile Fibres	Kyoto University of Technical Arts and Textile Fibres	Dr. K. Hayashiya	Nutrition and Physiology of silkworms
Sept. 4	Section of Silkworm Biology	Sericultural Experiment Station Suginami-Ku, Tokyo	Dr. T. Ito	Nutrition of the silkworm
Sept. 4	Section of Chemistry	Sericultural Experiment Station Suginami-Ku, Tokyo	Dr. T. Fukuda Dr. C. Hirano	Chemistry of mulberry and silkworms Biochemistry of silkworms
Sept. 4	Biological Institute, College of General Education	University of Tokyo Meguro-Ku, Tokyo	Dr. H. Chino	Insect hormones and insect metabolism
Sept. 5	Biological Laboratory	Tokyo University of Agriculture and Technology Fuchu-shi, Tokyo	Dr. S. Kamioka Dr. T. Ichinose	Artificial diets for pest insects Biology of pest insects
Sept. 5	Laboratory of Pesticide Chemistry	Tokyo University of Agriculture Setagaya-Ku, Tokyo	Dr. R. Yamamoto Dr. I. Yamamoto	Chemistry of insecticides Insect attractants in rice
Sept. 5	Biology Section	Agricultural Chemicals Inspection Station Kodaira-shi, Tokyo	Dr. Y. Tamaki	Evaluation of pesticide chemicals
Sept. 6	Dept. of Plant Pathology and Entomology	National Institute of Agricultural Sciences Kita-Ku, Tokyo	Dr. T. Yushima Dr. S. Kamano	Biochemistry and nutrition of pest insects
Sept. 7	Laboratory of Pathology and Entomology	Tohoku Branch, Sericultural Experimental Station Iizaka-shi, Fukushima-Ken	Dr. T. Sugiyama	Nutrition of silkworm and mulberry breeding
Sept. 8	Agricultural Chemistry Section	Fukushima Agricultural Experiment Station Kooriyama-shi, Fukushima-Ken	Dr. H. Tachiya	Chemicals and agriculture

GENERAL COMMENTS

Japan with a surface area of about 260,000 square miles, is just slightly larger than the Canadian province of Manitoba. Of this area 60 percent is mountainous and forested, and about 30 percent is available for agriculture. Urban sprawl appears to be a problem in Japan also, for cities large and small occupy the remaining 10 percent of the land mass.

The population of Japan appears to have stabilized at near 100 million of which 10 million live in Tokyo. Many people who work in the cities commute from the rural areas by train daily. Privately owned automobiles are scarce and the Japanese railways constitute the major means of travel. Most North Americans are aware of the Super-Express, the electric train which averages about 100 m.p.h. as it runs between Osaka and Tokyo. Much less is heard of the many other trains that convey the vast majority of commuters and travellers. We were told that over 2,000 trains used the main Tokyo station daily.

Within Tokyo the subway system is also efficient, rapid, and economical. In the central part of Tokyo the subway stations are identified in both Japanese and English. However, in the peripheral parts English is omitted and for one who does not read Japanese this poses a problem. Fortunately, many Japanese people speak English and we were always able to get assistance when in danger of becoming lost.

The Japanese educational system follows the North American pattern, with six years elementary, three years junior high and three years of high school. English is taught in school during the last six years. In addition, there is Educational Television and "Learn to Speak English" is one of the courses. As a consequence of the interest in learning English many Japanese have a good knowledge of the language. In many cases, however, their ability to read and write English is greater than their ability to speak English. Their pronunciation of English words is, naturally, different from ours; consequently misunderstandings are bound to occur. There were times when I was uncertain whether the answer received to a question was in fact the answer to that question or to one thought to have been asked.

The ability of the Japanese to use English is illustrated by our experience at Nagoya University. A "Welcome Seminar" had been arranged there and we as guests each gave a 10-minute report. Staff members and graduate students alike also gave 10-minute reports. The meeting showed us the range of interests in the department with a minimum expenditure of time. The outstanding feature of the "Seminar" was that graduate students and staff all presented their reports in English. In most parts of North America I suspect that any attempt to conduct such a Seminar in a second language would be doomed from the outset.

AGRICULTURE IN JAPAN

With a large population and a small arable acreage it is evident that efficient agricultural production is necessary. Immediately after World War II land was divided into approximately 2 1/2 acre parcels and given to the laborers who were working it; for several years thereafter land could neither be offered for sale nor purchased. Although farmers are now permitted to buy and sell land, 2 1/2 acres still constitutes the average farm. Farm labor is in short supply and there has been a consistent trend toward mechanization as a means of maintaining production. Much effort is devoted by agricultural agencies toward providing information on suitable farm management and land utilization practises.

