The University of Manitoba Field Station Delta Marsh

1977 Annual Report Number 12

THE UNIVERSITY OF MANITOBA FIELD STATION

(DELTA MARSH)

T W E L F T H A N N U A L R E P O R T

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Edited by

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and

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April 1978

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DIRECTORS REPORT 1977

INTRODUCTION

An important event this year was the establishment of a Resident Biologist position, initially for an eleven month period. We were very happy to welcome Marianne See and her husband Jerry Tande to the Field Station in June. As can be seen in subsequent sections of this report they have played a constructive role at the Field Station. We are presently seeking funds from outside sources to provide long term support for a position of this nature.

Dr. J. Gee assumed the role of Acting Director in September when the Director commenced a leave of absence.

Staff

Dr. J. M. Shay	Director	Dr. R. Riewe	Biology Teaching Unit
Dr. J. H. Gee	Acting Director	Dr. S. Sealy	Zoology
Ms. M. See	Resident Biologist	Dr. C. T. Shay	Anthropology
Mr. J. Tande	Resident Biologist	Dr. J. Stewart	Botany
Dr. R. Evans	Zoology	Dr. J. Teller	Earth Sciences
Dr. R. Longton	Botany	Dr. H. E. Welch	Zoology

Support Staff

B. Wallis	Administrator	N. Mulder	Manager
S. Corfield	Cook	S. Kennedy	Domestic Assistant
D. Klippenstein	Domestic Assistant	B. Thoraninson	Maintenance Asst.

Graduate Students

J. Anderson	Zoology	D. MacKenzie	Zoology
S. Cosens	Zoology	C. McKenzie	Zoology
L. Gamble	Zoology	M. McKernan	Botany
N. Hooper-Reid	Botany	J. Yaremchuk	Zoology
G. Kgoroba	Zoology		

Summer Assistants

L. Brownlie	Daren Klippenstein
B. O'Malley	G. Sutherland

RESEARCH

Five thesis projects were completed during the winter and the spring; the studies involving seasonal changes in mass and composition of tissues in the meadow and red backed voles, ontogeny of vocalization in coots, the parasites of muskrats, the adaptive significance of different meristic counts in fish population and the primary productivity of epiphytic algae. Two new projects were initiated - the population dynamics of ticks and the ecology of short and longtailed weasels. The study of Eastern and Western Kingbirds and two long term projects - the population structure of Northern Orioles and the parasites of Lake Manitoba fishes and of blackbirds were continued. The Resident Biologist undertook two single season preliminary studies - the dendrochronological reconstruction of water levels for Lake Manitoba and the development of a fire management plan for portions of the Oxbow Woods.

The reduction in research students in residence this summer was partly due to the number involved in writing their theses and who still required support by their supervisors thus limiting the funds available for new projects. We congratulate two students who sucessfully completed their Ph.D. degrees - Robert McArthur whose thesis was entitled "Behavioral and physiological aspects of temperature regulation in the muskrat (Ondatra zibethicus)" and Eva Pip for "The study of aquatic plant-snail association."

We are also pleased to report that Susan Cosens, Deborah Hood and Graham Mutch completed their M.Sc. theses. Josephine Andersen, Dan Busby, Paul Goossen, Nina Hooper-Reid, Chris McKenzie, Marilyn Rayner and Jerry Yaremchuk are in the final stages of writing.

TEACHING

The first week of the graduate course in Landscape Architecture Field Ecology (31:705) was held at Delta and instructed by Marianne See and Jerry Tande. Field Ecology (1:342/22:345) was offered during the 10 days prior to the fall term and was directed by Drs. J. Gee, R. Longton and J. Stewart assisted by Heather Smart and Maire Luoma.

Principles of Quaternary Paleoclimate Reconstruction (7.739), a graduate course taught by Drs. C. T. Shay and J. Teller and the Plant Ecology course (1:338) instructed by Dr. J. Stewart spent a weekend at the Field Station in October. Twenty students of the University of Winnipeg's Introductory Winter Ecology course conducted by Drs. R. Moodie and R. Staniforth assisted by J. Huebner were with us for a weekend in January.

Due to low enrolments which may be related to the current financial stringincies and consequent difficulty in obtaining summer employment, only one course, Ornithology (22:468) was offered this year.

In order to stimulate interest in the Summer Session courses and to publicize the activities of the Field Station to a broader range of potential students we have embarked on an expanded publicity campaign. A combination brochure/poster modelled on public announcements from other field stations was designed by the resident biologist. This is being widely distributed to institutions in Canada and the United States as well as locally in Manitoba.

Discussions are in progress regarding the expansion of our summer course offerings to allow for more specialized courses to complement the basic program which has been given for several years. To accommodate High School science teachers, who often attend courses at the Faculty of Education during the first half of summer session, we have made provision for a second section of Introductory Ecology in 1978.

Dr. Michael Bruser Bursary

We congratulate Leanne Jablonski who was awarded this bursary for the 1977 season.

Continuing Education

Six weekend courses were offered in the Delta Marsh Series of the Continuing Education Division:-

Winter Involvement	Jan. 7 - 9	Mr. A. Watson & Mr. R. Phillips
Arctic Lifestyles	Jan. 28 - 30	Dr. R. Riewe, Mr. R. Pirt, Mr. D. McMaster
Outdoor Leadership	March 4 - 6	Mr. R. Lay & Mr. R. Hamblin
Log Houses	April 15 - 17	Mr. J. Lazotte & Mr. R. Patterson
Nature Photography	May 10 - 22	Mr. F. Walton & Mr. P. Taylor
Tree Ecology	June 17 - 19	Mr. E. K. Smith & Mr. J. Hreno

The average attendance of 20 students per weekend attests to the popularity of this series and judging from end of course critiques, all were enjoyable and beneficial learning experiences. They attracted individuals from a wide spectrum of society and from places as far afield as Kenora, Ontario; and Thompson, Manitoba.

High School

The Spring Field Ecology program had to be cancelled because Provincial STEP funds, needed to employ an instructor, were withdrawn. With the arrival of Marianne See and Jerry Tande we were able to plan and implement a three part program for the 1977/1978 season. During the fall and early winter approximately 200 grade 11 and 12 students were introduced to an autumn and winter ecology program which included winter shrub and tree identification and snow ecology.

Since it is the younger students who seem to respond most positively to field teaching we hope to extend the program into the junior high level. This will be entirely dependent on funding for staff.

Annual Seminar

The tenth Annual Seminar was held on Saturday March 5th. Eight papers were presented to a diverse audience including members of the University of Manitoba Geography, Botany and Zoology departments and biologists from the University of Winnipeg. Also present were staff from the Freshwater Institute and from the Departments of Renewable Resources and Environmental Management of the Provincial Government.

10TH ANNIVERSARY AND DEDICATION OF LAWRENCE LABORATORY

The 10th Anniversary of the full operation of the Field Station coincided with the 100th Anniversary of the University. In June a luncheon for past and present faculty, graduate students and staff was held in celebration. After lunch the new research laboratory was dedicated to the memory of A. G. Lawrence, a well known Manitoba naturalist.

Alexander George Lawrence was a founder member of the Natural History Society of Manitoba and an active member until his death in 1961, serving as President from 1934-36. He wrote the weekly newspaper column "Chickadee Notes" in the Winnipeg Free Press for almost 34 years. Although he was a bird lover from the first he expanded his interest to cover all fields of natural history especially botany and geology. A fossil cephalopod found by him near Treherne was designated as the holotype of a new variety and named in his honour, Actinocamax manitobensis (Whiteaves) var. lawrencii. He was also a first class wildlife photographer spanning the era from glass plate cameras to modern color photography. He made a number of outstanding bird films. However his most fitting memorial is the present Manitoba Naturalist Society which he helped foster during its formative years. (Manitoba Nature Special Historical Edit. 1977).

The opening ceremony was carried out by his daughter Mrs. Jerdine Crawford. The laboratory will provide much needed space for resident research staff but is designed for alternative use as teaching space when required.

RESIDENT BIOLOGIST

Although Marianne and Jerry have only been on staff for a few months their work and presence has demonstrated the very real need for a Resident Biologist at the Station. We sincerely hope that this position can continue for it impinges upon many important aspects of the Field Station's evolving role particularly the wide variety of teaching demands we have to meet. High School and public education programs can be far more effectively

instructed by those who have had the opportunity to become familiar with the local area.

There is also a need for routine research, continuity in such areas as coordination of land use and collection, collation and assembly of routine data (such as climatological records, phenological dates, mammal sightings and bird migration). When effectively assembled such data would be of immense use to both instructional staff and researchers and the local knowledge of the Resident Biologist would complement the expertise of the teaching faculty and enhance the quality of Summer Session and pre fall term credit courses. Such an input cannot be provided with short term appointments and the resultant need to annually train new individuals.

Additionally through informative talks to schools, local residents and service organizations and by articles for the press explaining the Field Station programs an increased understanding and awareness of the role of the Field Station could be developed.

We are actively seeking funds from University, Government and community sources to establish the position on a firm and ongoing financial basis.

GENERAL

After the driest fall and winter on record the fire risk in the spring was extreme both in the wooded ridge and the marsh. Precautions were taken to protect the buildings by clearing adjacent underbrush and providing additional water outlets for fire hoses; a strange comparison with the previous spring when flood waters inundated us.

Although the early spring continued the dry weather of the fall and winter, the balance of the summer was the wettest and coldest on record and the water deficit in the marsh and surrounding area was virtually eliminated by fall. The construction work to raise portions of the access roads, build a dyke and install gated culverts to complete the flood protection scheme for the buildings and part of the property was scheduled for late August, normally the driest part of the summer. Despite the almost daily rains this work was successfully completed without interference to the teaching and research programs and with only a short interruption of access to our neighbors the Portage Country Club

During the winter, in addition to furnishing the Lawrence Laboratory the alterations to the Agassiz teaching laboratories were completed.

ACKNOWLEDGEMENTS

The effective operation of the Field Station depends upon the interest, support and cooperation of a variety of individuals. To all those on campus who have contributed to the smooth running of the 1977 program, our sincere thanks, and to Judy Hay in the Continuing Education Division for her assistance in the Delta Marsh Series of Weekend programs.

Our appreciation is extended to the Portage Country Club and the Delta Waterfowl Research Station for permission to carry out research on their properties.

We also gratefully acknowledge the dedication of the permanent staff and the many individuals who help to produce the pleasant and stimulating environment we are privileged to enjoy at the Field Station.

John Lee

Acting Director.

Jennifer M. Shay

Director.