The importance attached to new agricultural information by the farming public was apparent when we visited the Fukushima Agricultural Experiment Station. The staff had devoted much effort in preparing for "Open House". Every laboratory had appropriate displays and demonstrations; topics ranged from biology and control of pest organisms through to farm management and economics. There were also displays directed to farm women on such topics as sewing, cooking, sanitation, and child care. We arrived on the afternoon of the third day of "Open House"; 50,000 people had already passed through the gates.

Agriculture in Japan is both diversified and intensive; in most of Japan two crops are grown each year. Rice is the major cereal crop although barley and wheat are also produced. In addition, there are vegetables, small fruits, tree fruits, tobacco, tea, and mulberry. Each crop has its own disease, insect, and nematode problems.

ENTOMOLOGY IN JAPAN

It was difficult to determine the number of entomologists employed in Japan although the figure most frequently quoted was 1500. Most entomologists are located at National, Prefectural, and University laboratories. There are, however, about 500 extension entomologists distributed throughout the country who aid and advise the farmer directly. There are also a great many amateur entomologists. A general interest in and love of nature seems to be a national characteristic; perhaps it stems from their Shinto heritage. Their interest in nature is evidenced in their choice of subjects for the many colorful postage stamps.

During our stay in Japan we visited research workers at 13 institutions, toured a silk factory, and visited two silkworm farmers. Because of our interests we visited with those scientists mainly concerned with biochemistry, physiology, and nutrition of insects. Of course a great deal of work is being done on other phases of entomology too.

The laboratories we visited appeared to be well equipped although some of them are old and most are overcrowded. Much of the equipment was made in Japan but foreign products were also present. The shortage of sub-professional help in the laboratories was surprising. Apparently, emphasis on industrial production has caused laboratory assistants to move to industrial jobs. Consequently, scientists do much of their own technical work. Moreover, many scientists type their own letters to non-Japanese colleagues and also type manuscripts for non-Japanese journals. Wherever we went library facilities were good and major journals from foreign countries were readily available.

The rice stem borer, Chilo supressalis Walker causes greater economic losses than any other insect in Japan. Hence, the research effort devoted to this species is extensive and projects vary widely in content. Emphasis was placed on the mass-rearing of this species under artificial conditions so that detailed laboratory investigations could be undertaken. They have been successful in this venture and now larval diapause, genetics of voltinism, metabolism, and detoxication of insecticides are being investigated. The appearance, in 1960, of a strain of rice stem borer resistant to ethyl-parathion added urgency to such studies. Other major pest species of rice include the green rice leaf hopper, Nephotettix cincticeps Uhler, and the smaller brown plant hopper, Laodelphax striatellus Fallen, both of which transmit virus diseases, the rice stem maggot, Chlorops oryzae Matsumura, and the southern green stinkbug, Nezara viridula L. It is clear that the generally mild climate and the intensive cropping practises employed aggravate and magnify the insect damage.

Our visit to the Tea Research Station was both informative and interesting as we had had no prior contact with the tea industry. This unit of the Ministry of Agriculture and Forestry, devoted exclusively to research on tea, is located at Kanaya, about 100 miles south-west of Tokyo. The research program encompasses all aspects of the tea industry, both green and black, except economics. At the main station (there is a branch station on Kyushu Island) there are active research programs on: physiology of the tea plant; breeding and selection; agronomic practises; disease, insect and nematode control; soil and fertilizer use; tea manufacture; and chemistry of tea quality. The staff numbers 110 of which 65 are research personnel. Apparently we were the first westerners to visit that Station and as such were accorded a very special welcome.

SERICULTURE

Sericultural research is concerned with the silkworm, the mulberry plant, and silk technology. It was of interest to learn, therefore, that scientists working on the silkworm, Bombyx mori L., were not considered as entomologists, Nevertheless much interesting work has been done on the nutrition and biochemistry of the silkworm and we were interested in learning about the silk industry and its problems. As indicated in Table 1 we had the good fortune to visit the National Sericultural Institute in Tokyo and also the Tohoku Branch Station. The silk industry in Japan is about 500 years old and still contributes significantly to the Japanese economy. The Iizaka area north of Tokyo, which we visited, produces three crops of silk annually. The insects are housed in sheds with earthen floors. Newly-hatched larvae begin feeding about mid-May for the first crop, early in July for the second, and early in August for the third. Insect pests such as the fall army worm, Hyphantria cunea Dury, scale insects, and leafhoppers, destroy mulberry foliage. Moreover, rust, mildew, and virus diseases also attack mulberries and because of its fastidious eating habits Bombyx mori will not eat diseased areas of leaves. Spring frosts are also a hazard that the silkworm farmer encounters with his first crop. The losses due to frost have been much reduced in recent years by feeding the young larvae on artificial media for a few days. Much research effort is currently devoted toward the improvement of these artificial diets. The silkworm farms we visited produced about 50,000 and 80,000 larvae, respectively, which represented about 30 percent of the total farm income. Cocoons sold for about $4.00 per kg. or about 8/10 of a cent each. Eggs of the silkworm are produced in factories which collect, store, break diapause, and hatch them. Farmers buy the young larvae much as poultrymen in Canada buy young chicks. For very young larvae the leaves are stripped from the mulberry branches and cut into narrow ribbons; as larvae grow larger whole branches are provided and the larvae strip the leaves from them. The farmer provides fresh foliage to the silkworms three or four times each day. Because the larvae always congregate and feed on the upper surfaces, removal of waste and debris is relatively easy. The stripped mulberry branches are dried and used as fuel, whereas the insect feces are used as fertilizer, rich in both nitrogen and phosphorus.