Resident Biologist Report

TEACHING

Landscape Architecture Field Ecology

The Landscape Architecture Field Ecology course (31.705) was instructed this year by the resident biologists. The Landscape Architecture course consists of an intensive introduction to field ecology and is the only graduate course currently offered at the Field Station.

High School Field Ecology Program 1977-1978

A Field Ecology Program for high school students was again offered this year, its fifth season of operation. This year resident staff have coordinated an expanded, three-part program to extend from autumn 1977 to spring 1978. Its goal is to shift more emphasis into teacher-training, while continuing with student visits as in previous years.

Part 1 - Autumn Field Trips.- These were introduced for grades 11 and 12. Specific aspects of autumn and winter ecology were emphasized, such as winter shrub and tree identification and snow ecology. The field program exercises consisted of (a) a quantitative study across the beach ridge, or (b) an autumn or winter field trip, identifying plants, birds and animal sign on the ridge and marshlands. Resource materials developed for these exercises included:

(1) "A short key to the trees and shrubs of the forested ridge, University Field Station, Delta Marsh", 10 pp.,
(2) "A field guide to animal sign of the Delta Marsh area", 43 pp.,
(3) Bird identification forms,
(4) A checklist of forested ridge plant species.

Copies of these materials were supplied to students participating in autumn field trips.

The new autumn program component was very well received by the 191 participating students from eight high schools. Teachers' responses from questionnaires indicated that they intended to further develop concepts which were introduced in the day visits, specifically: succession, biotic and abiotic interrelationships, predator-prey interaction and increased environmental awareness.

Part 2 -Teachers' Workshops. The second part of the program will consist of two-day workshops in April at Delta, in which the teachers will receive guidance and practice in the specific field exercises which their students will be undertaking in their spring visits. A series of field exercises covering several aspects of marsh ecosystems have been prepared as follows:

(1) Ecological studies in forest habitats,
(2) Animal tracks and sign,
(3) Ecological studies in marsh habitats,
(4) Pond ecology,
(5) Field biology projects for small groups,
(6) Bird ecology study,
(7) Marsh survey by canoe for small groups.

The workshops are intended to equip teachers with the basic background they need to plan, carry out and integrate the field teaching with classroom instruction. The resources of personnel and facilities at the Field Station are well-suited to public services such as teacher-training.

Part 3 - Spring Field Trips. High school visits in May and June 1978 constitute the third part of the Field Ecology Program. This portion is similar to the spring program of previous years. However, in most if not all of the visits, the teachers themselves will be able to direct the day course, with the Field Station staff assisting. The increasing emphasis on teacher orientation is felt to be an important and necessary step in improving the effectiveness of these field trips. It will also potentially lead to greater utilization of Delta and other areas for educational excursions. In regard to any field trips at the Field Station, careful planning is being undertaken to assure that field trip impact is located away from research areas.

This year's High School Field Ecology Program has been publicized in the "Outsider", an outdoor education newsletter distributed to schools throughout the province. A program outline has also been presented in the Public Forum on Environmental Education sponsored by the Manitoba Environmental Council. It is also important to consider extending the program into junior high and elementary school classes, since it is the younger students who seem to respond best to field teaching.

FIELD STATION COORDINATION

Data Acquisition

The routine data acquisition program at the Field Station is being examined this year in terms of current and projected scientific programs. At present, data are collected in the following categories:

(1) Meteorology: all year - max-min temperatures, wind speed and direction anemometer, pyrheliograph, actinograph. Spring-fall - evaporation pan and cup anemometer (Station Manager).

(2) Hydrology: spring-fall - water levels in marsh near the station (Station Manager).

(3) Plant Phenology: spring-fall - date of first flowering.

(4) Plant Productivity: summer - Phragmites communis (J.M. Shay).

(5) Large Mammals: all year - deer observation forms.

(6) Bird Populations: summer - netting and banding (S. Sealy).

(7) Archeology: spring-fall - a new combination data form/filing packet has been designed by resident staff this year to process artifacts which wash out of lakeshore deposits.

(8) Miscellaneous: additional intensive data acquisition is represented by short-term studies usually carried out by students. These are summarized in this and previous annual reports.

In order to develop a feasible and appropriate program for the Field Station, an extensive study is being made of data acquisition systems at other field stations. A detailed questionnaire was therefore designed and distributed to stations in both Canada and the United States. As of this writing, 36 stations have responded. Preliminary analysis indicates that routine data acquisition systems are of current interest at many field stations and that several directors would like to see organizational improvements. As the remainder of these questionnaires are returned, the responses will be analyzed in detail and recommendations for Delta will be formulated. The major issues which require attention are:

(1) What kinds of routinely collected information are needed by teaching and research staff? (e.g. meteorology, plant phenology, plant productivity, bird populations, small mammal populations, terrestrial and aquatic invertebrates, aquatic vertebrates, amphibians and reptiles, long-term vegetation change, archeology etc.)

(2) At what intervals should such data be recorded?

(3) Who should collect different types of data?

(4) Should an effort be made to collect and/or standardize information gathered from teaching programs at the station?

(5) Should use and disturbance be monitored?

(6) Is there a need to set aside permanent study plots?

(7) Should a copy of all data collected at the station be deposited at the station?

(8) Should research collections be deposited at the station?

(9) Are research collections from the station premises considered to be property of the station?

(10) Does the station require a data storage and retrieval system?

(11) If so, should this be computerized?

The topic of data acquisition for field stations is receiving increased attention in North America, evident in the recent consensus of the Organization of Biological Field Stations to closely examine this issue. Therefore, the survey results will be made available when recommendations for the Field Station have been completed.

Land Use Map for Research and Teaching

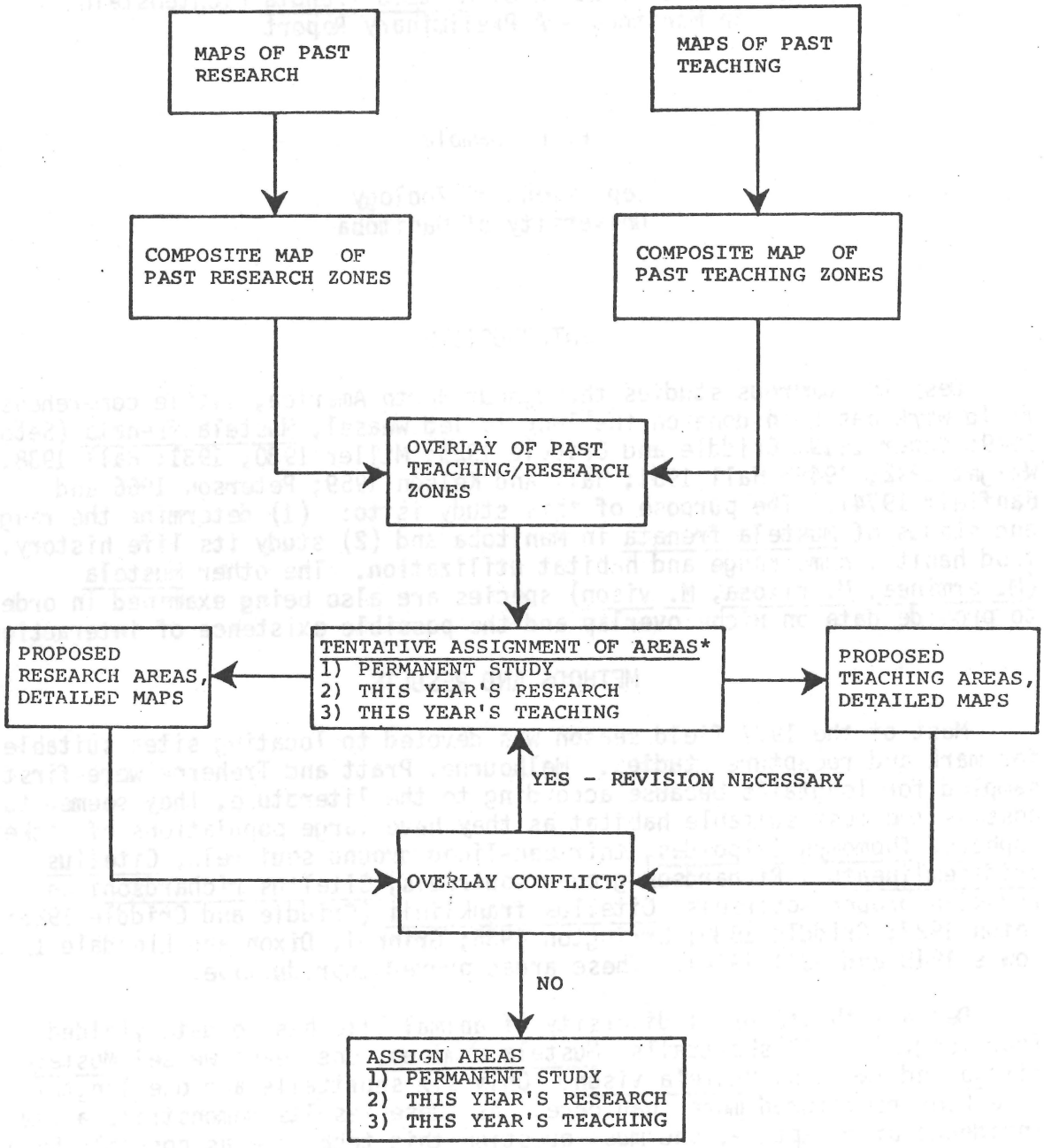
The Field Station facilities have been developed primarily for research and teaching, which can potentially be conflicting activities with respect to land utilization. It has been observed on completed data acquisition questionnaires that other field stations which promote both activities have found it necessary to designate certain land use areas. A land use map would be of considerable practical benefit to the scientific community which works on the property. Several considerations relating to routine data acquisition have also led to this idea, such as:

(1) permanent plots for monitoring change in biota, over time,
(2) standardizing data from field classes, using specified sites,
(3) minimizing interference with recording instruments positioned in field localities.

The considerations in producing such a map include the changing patterns of short-term (i.e. student) research and the highly variable access to certain parts of the property. Such difficulties serve to emphasize the flexibility which must be built into the application of the use map concept.

The sequence in Fig. 1 represents the process of map production resulting in policy decisions at two levels in the flow diagram. The first is the tentative assignment of use areas and requires the participation of teaching and research interests. This committee will need to evaluate past use patterns to reach its tentative land use designations, then examine detailed proposals for teaching and research use. In the event of conflicting use proposals, re-evaluation will be carried out by this group until an acceptable assignment of land areas is attained. The committee will also be responsible for approving additional research and/or teaching proposals for land use submitted during the year. Flexibility will be necessary for evaluating land use within a year, but especially from year to year.

At present time the base maps are being distributed to former and proposed users. This will enable the compilation phases to occur well ahead of the first major users of the season, the High School Field Ecology students.



*COMMITTEE INTERACTION BEGINS

FIGURE 1. Production process for a land use map for research and teaching at the University Field Station, Delta Marsh.

The Ecology and Distribution of Mustela frenata Lichtenstein in Manitoba - A Preliminary Report

R. L. Gamble

Department of Zoology
University of Manitoba

INTRODUCTION

Despite numerous studies throughout North America, little comprehensive field work has been done on the long-tailed weasel, Mustela frenata (Seton 1909; Soper 1919; Criddle and Criddle 1925; Miller 1930, 1931; Hall 1938; Wright 1942, 1948; Hall 1951; Hall and Kelson 1959; Peterson 1966 and Banfield 1974). The purpose of this study is to: (1) determine the range and status of Mustela frenata in Manitoba and (2) study its life history, food habits, home range and habitat utilization. The other Mustela (M. erminea, M. rixosa, M. vison) species are also being examined in order to provide data on niche overlap and the possible existence of interactions.

METHODS AND RESULTS

Most of the 1977 field season was devoted to locating sites suitable for mark and recapture studies. Melbourne, Pratt and Treherne were first sampled for longtails because according to the literature, they seemed to possess the most suitable habitat as they have large populations of pocket gophers, Thomomys talpoides, thirteen-lined ground squirrels, Citellus tridecemlineatus, Richardson ground squirrels, Citellus richardsoni and Franklin ground squirrels, Citellus franklinii (Criddle and Criddle 1925; Seton 1927; Criddle 1930; Errington 1936; Grinnel, Dixon and Linsdale 1937; Sowls 1948 and Hall 1974). These areas proved unproductive.

Delta with its great diversity of animal life has to date yielded four longtails, 49 shorttails Mustela erminea, one least weasel Mustela rixosa and two mink Mustela vison. Only six shorttails and one longtail have been recaptured more than once. As these results demonstrate a low incidence of recapture, one must question this technique as possibly being not representative of the population as most weasels demonstrate an acute learning behavior reinforced by toe clipping and handling. Occasionally however, some individuals overcome their initial fears and seem to resort to trap robbing thus frequently being recaptured often at the same trap site. This has been demonstrated in two shorttails and one longtail. Frequent recapture of individuals, although necessary in plotting territory and range, increase the likelihood of succumbing to trap exposure. As recaptures of carnivores are infrequent, such losses are regrettable.

Track analysis demonstrates a tendency for weasels to veer towards a trap for inspection, occurring more frequently in recaptured individuals. One must then question the reliability of this technique in establishing territory and range. Telemetry thus, may be a more reliable means of accumulating data. Sernylan a narcotic still in the experimental stages seems to be a useful drug for anaesthetizing weasels for handling, as losses have been negligible. One shorttail died after treatment with this drug but seemed emaciated. The response to Sernylan is usually immobilization of the animal in five to ten minutes.

Each of the standard measurements (total length, tail length, hind foot, ear notch and weight) are recorded for each captured specimen. It seems weasels decrease in weight from summer to winter possibly due to changes in metabolic activity related to their high surface to mass ratio.

Distribution and Status

In order to determine distribution and species status, it has been necessary to purchase longtail weasel carcasses from trappers. Although notices have been posted in conservation offices, Renewable Resources, Provincial parks, trapping licence vendors and post offices, returns are low. Many trappers can not distinguish between shorttails and longtails because of the rarity of the latter.

Winter Track Surveys

Winter track surveys have been taken to determine habitat utilization and movement. This also has not been too rewarding since weasels tend to be subnivean. One longtail which frequents the Delta Field Station often forages in the snow caves beneath the cattails Typha latifolia and reeds Phragmites communis. Snowshoeing and skiing over this cover collapses these cavities and disrupts the habitat. Further Mustela (sp.) tend to follow ski trails which may confuse the home range data.

Stomach and Scat Analysis

Stomach content analysis will be undertaken on acquired specimens. Digestion may continue briefly in these specimens before freezing but hair and bone materials usually remain.

Since weasels are secretive in their habits and often defecate in burrows, scats can usually only be collected from trapped specimens. On occasion scats have been acquired at scent posts but in many instances cannot be distinguished from other Mustela species as size is relative to diet.

Subspecies Analysis

Intact skulls acquired through trappers and museums are being analyzed to determine subspecific differences as defined by Hall (1951). This requires 19 calibrated measurements taken three times on each specimen of

which the average is computed and recorded. Three subspecies may exist in Manitoba although Mustela frenata longicauda Bonaparte is generally recognized. Mustela frenata spadix (Bangs) is recorded from both North Dakota and Minnesota, but due to low sample sizes, Hall (1951) does not record it in Manitoba. Hall (1951) notes the unusual features of specimens from the Turtle Mountains in Manitoba and proposes a further subspecies may exist in this region. As Manitoba is a transition zone between eastern and western forms, an intergrade might exist. Acquiring weights and measurements from museum specimens may be essential in demonstrating Bergman's rule for this species, since individuals taken in the Prairie Provinces appear larger than their southern counterparts.

Ageing

Relative and absolute ageing will be achieved by: (1) baculum weight and length and (2) tooth sectioning.

Parasite Analysis

Mr. C. McKenzie, Drs. L. C. Graham and T. A. Dick have been examining the lungs, intestines and diaphrams respectively, for endoparasites. Dr. Graham has found a high incidence of Alaria which are known to cause human deaths. Life cycle data is inadequate in Alaria and requires review of the definitive host. As amphibians and reptiles are intermediate hosts, it can be assumed that weasels must include these as part of their diet (Russel 1930; Grinnel, Dixon and Linsdale 1937; and Hall 1951). Amphibians and reptiles will be offered to captive weasels to determine their initial response to this prey.

DISCUSSION

The longtail weasel is viewed as a prairie species somewhat restricted to the vicinity of water due to its high metabolic requirements (Hall 1951 and Brown and Lasiewski 1972). Accumulated data from trapping records and field work suggests this species prefers water courses and marshes (wet meadows) over open prairie because in winter when water is no longer a limiting resource, this species still confines its activities to these areas. In shorttails which also require free water, activity is not confined to wet meadows, instead they prefer wooded habitat. Current agricultural practices destroy suitable longtail habitat by draining much of the marsh, which once encompassed southern Manitoba and by reducing cover. Ruttle (1968) notes, that longtails have declined due to disease and new methods of harvesting grain.

This species, as are many predators, is prone to biological magnification, which has increased in severity with the increased use of toxic fertilizers, pesticides and herbicides. These effects are difficult to interpret as often it does not result in immediate death of the individual but results in decreased fecundity.

Trapping has a minimal effect on longtail populations as specimens are only trapped incidentally in mink sets.

Weasels are of value to Manitoba through trapping revenues but even more so as rodent exterminators. Most people tend to overlook the everyday habits and use the casual ones such as chicken stealing for general consideration. Criddle and Criddle (1925) estimated that longtailed weasels destroy fully 2,000 rodents for every fowl.

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A Study of the Seasonal Population Dynamics of the Ticks *Dermacentor variabilis* (Say) and *Haemaphysalis leporispalustris* (Packard) in a Marshland Habitat: A Preliminary Report

K. G. Kgoroba

Department of Zoology
University of Manitoba

INTRODUCTION

The climatic conditions of moisture, temperature and light, as well as the presence of a large number of suitable hosts at Delta Marsh allow relatively high densities of the ticks *Dermacentor variabilis* (Say) and *Haemaphysalis leporispalustris* (Packard). Several small mammal and bird species act as hosts. The most important hosts for *D. variabilis* are meadow vole (*Microtus pennsylvanicus*), red-backed vole (*Clethyionomys gapperi*), meadow jumping mouse (*Zapus hudsonicus*) and deer mouse (*Peromyscus maniculatus*). For *H. leporispalustris* the important hosts are Brown Thrasher (*Toxostoma rufum*), Gray Catbird (*Dumetella carolinensis*), American Robin (*Turdus migratorius*), Common Grackle (*Quiscalus quiscula*) and Northern Water Thrush (*Seiurus noveboracensis*). Preliminary observations from studies on the distribution and numbers of the various growth stages of the ticks indicates that macro and microclimatic factors of moisture, light and temperature effect the seasonal dynamics of the ticks in the spring, summer and fall. Studies on seasonal activity of *Dermacentor variabilis* (Say) have been carried out by McEnroe (1975) in Massachusetts (U.S.A.). Dodd, Martell and Yescott (1968) also documented the effects of the climatic conditions on *D. variabilis* in Nova Scotia. No studies have however been undertaken on *D. variabilis* in Manitoba or in a Marshland habitat.

The objectives of this study are:

a) to study seasonal dynamics of *Dermacentor variabilis* on rodents,

b) to study seasonal dynamics of *Haemaphysalis leporispalustris* on birds and rodents,

c) to study seasonal dynamics of *Dermacentor variabilis* on vegetation,

d) to study the life cycle of *D. variabilis*,

e) to determine if other species of ticks are present at Delta Marsh.

MATERIALS AND METHODS

A field study of a large number and variety of animals was conducted at Delta Marsh in the summer of 1977 between June and August. Several methods were used for retrieving animals:

a) A trapping grid 70 x 100 metres was set up in Oxbow woods. A total of 80 points were staked out 10 m apart in all directions, to produce a grid. Each point was marked with a 1½" long lath to which an orange tape was attached. Eighty Sherman traps were placed in the vicinity of each post and numbered according to rows and columns. The traps were set on three consecutive nights, at two week intervals and baited with a mixture of peanut butter and rolled oats (2:1 by volume). Cotton batting was added to provide nesting for cold and wet nights. Mice caught in the traps were collected the following morning between 8:00 and 9:00 a.m., taken to the laboratory, anaesthetized with ether and examined for ticks. Each rodent was toe-clipped according to a predetermined pattern to permit future identification upon recapture. The rodents were then returned to the specific areas where they were caught by 3:00 p.m. the same day. Ticks were removed and placed in labelled vials in 70% alcohol for later identification.

b) Most birds were obtained from Dr. Sealy's research group at Delta and in addition, wire cage traps were used to trap ground birds. A few birds were collected with a 410 shotgun.

c) Wire cage traps were also used for trapping skunks, raccoons, rabbits, squirrels and weasels.

d) A few other animals were also retrieved from road kills.

e) To determine tick numbers on vegetation, a white terrycloth square 1 x 1m was sewn on to a 1m long rod and dragged over areas of the following habitats: (i) low grassland, (ii) high grassland, (iii) edge of woods, (iv) herbs and, (v) in woods.