The silkworm population develops synchronously. All larvae moult from stage to stage with remarkable precision and when ready to spin their cocoons the whole population does so, almost on the same day. The farmer introduces racks of collapsible cardboard dividers, much like those used in egg crates, just before the larvae pupate. Larvae isolate themselves, one to a square, and each spins a cocoon consisting of a single silk fiber perhaps a mile long in not more than three days. At this point the farmer ships the cocoons to the silk factory for subsequent processing.

Research has contributed much to improvement of the silk industry. At the turn of this century, 822 kg of mulberry leaves were required to produce 60 kg of silk whereas, in 1960 only 357 kg were required. Similarly 60 years ago 2.6 Ha of land were required to produce the mulberry trees necessary for 60 kg of silk -- the comparable figure today is 0.5 Ha. This improvement in efficiency of silk production has resulted from: 1) development and use of more efficient strains of silkworm; 2) development and use of better varieties of mulberry; 3) use of improved techniques for rearing the silkworm; 4) improvements in cultural methods for growing mulberry, i.e. fertilizer regimes and insect and disease control procedures.

Control of pest insects constitutes a major problem for the silkworm farmer. For example, the fall webworm will often ravage the mulberry plantings unless it is controlled. If insecticides are used in the control program and a toxic residue remains on the mulberry foliage the silkworm population can be decimated. Organophosphates are commonly used in insect control programs because of their relatively rapid breakdown. However, timing is extremely important and ideally no insecticide will be applied less than two weeks before the foliage is harvested. Of course extreme care must also be taken to avoid drift of pesticides applied to nearby crops and plots. The Japanese are very conscious of problems imposed by the presence of pest species that must be eliminated without damaging or destroying those that are beneficial.

CONCLUSION

In the foregoing I've attempted to describe some of my experiences in Japan. I left that country with two major impressions. First, Japan is a country of contrasts: a small land mass and a large population; a dense population and yet a shortage of labor; old traditional dwellings adjacent to new western-style office buildings; narrow winding streets constructed for now outmoded means of transportation yet traversed at frighteningly high speeds by modern high-powered cars, trucks, and buses. Second, the Japanese people are happy, helpful, friendly, and industrious. Their economic recovery since 1945 is a tribute to their hard work and inherent ability. I would predict that in the years ahead major changes will occur in their agriculture. Farm units will be enlarged, more mechanization will occur, and the efficiency of production will be further increased.

THE LARVAL FEEDING HABITS OF THE EASTERN PINE-SHOOT BORER *Eucosma gloriola* HEINRICH (LEPIDOPTERA: TORTRICIDAE) IN JACK PINE REGENERATION IN MANITOBA

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ABSTRACT

The larval feeding habits of Eucosma gloriola Heinrich in new growth of jack pine were studied in the Sandilands Provincial Forest, Manitoba, between 1962 and 1966. Head-capsule widths indicate five larval instars. The majority of the first-instar larvae enter the pith behind a needle fascicle. The larvae mine downward until they reach the fifth instar, and then mine upward for a short distance before notching the current growth near the bottom of the tunnel. They continue their upward progress and emerge near the top of the tunnel.

INTRODUCTION

The eastern pine-shoot borer, Eucosma gloriola Heinrich, was first recorded in 1930 by Heinrich (1931) in southwestern Connecticut, and is now known to occur in other parts of the United States and Canada (DeBoo 1966). Damage by this insect in Manitoba was first observed in 1950 on jack pine (Pinus banksiana Lamb.) in the central portion of the Sandilands Provincial Forest (Wong et al 1950). Borer populations increased in this area in 1962, seven years after a wildfire destroyed 12,000 acres of jack pine. The life history of E. gloriola in Manitoba has been briefly described by Wong and Lawrence (1963), and the increase in population levels from 1962 to 1965 on three different sites was noted by Wong and Campbell (1966). The present study was primarily devoted to an account of the larval feeding habits of this insect in shoots of jack pine trees less than 12 feet in height.

METHODS

Weekly collections of leaders and laterals of jack pine regeneration in the Sandilands Provincial Forest were made during the larval period. A total of 1,038 shoots were collected from early May to mid-August between 1962 and 1966 and examined in the laboratory under a dissecting microscope. Some of the infested shoots were cut in 8-inch lengths and placed in glass jars containing soil to provide supplementary information on larval feeding habits and development.

LARVAL DEVELOPMENT AND HABITS

Head-capsule widths of 847 E. gloriola larvae suggest five distinct instars (Fig. 1), and their seasonal occurrence is depicted in Fig. 2.

The first instar enters the pith of the new growth of the leader or a lateral of jack pine regeneration from early June to early July, usually behind a needle fascicle, but occasionally behind a cone, bark scale, small secondary shoot or the side of a needle fascicle. The entrance holes, about 0.3 mm in diameter, are made anywhere along the new growth, 1 to 3 mm above the base of the needle fascicle, bark scale, etc. The larva generally mines downward, the tunnel becoming wider as the larva increases in size with successive molts. The fifth-instar larva mines downward for a short period, then reverses its direction and mines upward for 5 to 100 mm before making one to four notches in the new wood. Butcher and Hodson (1949) believe the girdling of the new wood by the shoot borer may be a "precautionary measure" to prevent the larva being trapped in the pitch. It is these notches that cause leaders and laterals to break in high winds. The fifth-instar larva may extend the tunnel 3 to 57 mm beyond the entrance hole, depending on the size of the shoot, before reversing its direction again to make an exit hole 2 to 73 mm below the top of the tunnel. The total length of the tunnel mined by the larva may extend from 102 to 294 mm from base to apex. The typical feeding behaviour of an E. gloriola larva from the time it enters to the time it emerges from the leader of jack pine regeneration in mid-July is depicted in Fig. 3.

In areas where E. gloriola occurs in high numbers, up to six larvae have been found in a single leader of jack pine. These larvae entered the same shoot at different distances above the base of the new growth. The frass produced by the early larval instars is reddish brown and more tightly packed in the tunnel than the whitish frass of the fifth-instar larva. When one larva encounters the tunnel of another, it generally changes from positive geotropism to negative geotropism, but will continue in the same direction if the mines are separated by pith or frass. The numbers of exit holes present indicate that not more than three larvae are able to complete their development in the larger shoots. Only one exit hole is present in the smaller shoots. Similarly, Butcher and Hodson (1949) observed five advanced larval instars of this insect in the same shoot in Minnesota, but only two or three larvae were able to complete their development, and these were in the larger shoots.

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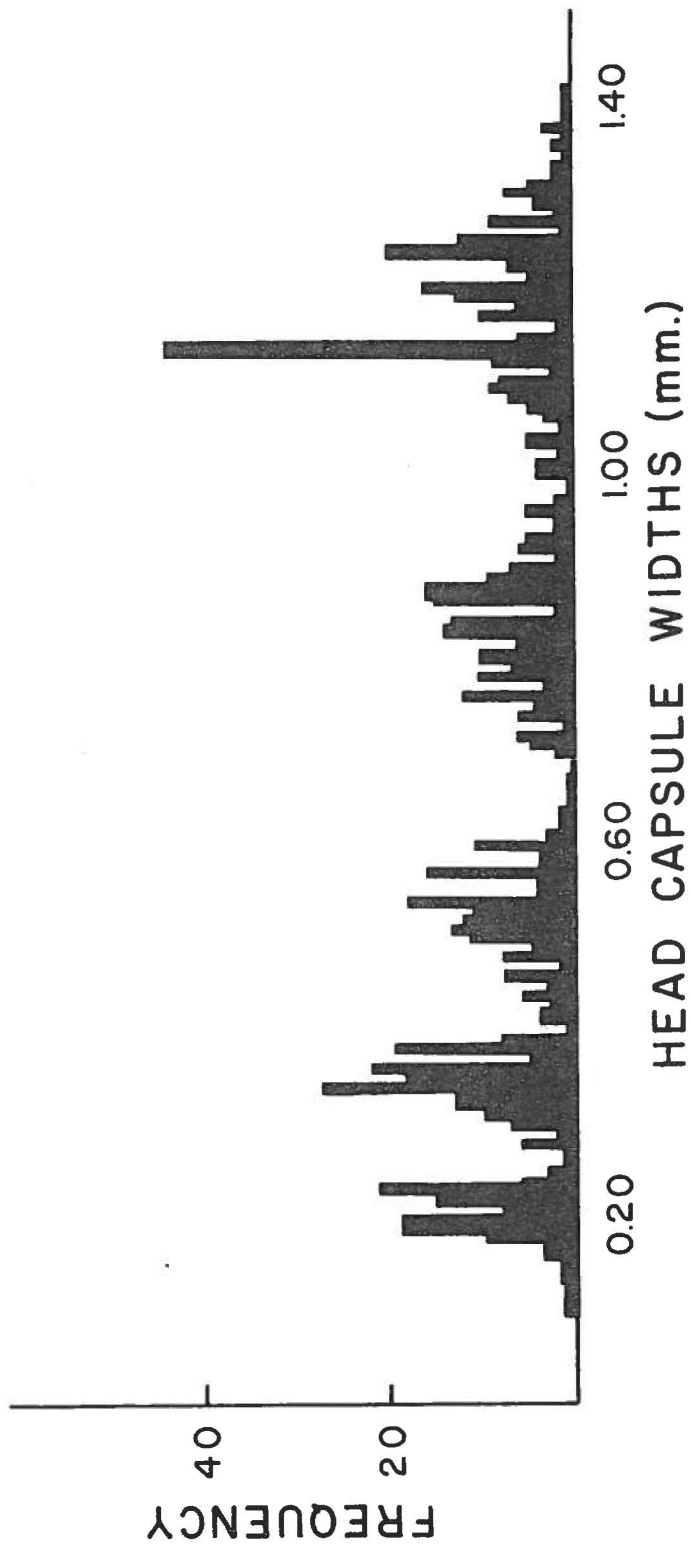