Four drags of 25m length were made giving a total number of ticks for a 100 square metre sample area in each habitat. Time, temperature at ¼m, ½m, 1m and 2m, above ground level, weather conditions, i.e. sunny or cloudy and moisture of soil were noted. Humidity was recorded on the sample plot continuously for the three months by means of a Hygrothermograph. Mean and range of numbers of ticks were calculated for each day of vegetation sweep. In mid-summer a survey was made of the flora in each habitat.

RESULTS AND DISCUSSION

Records of Ticks on Animal Hosts

A total of 482 mice were examined and 451 Dermacentor variabilis ticks removed. This showed a significant figure of 72.3% infestation. (see Table 1). Sixty-four birds were examined and showed 37.5% infestation with ten new host records for Manitoba. All ticks from birds were Haemaphysalis leporispalustris. (see Table 2 last column with asterisk). Sixty-nine other mammals were examined (see Table 3). Seven out of 13 genera showed infestation.

Seasonal dynamics on Rodents

From Table 4, it can be seen that June was the peak period for ticks with 42.9%, 41.9%, 68.8% and 86.4% infestation for Z. hudsonicus, P. maniculatus, C. gapperi and M. pennsylvanicus respectively with infestation dropping to 5.8%, 2.4%, 5.2% and 16.1% in August. These figures are significant (Dodds, Martell and Yescott, 1968). In Figure 1, the graph shows a peak in June with a rapid decline in August. Dodd et al (1968) found that the tick activity in their study started in May, peaked in June and started to decline in July to August. Both above results agree with the results of the vegetation study in the optima and decline of tick activity. Microtus pennsylvanicus shows the highest percentage infestation for the entire period of the survey. This is because these mice have a thick coat of fur which serves as a suitable cover. Also, the trapping grid results indicate that they were caught more on the edge of wood and in the tall grassland area which is the area preferred by questing ticks. Peromyscus maniculatus have less and very short fur, compared to the other mice. Their grooming habits could therefore be more efficient than the other species. It is also to be noted that only larvae and nymphs were found on the mice, thus satisfying the two-host part of the three-host characteristic of the ticks. No adults Dermacentor variabilis were found on mice. (Table 5).

Seasonal dynamics on Plants

It is noteworthy that in the vegetation study, ticks were found more on the edge of the woods where it was not too hot on sunny days but had sufficient humidity. The results here need further verification. Inside the woods, where there was little low cover, as well as on the low grassland area, the tick population was almost negligible.

An area which was not among the five vegetation study habitats, but which had high grass and footpaths caused by mammal travels had a very high number of questing or preparasitic adult ticks.

Table 1. Mice and rats caught in traps. June - August 1977

A	B	C	D	E	F	G	H	I									
	Number of Mice Caught				Stage of Tick Development												
	June	July	August	Total Number of Mice	Larvae	Nyphs	Adults	Total Tick Popul.	Attached	Unattached	Engorged	Unengorged	Number of Mice infested	Number of Mice Uninfested	% infested	% ticks attached	% ticks engorged
Peromyscus maniculatus	31	48	42	121	68	21	-	89	83	6	34	55	20	101	16.5	93.3	38.2
Clethrionomys gapperi	16	107	77	200	36	132	-	168	164	4	98	70	59	141	29.3	97.6	58.3
Microtus pennsylvanicus	22	44	56	122	61	117		178	168	10	111	67	48	74	39.3	94.4	62.4
Zapus hudsonicus	7	14	17	38	8	8	-	16	14	2	14	2	7	31	18.4	87.5	87.5
Mus musculus	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-
Rattus norvegicus	2	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-
TOTALS	78	214	192	484	173	278	-	451	429	22	257	194	134	350	72.3	95.1	60

Table 2. Birds examined June - August 1977.

	HOST	Number of Birds	Larvae	Nymphae	Adults	Total	Attached	Unattached	Engorged	Unengorged	Number infected	% Infected	New Host Records
1.	Brown Thrasher	5	-	4	19	23	22	1	20	3	3	60	*
2.	Cat Bird	5	1	-	-	1	1	-	1	-	1	20	*
3.	Robin	2	-	11	-	11	11	-	6	5	1	50	*
4.	Verry	5	1	-	-	1	1	-	1	-	1	20	*
5.	Yellow throated Vireo	1	-	-	-	-	-	-	-	-	-	-	
6.	Brown headed Cowbird	9	1	6	3	10	9	1	9	1	3	33.3	*
7.	Northern Water Thrush	1	-	1	-	1	1	-	1	-	1	100	*
8.	Northern Oriole	4	1	2	-	3	3	-	1	2	2	50	*
9.	House Sparrow	2	-	-	-	-	-	-	-	-	-	-	
10.	Common Grackle	10	18	10	41	69	64	5	32	37	8	80	*
11.	House Wren	2	-	-	-	-	-	-	-	-	-	-	
12.	Red-Winged Blackbird	4	3	-	-	3	3	-	3	-	2	50	
13.	Western King Bird	2	1	-	-	1	1	-	1	-	1	50	*
14.	Eastern King Bird	1	-	-	-	-	-	-	-	-	-	-	
15.	Western Oriole	2	-	-	-	-	-	-	-	-	-	-	
16.	Yellowhead Blackbird	3	-	-	-	-	-	-	-	-	-	-	
17.	Fly Catcher	1	-	-	-	-	-	-	-	-	-	-	
18.	Orchard Oriole	1	-	-	-	-	-	-	-	-	-	-	
19.	Song Sparrow	1	-	-	1	1	1	-	1	-	1	100	*
20.	Rose Breasted Grosbeak	3	-	-	-	-	-	-	-	-	-	-	
	TOTAL	64	26	34	64	124	117	7	76	48	24	37.5	

Table 3. Other mammals examined June - August 1977

	HOST	Number	Larvae	Nymphae	Adults	Total	Attached	Unattached	Engorged	Unengorged	Number infested	% infested	New Host Records
1.	American Red Squirrel	9	-	2	-	2	2	-	2	-	2	22.2	
2.	Franklin Ground Squirrel	11	-	-	3	3	2	1	2	1	3	27.27	
3.	Thirteenlined Ground Squirrel	1	-	-	-	-	-	-	-	-	-	-	
4.	Eastern Cottontail Rabbit	1	-	16	14	30	14	16	14	16	1	100	
5.	Jack Rabbit (White tailed)	1	-	-	-	-	-	-	-	-	-	-	
6.	Snow shoe hare	1	-	-	106	106	100	6	54	52	1	100	
7.	White Tailed Deer	1	-	-	1	1	-	1	-	1	1	100	
8.	Longtail Weasel	1	-	-	-	-	-	-	-	-	-	-	
9.	Shorttail Weasel	4	1	-	-	1	-	1	-	1	1	25	
10.	Raccoon	1	-	-	-	-	-	-	-	-	-	-	
11.	Stripped Skunk	1	-	-	5	5	5	-	2	3	1	100	
12.	Red Bat	1	-	-	-	-	-	-	-	-	-	-	
13.	Masked Shrew	36	-	-	-	-	-	-	-	-	-	-	
	TOTAL	69	1	18	129	148	123	25	74	74	10	-	

Table 4. Percentage of infected mice. June - August 1977

A	B	C	D	E
Month	Zapus hudsonicus	Peromyscus maniculatus	Clethrionomys gapperi	Microtus pennsylvanicus
June	42.9	41.9	68.8	86.4
July	21.4	12.5	41.1	45.5
August	5.9	2.4	5.2	16.1

Table 5. Ticks from mice and stages of development. June - August 1977.

Month	A Life Stage of Tick	B Zapus hudsonicus	C Peromyscus maniculatus	D Clethrionomys gapperi	E Microtus pennsylvanicus	F Totals
JUNE	Larvae	6	65	5	49	125
	Nymphs	4	12	33	44	93
	Adults	-	-	-	-	0
	I Total	10	77	38	93	218
JULY	Larvae	2	3	39	11	46
	Nymphs	3	8	94	60	165
	Adults	-	-	-	-	0
	II Total	5	11	124	71	211
AUGUST	Larvae	-	-	1	1	2
	Nymphs	1	1	5	13	20
	Adults	-	-	-	-	0
	III Total	1	1	6	14	22
TOTAL I, II & III		16	89	168	178	451

CONCLUSION

As this is a preliminary report, not all areas of the objectives have been covered but much remains to be done. It should be noted, however, that the study commenced in June, 1977 but with the spring season starting much earlier than normal in 1977 it was not possible to begin the study coincidentally with the emergence of ticks from winter hibernation. As a result, the present report reflects the optima and decreasing periods of tick activity and thus does not show the complete cycle of tick activity from early spring through summer to fall.

ACKNOWLEDGEMENTS

I wish to thank the Canadian International Development Association for a scholarship and the National Research Council of Canada for providing funds for this study through my supervisor, Dr. H. E. Welch. I also thank all those who have given valuable assistance in various way up to this point.

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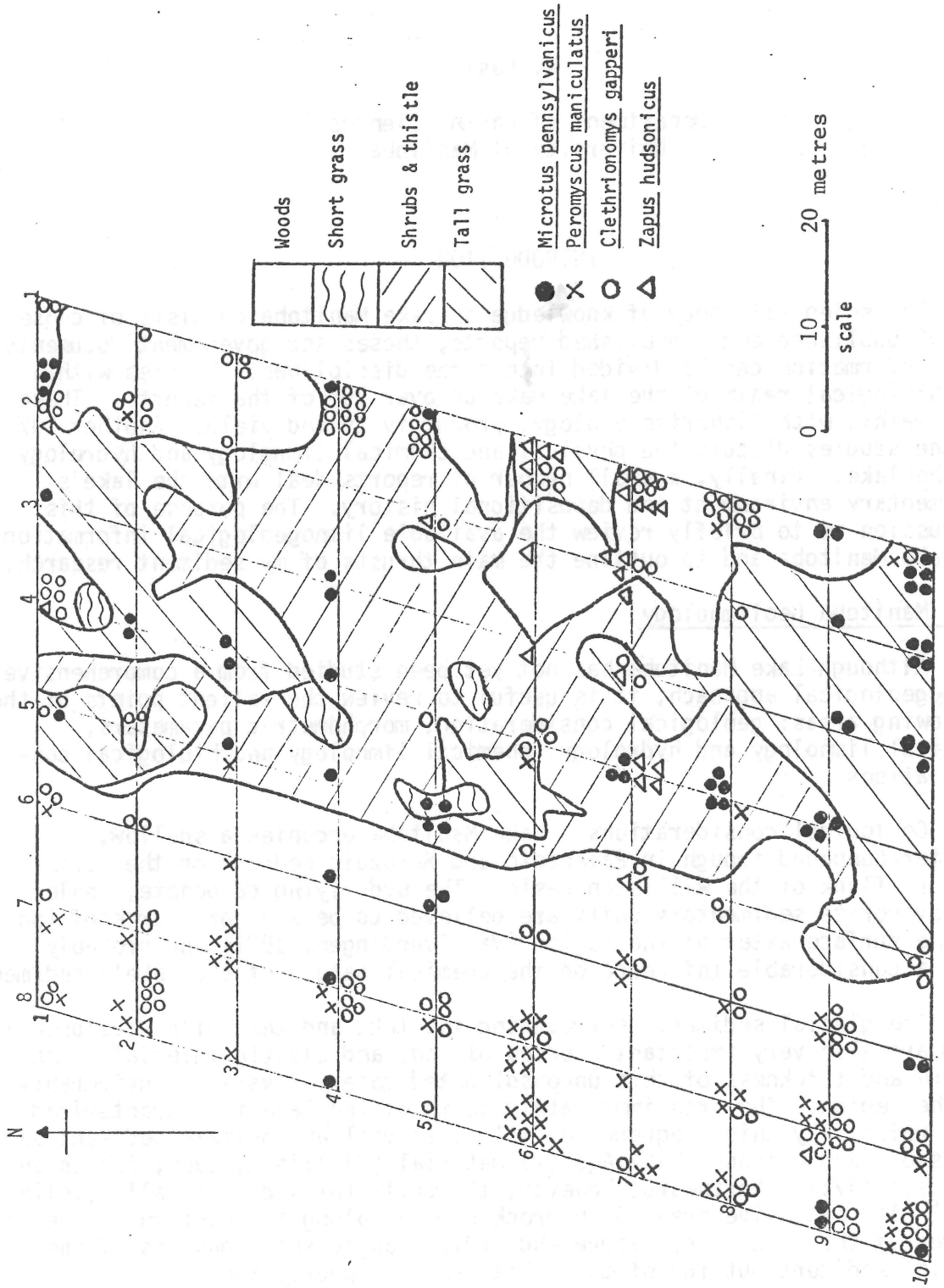

Figure 1. Trapping grid and map of mice catches in Oxbow Wood.

A Summary of Lake Manitoba Geolimnology and Proposed Sediment Research

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INTRODUCTION

The scientific body of knowledge on Lake Manitoba consists of close to 100 published and unpublished reports, theses and government documents. This information can be divided into three disciplines. Studies within the biological realm of the lake make up over 75% of the reports. These deal mainly with fisheries biology, productivity and yield. Another 20% of the studies discuss the physical and chemical limnology and hydrology of the lake. Finally, a small number of reports deal with the lake's sedimentary environment and depositional history. The purpose of this discussion is to briefly review the available limnogeological information of Lake Manitoba and to outline the main thrusts of my sediment research.

Lake Manitoba Geolimnology

Although Lake Manitoba has not yet been studied from a comprehensive limnogeological approach, it is useful to review the salient points of the following areas: geological consideration, morphometric parameters, physical limnology and hydrology, chemical limnology and biological considerations.

Geological considerations - Lake Manitoba occupies a shallow, glacier-deepened trough in Paleozoic and Mesozoic bedrock on the northeastern flank of the Williston basin. The underlying carbonate, shale and evaporite sedimentary units are believed to be a major source of ions in the surface water of the region (van Everdingen, 1971) and probably have a considerable influence on the chemical nature of the lake's sediment.

The glacial sediments surrounding the lake and the soils developed in them are also very important sources of ions and clastic material. The nature and thickness of this unconsolidated material varies considerably in the region. The area immediately south of the lake is characterized by a relatively thick sequence of tills, fluvial and deltaic sediment and nearshore and offshore Lake Agassiz material (Gilliland, 1965; Fenton and Anderson 1971). Northward, however, the drift thins dramatically (Teller 1976) with extensive areas of bedrock exposed along the eastern and western shores of the lake. The nature and stratigraphic relationships of the glacial sediment outside of the Delta area are poorly known.

These various geologic features not only provide sources of chemical and clastic material but also have a direct influence on the lake's sedimentation pattern and characteristics by controlling the bathymetry, slope and roughness of the bottom.

Morphometric Parameters - Figure 1 is a generalized bathymetric map of the south basin of Lake Manitoba and Table 1 summarizes several morphometric parameters and calculations for the basin. The rather unusual combination of large geographic area (3900 km^2) very shallow depth (z_m=7.1m, $\bar{z}$=3.2m), long maximum and effective fetch distances and lake basin form (smooth, concave) provide the situation in which wind generated waves and seiches can completely homogenize the water column during the ice free season.

Physical Limnology - This lack of widespread thermal straficiation development during the open season is one of the most important physical features of Lake Manitoba from a sedimentological point of view. While 'ordinary' wind-generated waves are able to affect roughly 66% of the lake's bottom, storm-generated waves can erode, re-suspend and re-distribute bottom material from any point in the lake (calculated from hydraulic data summarized by Galay, 1964). Wind set-up, which can cause lake level fluctuations of up to 7 feet at the south end of the basin (Galay 1964), is also an important mechanism of sediment re-distribution in such a shallow lake.

Figure 2 is based on data collected from 25 stations in the south basin by the Environmental Management Division of the provincial government (Crowe, unpublished data) and others (Tudorancea and Green, 1975). The mean grain size pattern of the bottom sediment is not simply a response to bathymetric control but also shows the influence of (1) energy distribution by wind and storm waves, (2) normal lake current activity and, possibly, (3) variable source characteristics.

In addition, the high O_2 saturation levels associated with the isothermal water column means that organic material brought into the basin or produced within the lake will probably not be readily preserved in the sedimentary record. Figure 3 shows that the organic content of the bottom surface sediments is relatively low for such a highly productive lake. This is probably due to the rapid aerobic decomposition.

Another associated physical feature is the high turbidity of the water during the open season. Secchi disc transparencies have been recorded as low as 17 cm (Tudorancea and Green,1975). Rather than algal bloom turbidity, this is probably more of a reflection of the lake's shallow depth and the ability of waves to re-suspend bottom sediment.

Chemical Limnology - The chemical nature of Lake Manitoba has been well documented primarily through a three year water quality monitoring study by the Environmental Management Division (J. Crowe, personal communication). Although the detailed results of this study are not yet

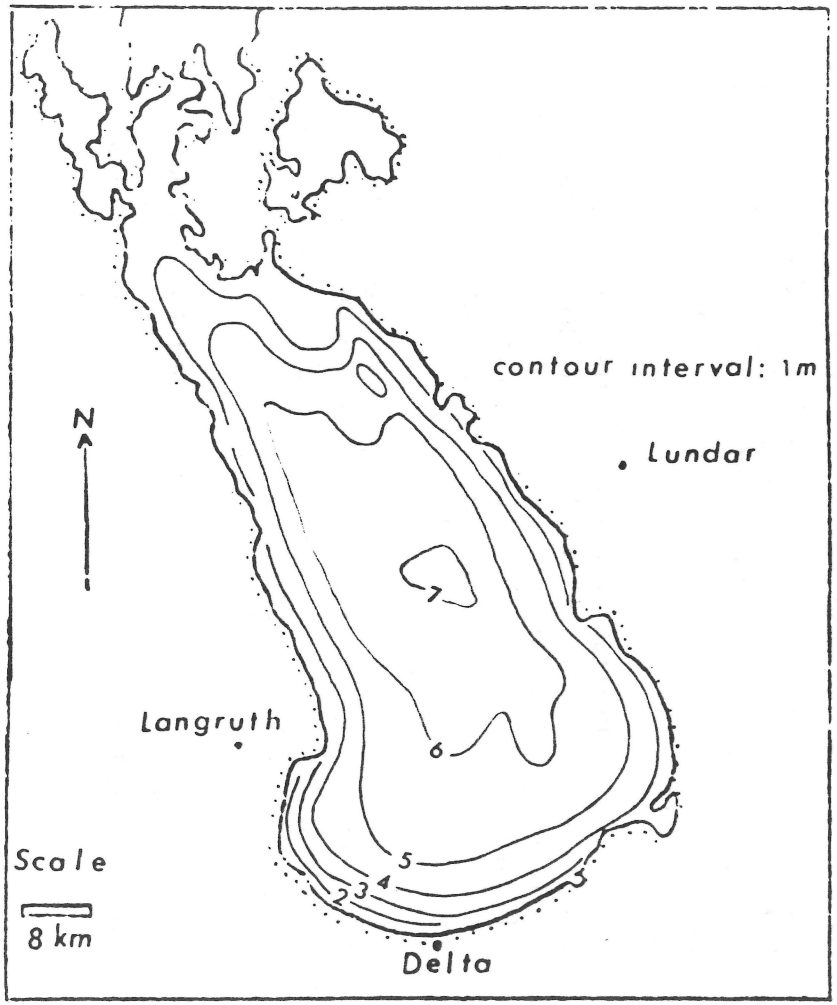

Fig. 1. Bathymetric map of south basin of Lake Manitoba (compiled from data collected by Department Mines, Resources and Environmental Management and Tudorancea and Green, 1975).