Fig. 1 Frequency distribution of 847 larval head-capsule widths of _E. gloriola_, Sandilands Provincial Forest, 1962 to 1966.

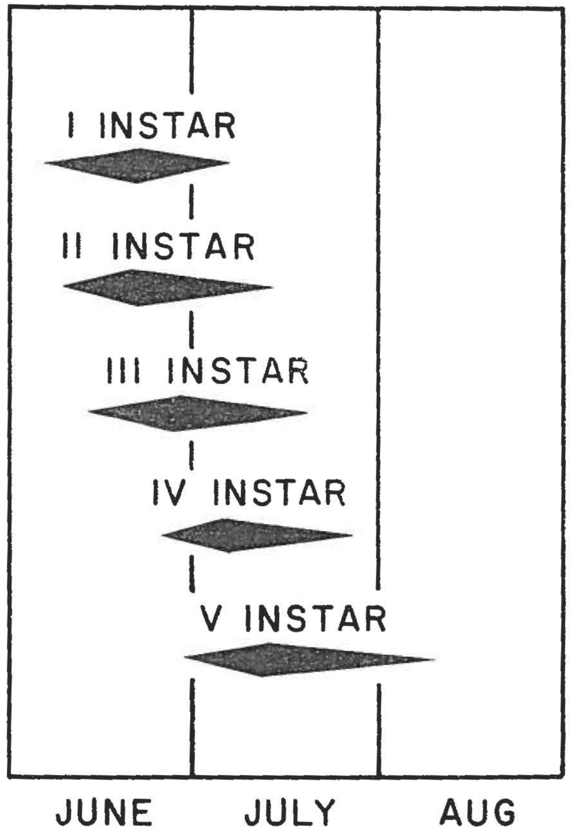

Fig. 2 Seasonal occurrence of the larval instars of E. gloriola in the leaders and laterals of jack pine regeneration, Sandilands Provincial Forest, 1963 to 1965.

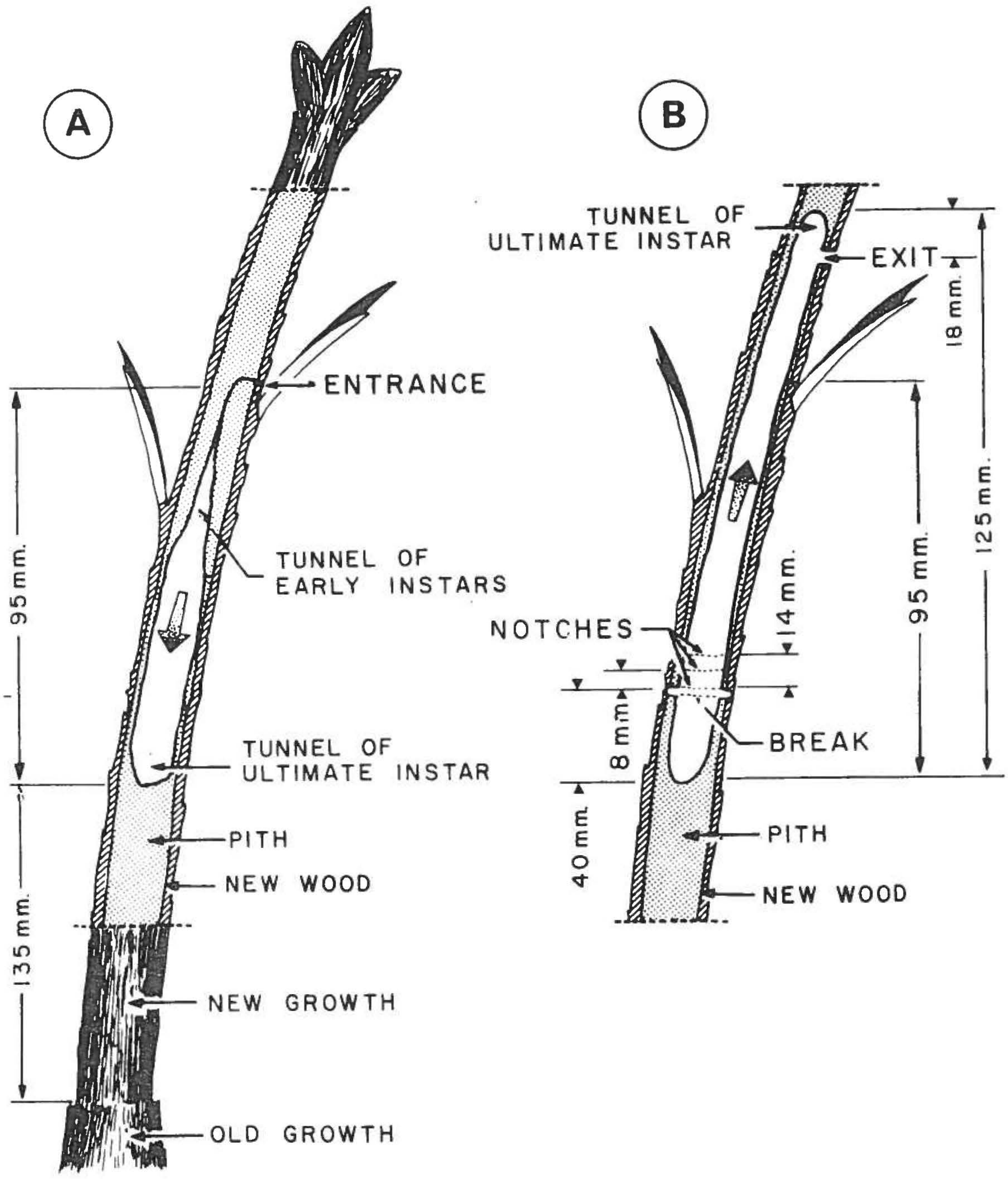

Fig. 3 Schematic illustrations of the tunnels made by a typical larva of E. gloriola in the leader of jack pine regeneration. A – following completion of downward movement; B – following completion of total feeding period.

NOTES AND ABSTRACTS

EFFECTS OF CHEMOSTERILANTS AND GROWTH REGULATORS ON THE PEA APHID FED ON AN ARTIFICIAL DIET

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Nymphs of the pea aphid, Acrythosiphon pisum (Harris), were fed on synthetic liquid diets containing chemosterilants or growth regulators. Thirty chemosterilants and three growth regulators were tested. At specified dosages, all materials caused either mortality, permanent sterility, temporary sterility, or reduced fecundity.

STUDIES OF FOOD TRANSMISSION AMONG HONEY BEES

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Food transference is widespread within colonies of honey bees and serves as a means of communicating information about crops, facilitating recognition of members of a colony, and distributing social pheromones. Studies are underway to ascertain how food is transferred from one bee to others and what attracts them to the "offering" bee under both laboratory and field conditions. The positions of the antennae, along with foreleg palpation, are being noted. Studies are also underway to determine how many bees can be sustained by one bee, and for how long.

REARING HONEY BEE QUEENS IN SMALL CAGES IN THE LABORATORY

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Adult queen bees have been reared successfully in small cages that contain 100, 200, or 400 worker nurse bees held at 30 or 35°C and 40-60 percent relative humidity. The worker bees, seven days old when the tests began, were given a mixture of freshly ground pollen and honey (1: 4 v/v). The worker bees accepted and cared for young female larvae placed directly in artificial, hand made queen cell cups whether or not they were held for a day in a colony of bees. Studies on caste determination are being initiated using the above technique.

OVERWINTERING OF Cryptolestes ferrugineus IN THE PRAIRIE PROVINCES

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Cryptolestes ferrugineus, the rusty grain beetle, is one of the most important pests of stored grain in the Prairie Provinces. Although the optimum temperature for its development is near 35°C (95°F), it must survive winter temperatures in unheated granaries to remain a wide-spread pest of farm stored grain. The temperature in an unheated granary containing 1,000 bushels of wheat will range between 0 and -20°C (32 and -4°F) during the three coldest months depending on the location in the grain mass and on the outdoor temperatures.