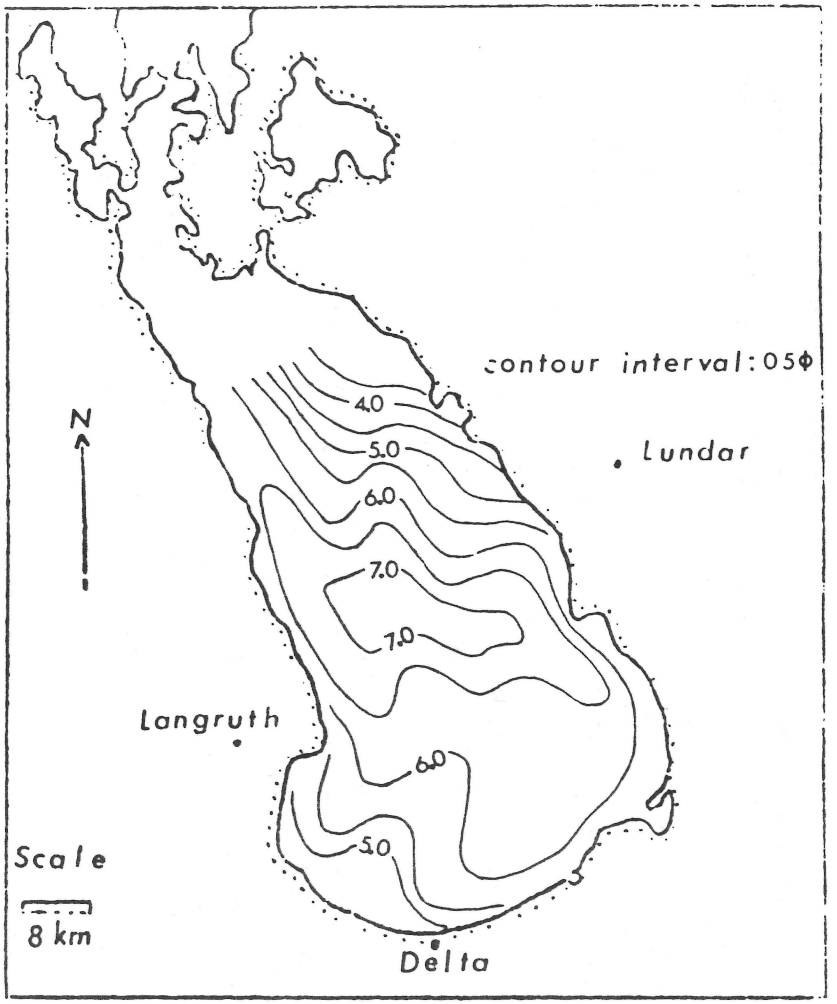

Fig. 2. Mean grain size of bottom sediment (compiled from data collected by Department Mines, Resources and Environmental Management and Tudorancea and Green, 1975)

Table 1. Summary of Morphometric and Chemical Parameters of the South Basin of Lake Manitoba

Maximum depth $z_m = 7.1m$ — Surface area $A = 3907.2km^2$
Maximum length $l = 105.4km$ — Length of Shore $L = 324.6km$
Breadth $b = 47.2km$ — Volume $V = 12.66km^3$
Mean depth $\bar{z} = \frac{V}{A} = 3.24m$ — Median depth $z_{med} = 5.55m$

Shoreline development $D_L = \frac{L}{2(\pi A)^{1/2}} = 1.81$

Volume development $D_V = \frac{3\bar{z}}{z_m} = 1.37$

Mean basin slope = 0.05% (0.03°)
Mean slope between 0 and 5 meters depth = 0.147% (0.08°)
Relief factor $R_r = \frac{z_{med}}{A} = 0.109$

Roughness factor $R = \frac{0.165\ (e + 2)\ \epsilon si}{z_{med}\ (A)} = 2.87$

	Bajkov (1930)	Gilliland (1965)	van Everdingen (1971)	Crowe (1974)	Tudorancea Green (1975)
pH	8.3-8.6	8.1	-	8.2	8.0-9.0+
Total Hardness (mg $CaCO_3$/l)	-*	433	-	480	348-420
Alkalinity (mg $CaCO_3$/l)	-	260	-	253	246-292
Specific Conductivity (micromhos)	-	-	-	2490	-
Total Dissolved Solids (mg/l)	666	1325	-	1515	1150-1950
Calcium	33	24	56-80	50.9	-
Magnesium	44	91	53-77	86/2	-
Sodium	-	339	310-375	360	-
Iron	0.1	0.2	-	0.08	-
Chloride	180	510	487-620	530	-
Sulfate	94	184	95-125	280	-
Carbonate	-	24	-	13.8	-
Bicarbonate	105	293	286-376	280	-
Phosphate	-	-	-	0.07	-
Nitrogen as Nitrate	-	0.25	-	-	-

* not analyzed
+where basin averages are not reported, range of values are listed

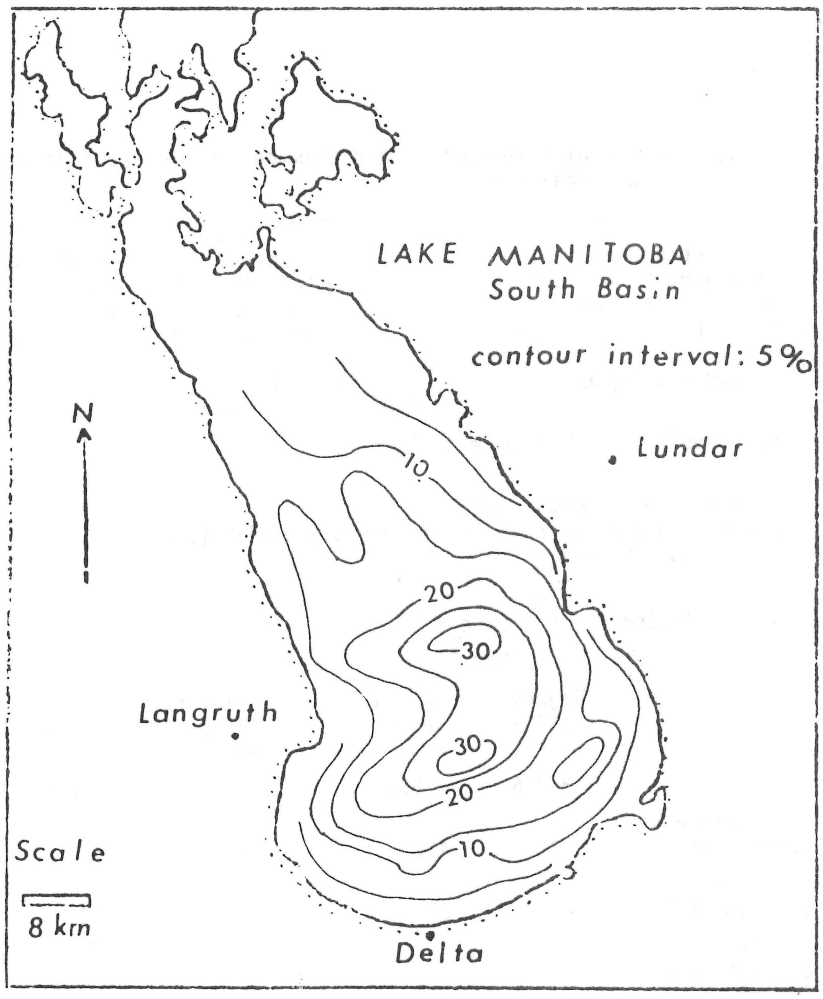

Fig. 3. Organic content of bottom sediment (compiled from data collected by Department Mines, Resources and Environmental Management and Tudorancea and Green, 1975).

available in published form, Crowe (1974) summarized some of the important data. The lake has high alkalinity and total hardness values with pH between 8.0 and 9.5. Dissolved solid content is also high with chlorides and sulfates being the most prevalent ions. There is a marked difference in chemical nature between the north and south basins as well as between summer and winter conditions. Despite this and other documentation of the lake's water chemistry (e.g., Bajkov, 1930; Tudorancea and Green, 1975; see Table 1), the chemical nature of the bottom sediment has not been studied.

Biological Considerations - As previously noted, most of the information on Lake Manitoba is biological in nature (see Boyd, 1972). The lake is eutrophic with a very high benthic productivity (Crowe, 1974). Tudorancea and Green (1975) stress that the low diversity of the benthic population is probably a reflection of the environment's physical and

chemical homogeneity, although biotic factors such as competition and predation must also be important in explaining certain spatial variations.

The biological community in Lake Manitoba can influence the nature and pattern of sedimentation by (1) contributing both particulate organic matter and inorganic components to the record, (2) destroying primary sedimentary structures through burrowing and grazing activities, and (3) altering the rates of chemical exchange between the sediment and water.

Objectives of Sediment Research

Stratigraphic analysis and interpretation of the physical, chemical and biological records within the sediment can provide an integrated picture of past lake environments and events in the drainage basin. An extensive drilling program financially supported by the Environmental Management Division, N.R.C. and the Department of Earth Sciences is presently being undertaken to: (1) determine the present-day sedimentary facies relationships in the south basin, (2) determine the thickness and stratigraphy of the Holocene sedimentary fill, (3) investigate the variations in selected physical and chemical parameters in the record and (4) interpret the late Pleistocene and Holocene history of the lake on the basis of these changes.

From a practical standpoint, the knowledge gained in this study will be used to contrast natural versus man-induced environmental changes and to develop short and long term strategies leading to the preservation of the lake's water quality. Previous studies have identified several potentially geolimnologically related water quality problems:

(1) Increased siltation and bottom sediment changes/increased turbidity. For some years there has been reference to the changing sedimentation patterns and rates in the lake. Kennedy (1949) points out that fishermen contend the lake has "filled" about one foot in the past 50 years. Hochbaum (1965) also uses the personal experience of fishermen and cottage owners to document this change in sediment character and suggests that the indiscriminate drainage of wetlands and marshes surrounding the lake has greatly accelerated the natural changes occurring in the basin. There is also some evidence that the increased abundance of such fish species as sauger and carp reflect the changing sedimentation and climatic patterns (Kennedy, 1948; Hochbaum, 1965).

Despite the demonstrated influence (not necessarily detrimental) of sediment load and sedimentation patterns on the water quality and biological community of a lake (e.g., Swenson and Matson, 1976; Rosenberg and Snow, 1975), these changes have not been scientifically documented for Lake Manitoba. Crowe (personal communication) attempted to evaluate the sedimentation effects of the Portage Diversion on the south basin. She concluded that the suspended load being introduced into the lake can cause high turbidity values "near the diversion".

(2) Chemical alteration of the lake water. The water quality monitoring study of Lake Manitoba during the late 1960's provided the data required to assess the temporal changes of several chemical parameters. Over a 40 year period, the most dramatic chemical changes in the south basin were increases of over 100% in dissolved chlorides and sulfates (Crowe, 1974). In terms of total dissolved solid content, the lake has gone from a freshwater state to brackish since 1930. In addition, IJC (1977) has predicted further increases as a result of implementation of the Garrison Diversion unit.

(3) Shoreline erosion and southward transgression of the lake. Problems associated with shoreline regression are well documented in North America. On Lake Manitoba, regulation of water levels is frequently cited as a major cause of accelerated shoreline erosion. In addition, Penner (written communication, 1976) has suggested, on the basis of paleoecological and radiocarbon data (Sproule, 1975), that differential crustal rebound has caused a southward transgression of Lake Manitoba over the past 2400 years.

In each of these problem areas a study of the sedimentary record will help to properly document and quantify the changes and allow calibration of man-induced changes in relation to the overall evolutionary trends.