The effects of temperatures below freezing on survival of all stages in the life cycle were determined in the laboratory. Adults and last instar larvae were the most tolerant stages. Adults were shown to have a limited ability to acclimate to temperatures below freezing, and this characteristic probably enables Cryptolestes ferrugineus to survive the winter in the Prairie Provinces.

THE DEVELOPMENT OF AN ARTIFICIAL DIET FOR MASS REARING OF THE ONION MAGGOT Hylemya antiqua (MEIGEN)

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Rearing onion maggots on onion tissues for bioassay purposes is unsatisfactory because: (1) collecting large larvae for tests is tedious and time consuming; (2) the quality of commercial onions is highly variable; (3) growing a suitable supply of onions is laborious. Hence, an artificial diet was developed that overcame these problems. The initial artificial medium included brewer's yeast, corn meal, gelatine. water, ground onion flakes, methyl-parahydroxybenzoate and aureomycin. The diet was modified by making additions and substitutions until high oviposition and good larval survival and adult emergence were obtained. The gelatine-base diet developed for the larvae contained sucrose, evaporated milk, and yeast hydrolysate, all components of the adult diet. The new diet also contained wheat embryo, alphacel, water, aureomycin, methyl-parahydroxybenzoate and n-propyl disulphide. Insects reared through three successive generations on this artificial diet lost neither size nor vigor compared with those reared on fresh onions.

FIELD STUDIES OF INTERSEXES OF LOW ARCTIC AEDINE MOSQUITOES

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Earlier work (Anderson and Horsfall, 1963, 1965; Horsfall, 1963; Horsfall and Anderson, 1964; Horsfall, Anderson and Brust, 1964; Brust and Horsfall, 1965) has demonstrated that high temperatures applied to the larvae of many species of Aedes (Ochlerotatus) mosquitoes feminizes the sexually dimorphic structures of adult males. The degree of femaleness in genotypic males is a function of the temperature at which the larvae are reared. To date, temperature-induced intersexuality in mosquitoes remains a laboratory phenomenon.

The collection of three intersexes of Aedes nigripes (Zett.) at Baker Lake, N.W.T. (Brust, 1966) prompted field studies at Baker Lake in 1967 to determine if any larval habitats of this species attained temperatures sufficiently high to induce intersexuality in the adult mosquitoes.

Approximately 25 breeding sites, offering a variety of sizes, types, and temperature regimes, were observed during June-August. None of the pools showed temperatures at or near the intersex threshold (25-26°C.) of A. nigripes for any appreciable period of time.

A comparison of wild-caught intersexes of A. nigripes and also of A. hexodontus Dyar from Baker Lake with temperature-induced intersexes of these species obtained in the laboratory revealed that wild-caught intersexes are morphologically distinct from laboratory reared intersexes.

These data suggest that intersexes of Aedes spp. occurring naturally at Baker Lake, N.W.T. are not caused by abnormally high temperatures in the larval breeding sites.

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WIREWORMS AS PREDATORS OF THE PINE LOOPER IN THE NETHERLANDS

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The pine looper, Bupalus piniarius (L.), is a common defoliator of pines in northern Europe. In the Netherlands, this species has never been recorded at population levels sufficiently high to cause noticeable defoliation. During a one-year study, in association with Prof. Dr. H. Klomp, Dept. of Zoology, Agricultural University, Wageningen, larvae of Athous subfuscus (L.) were found to be the most numerous elaterid species in a pine stand infested by the pine looper. Although the percentage predation by elaterid larvae was low, the number of pupae attacked increased with increasing pupal density both in natural and experimentally augmented prey populations. It is concluded that these elaterid predators respond to changes in the populations of their prey and may contribute to the maintenance of a stable prey population.

HOARDING BEHAVIOR IN MAMMALS

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Hoarding was investigated in a number of wild and domestic small mammals. The behavior was treated as a functional response, and intrinsic and extrinsic factors related to it. A theory is proposed that explains much of the diverse accounts of hoarding in the literature.

ECOLOGY OF WIREWORMS IN SASKATCHEWAN

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Canada Department of Agriculture
Saskatoon

Ctenicera destructor (Brown) is the most widespread and destructive to crops of about 130 species of wireworms known to exist in Saskatchewan. Eggs of this and other species take several weeks to hatch after they are laid in soil in the field. However, they absorb most of the water they require during the first few hours after oviposition, and can take water from soil the moisture content of which is below the wilting point for plants. They are much more resistant to desiccation after the required water has been absorbed than before. Feeding patterns of populations of larvae of C. destructor appear to consist of two groups: (1) those feeding after the last molt in the late summer or fall and molting before feeding the following spring, and (2) those not feeding after the last summer or fall molt and feeding before the first molt the following spring. The latter feed heavily during May and early June when spring grain crops are susceptible to attack, while the former do not feed heavily until late June or early July. Minimum threshold temperatures for feeding appear to be higher in the fall than in the spring.

PROGRAM OF ANNUAL MEETING

OCTOBER 5 Agriculture Auditorium

8:30 a.m.	Registration
9:00 a.m.	Opening Remarks - S. R. Loschiavo, President Entomological Society of Manitoba.
	Address of Welcome - H. H. Saunderson, President The University of Manitoba.
9:15 a.m.	Invitational Paper ''Radiation and sterilization of insects. - R. C. Bushland, Director, Metabolism & Radiation Research Laboratory, U.S. Department of Agriculture, Agricultural Research Station, Fargo, N. D.
10:30 a.m.	Coffee
10:45 a.m.	Environmental research at Whiteshell Nuclear Research Establishment. - J. E. Guthrie, Environmental Control Section, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba.
11:15 - 12:30 p.m.	Lunch
12:30 p.m.	Departure from Faculty of Agriculture Building by auto for Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited, Pinawa, Manitoba.
2:00 p.m.	Guided scientific tour of Whiteshell Nuclear Research Establishment under the auspices and through the courtesy of the staff. Inspection of field experiments on distribution of radioactivity in ecosystems.

OCTOBER 6 Agriculture Auditorium

9:00 a.m.	Effects of chemosterilants and growth regulators on the pea aphid fed on an artificial diet. - A. G. Robinson and O. P. Bhalla.
9:15 a.m.	The Development of an artificial diet for mass-rearing of the onion maggot. - W. L. Askew.
9:30 a.m.	Dust bags for horn fly control on beef cattle. - A. J. Kolach.
9:45 a.m.	Overwintering of _Cryptolestes_ _ferrugineus_ in the prairie provinces. - L. B. Smith.
10:00 a.m.	Coffee

10:30 a. m.	Impressions of entomology in Japan. - A. J. McGinnis.
10:45 a. m.	Hoarding behaviour in mammals and its role as a functional response in predator-prey systems. - C. H. Buckner.
11:00 a. m.	Wireworms as predators of Bupalus piniarius in the Netherlands. - W. J. Turnock.
11:15 a. m.	Aerial spraying in Manitoba for control of jack-pine budworm. R. F. DeBoo and V. Hildahl.
11:30 - 1:00 p. m.	Lunch
1:00 p. m.	Studies of food transmission among honey bees. - R. Feng and S. C. Jay.
1:15 p. m.	Rearing honey bee queens in small cages in the laboratory. - J. Lai and S. C. Jay.
1:30 p. m.	Ecology of economic species of wireworms in Saskatchewan. - R. H. Burrage.
1:45 p. m.	Field studies of intersexes of Low Arctic aedine mosquitoes. - S. M. Smith.
2:00 p. m.	Business Meeting.
8:00 - 12:00 p. m.	Wine and Cheese Tasting Party, Faculty Club, Pembina Hall, The University of Manitoba.

ERRATUM

Vol. 22 (1966) p. 27 between lines 2 and 3 from bottom, insert:

"As a natural mortality factor; and the effects of temperature"

ADDITIONS TO THE LIBRARY

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Carter, George Stuart. Structure and habit in vertebrate evolution. Seattle, Univ. of Washington Press (1967) 520 p. illus.

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Zastita bilja; Plant protection, no. 91-95, 1966-67. (Savenzni institut zastitu bilja, Belgrade, Yugoslavia.)

LIST OF MEMBERS

Members are requested to check their addresses on this list and notify the Secretary of any errors or omissions. The address for both the Research Station, Canada Agriculture and the Department of Forestry and Rural Development is - 25 Dafoe Road, Winnipeg 19, Manitoba, Canada and is indicated as (1). The address for The Entomology Department, University of Manitoba, Winnipeg 19, is indicated as (2). Other addresses are given in full.

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1. The Manitoba Entomologist is printed annually and publishes articles on all phases of entomology. Each paper should contain the results of original research, or review in depth some aspect of entomology. While the primary aims are to publish material of regional interest, some papers of interest to other geographic areas or of general interest will be accepted.

2. Manuscripts should be prepared according to instructions described in the Style Manual for Biological Journals, published by the American Institute of Biological Sciences, 2000 P. St. N.W., Washington, D.C. 20036.

3. Manuscripts should be submitted in duplicate, including the original and one carbon copy on 8 1/2 x 11 paper, double spacing the entire manuscript. Each manuscript over two typescript pages should include an Abstract not exceeding 200 words.

4. Tables and illustrations should be clear and concise, kept within reasonable limits, and should not repeat material presented in the text. Notations identifying the author and title should be made lightly in pencil on the back of each illustration. Tables should be typed separately, one to a page at the end of the manuscript.

5. Each manuscript is reviewed by at least one referee, who will check for scientific content, originality, and clarity of presentation.