Preliminary Stratigraphic Data

Preliminary offshore drilling and sampling in the southwestern portion of the basin by Manitoba Hydro (samples and data provided by J. Ellis) revealed a generalized stratigraphy of 2-3m of gray to brown clay (interpreted by author as offshore lacustrine sediment) overlying 3m of brown, clayey silt (deltaic sediment?) and at least 4m of gray to brown, mottled, gravelly, sandy, clayey silt and silty clay (till). Shelby tube samples from the top 40cm showed that the lacustrine unit lacks visible bedding and ranges in color from olive gray to dark grayish brown. Small (1-2mm) spherules and "blebs" of unknown mineralogy (possibly gypsum) are present throughout both cores but most abundant at depths of 10-20cm. Whole and broken shell fragments and other unidentified organic debris are also present in small amounts.

Although the upper 10cm of this unit were not available for analysis and detailed analyses of the remaining samples are not yet completed, preliminary data (Fig. 4) suggests the material to be uniformly clay-rich with generally low organic and carbonate contents. Ramlackhansingh (1977) reports that the predominant clay mineralogies of the sediment are vermiculite (?), chlorite and illite with minor amounts of kaolinite. Unfortunately, due to the incomplete nature of the available sample record, conclusions regarding the Holocene sedimentary history of Lake Manitoba cannot be made at this time.

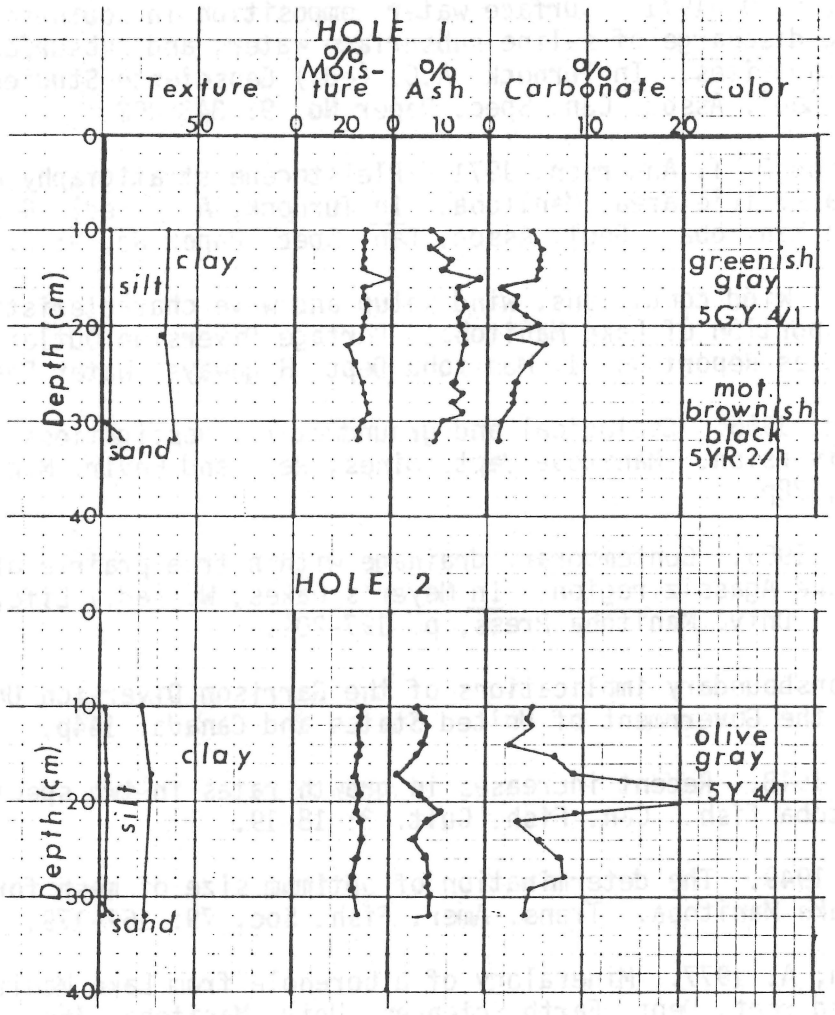

Fig. 4. Textural and physical properties of cores from Lake Manitoba (samples provided by J. Ellis, Manitoba Hydro).

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Nest Site Selection in Eastern and Western Kingbirds on the Delta Marsh Ridge, Manitoba.

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INTRODUCTION

The Eastern Kingbird (Tyrannus tyrannus) and the Western Kingbird (T. verticalis) breed at Delta in extraordinarily high numbers (Smith, 1966: 206). The sympatric association of these species in Manitoba is the result of a relatively recent eastward expansion of the breeding range of T. verticalis (see Bent, 1942). Both species may be found in local sympatry within their common ranges. Where one is abundant the other is usually much less so. Both species have similar sizes and foraging behaviours and in many ways appear to occupy very similar niches. Whitmore (1975) suggested that in some areas of allopatry these species show ecological as well as geographic replacement.

It is generally accepted that two closely related, morphologically similar species could not coexist indefinitely if their niches overlapped in any essential component that was in short supply. The principle of competitive exclusion (Hardin, 1960) predicts that the better adapted species would eventually exclude the other through competition for the same essential resource. Thus, if two species are to coexist they must be able to differentially exploit the resources in their environment. Natural selection would be expected to favour individuals of both populations which were least dependent on those factors that were potentially limiting for both species.

The purpose of the present study is to examine the syntopic association of the two kingbird species at Delta to determine the nature and extent of their coexistence and to discover the ecological adaptations that permit this coexistence. The variables most often cited as being of special importance as limiting factors are food, habitat (including breeding habitat) and time (McCrimmon, 1975). Accordingly, I have chosen to concentrate on nest site and food selection. This report presents the results of two seasons' study of nest site selection.

METHODS

During the breeding seasons of 1976 and 1977 the nests of both Kingbird species were located on a section of the forested ridge extending

2 km in length westward from the Assiniboine River Diversion and having an average width of 80 m. This section of the ridge was gridded into cells 100 x 100 m, using transit and tape. Habitat analysis was performed to determine: a) the nature of the distribution of the nests of each species over the study area, b) which features of the habitat appeared most consistently in the nest sites of each species and hence to what extent the distribution of the nests was correlated with environmental variables and c) to what extent nest site selection contributed to the segregation of the two species. Three categories of data were collected: nest site characteristics, nest tree characteristics and general habitat characteristics.

Data were obtained from circular plots (.07 ha) with a nest at the centre of each plot. Within each plot every tree 5 cm or more in diameter (DBH) was identified to species and was recorded in the appropriate size class. Average tree height within each plot was determined from the heights of 10 randomly selected trees, measured with a Haga altimeter. An estimate of canopy cover at or above the height of each nest was obtained by taking 100 plus-or-minus readings for the presence or absence, respectively, of foliage, along each of two intersecting transects of the plot (after James and Shugart, 1970).

For each nest tree the following variables were measured: nest tree height and diameter, species, crown length, width and depth and nest height. The location of each nest was determined using bearings and distances to corners of the grid.

General habitat data were collected from 5 x 20 m rectangular plots located throughout the study area using a stratified random sampling scheme. Within each plot every tree 5 cm or more in diameter was identified to species and was recorded in the appropriate size class.

RESULTS AND DISCUSSION

The nests of both species showed similar distributions over the length of the study area (Fig. 1). The only apparent clumping of nests occurred for both species in the relatively disturbed area of the ridge which included the field station buildings. Smith (1966) also reported a higher density of both species around the inhabited areas of Delta. An obvious difference was observed in the distribution of the nests of each species across the width of the ridge (Fig. 2). In both years the majority of nests of *T. verticalis* were located on the north half of the ridge, whereas the nests of *T. tyrannus* were distributed over both halves of the ridge with equal frequency.

An examination of the importance values of the tree species at the nest sites of the two species revealed some interesting differences in the floristic composition of the nest sites (Table 1). The values for green ash (*Fraxinus pennsylvanica*) and peach-leaved willow (*Salix amygdaloides*)

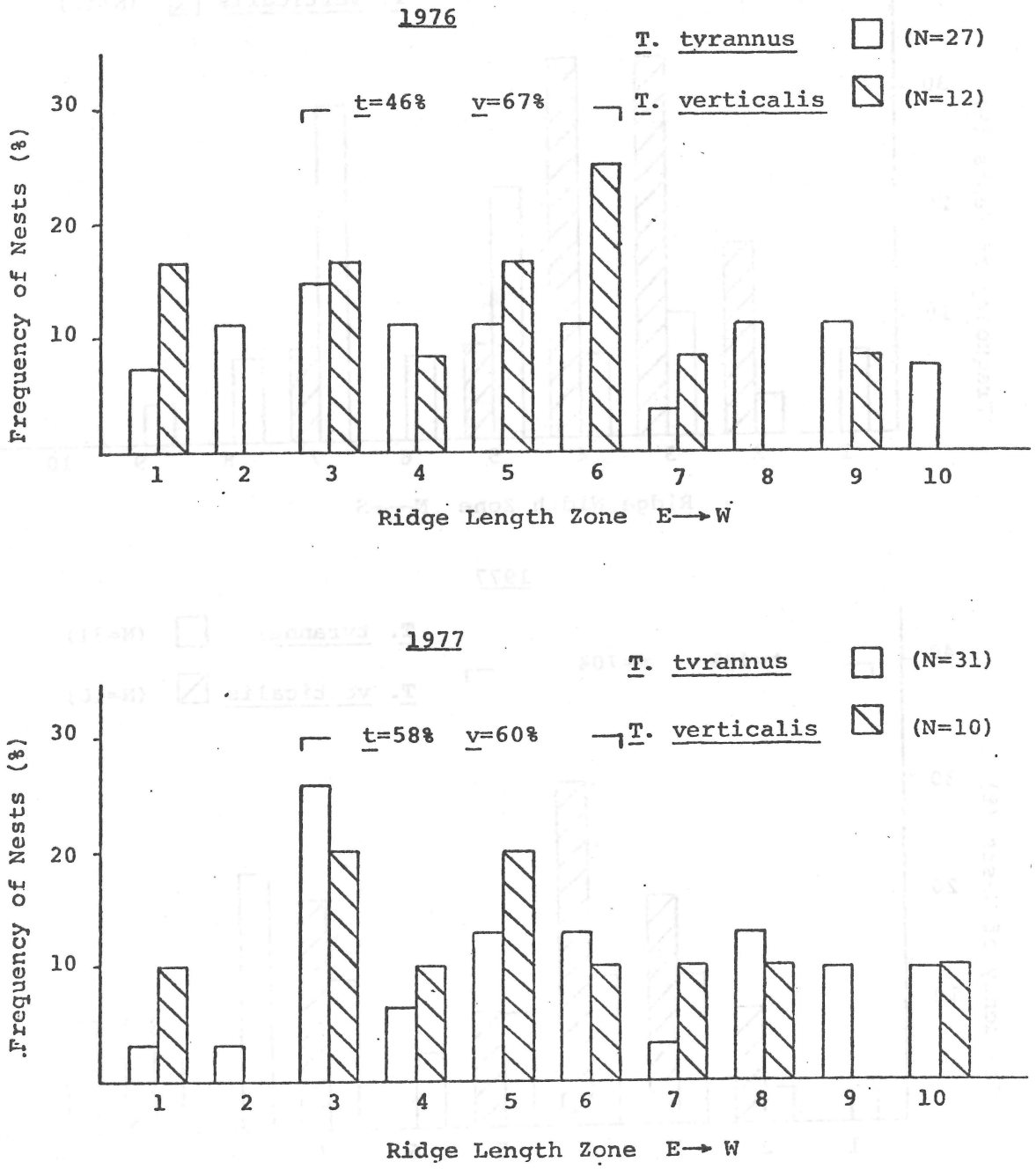

Fig. 1. Frequency distribution of kingbird nests along the length of the Delta ridge.

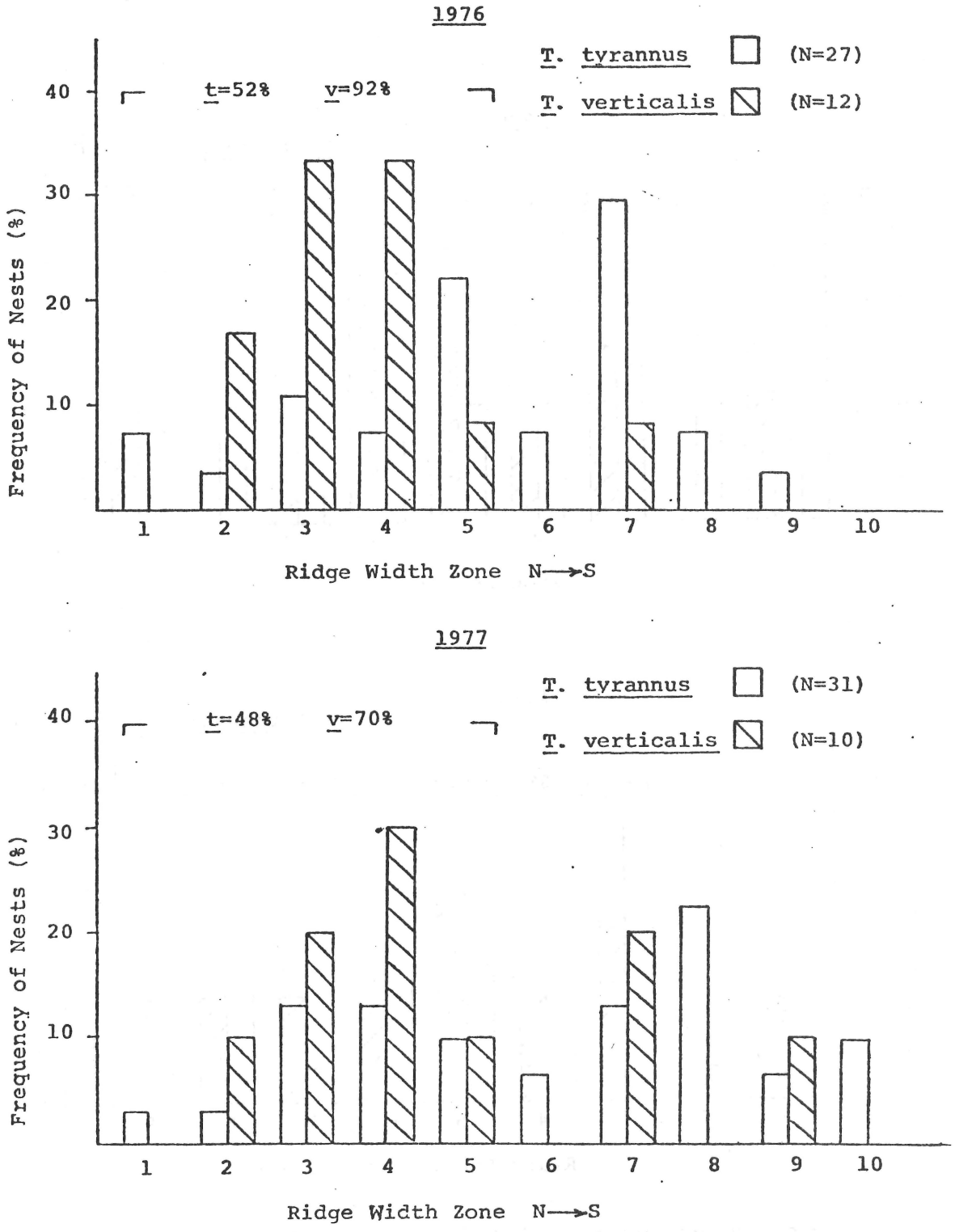

Fig. 2. Frequency distribution of kingbird nests across the width of the Delta ridge.

Table 1. Importance values of the major tree species at kingbird nest sites in relation to availability on the Delta ridge

Tree species	T. tyrannus (N=58)	T. verticalis (N=22)	Ridge
Acer negundo	23.6%	21.2%	26.4%
Fraxinus pennsylvanica	24.6	32.0	21.0
Populus deltoides	7.3	5.5	3.0
Prunus spp.	0	0	2.2
Salix amygdaloides	28.9	37.7	30.4
Salix interior	15.6	3.6	17.0

were much higher at T. verticalis sites than at tyrannus sites. These values were also higher than the importance values for these species on the study area in general. The most striking difference, however, was in the importance of sandbar willow (Salix interior)which, in both years, had 4.5 times the value at tyrannus sites that it had at verticalis sites. Sandbar willow, a pioneer species, is associated with the edges of the ridge, especially the south edge (Fig. 3). Both edges of the ridge are exposed to less stable environmental conditions than those experienced in the centre of the ridge. The south half of the ridge and particularly the south edge, is lower and is consequently more subject to fluctuations in soil moisture level than the north edge. T. tyrannus has been described as typically an edge species, having a tendency also to nest in flooded forests (Smith 1966; Bent 1942). The occurrence of T. tyrannus nests on the south half of the ridge and as a consequence, the high proportion of sandbar willow at many tyrannus nest sites, is therefore quite consistent with the observed nesting habits of this species. Figure 3 gives an explanation for the higher values of ash and peach-leaved willow around verticalis nest sites. More than half the total number of stems tallied for each of these species, as well as for maple (Acer negundo) occurred on the north half of the ridge. Viewed in this respect, the importance values around verticalis sites seem quite consistent, except for the value of maple.

An interesting difference was observed in the structural composition of tyrannus and verticalis nest sites as well. Verticalis sites were characterized by fewer stems but greater basal area of stems (Table 2) than tyrannus sites. This tendency for verticalis nests to be located in

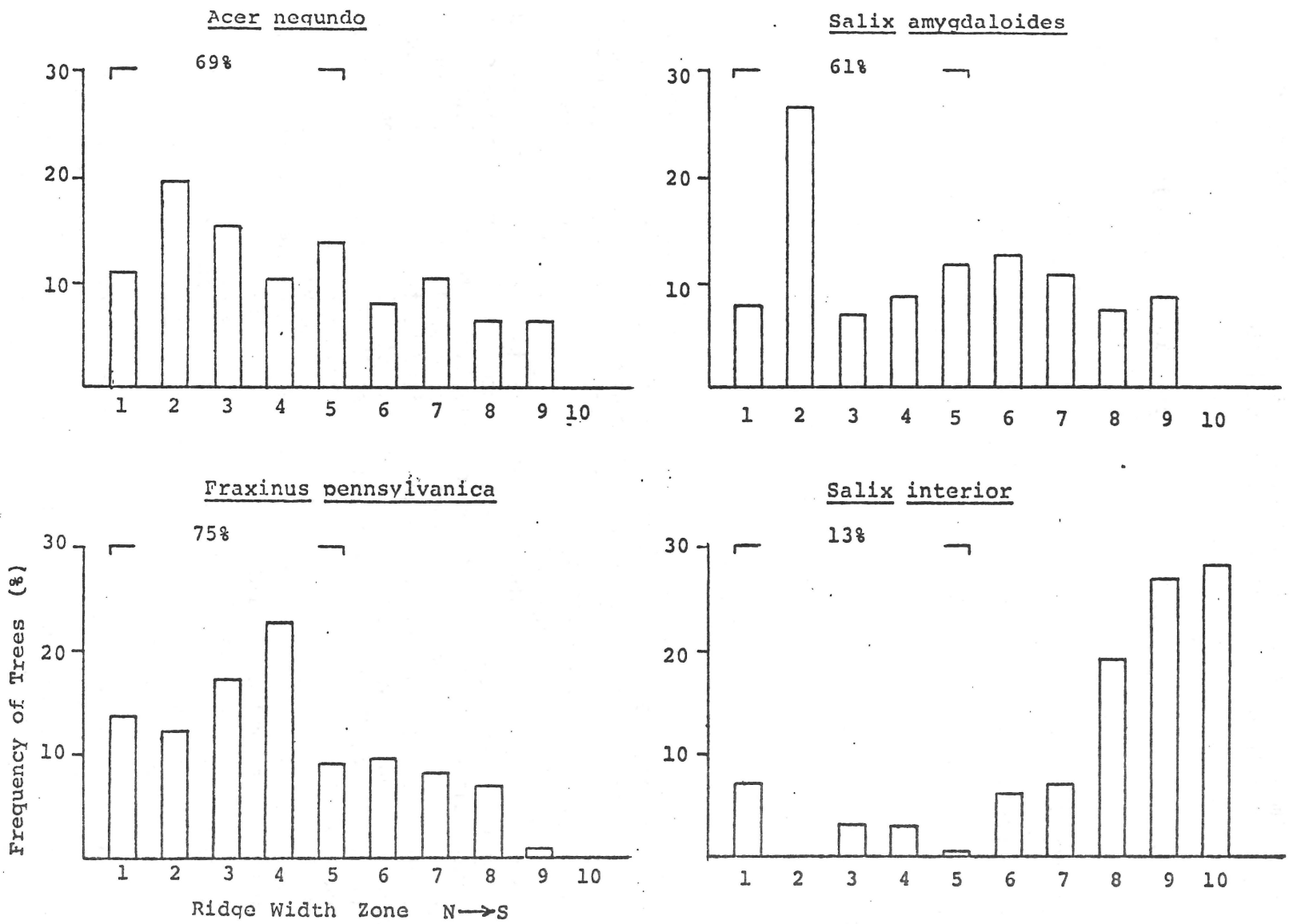

Fig.3. Frequency distribution of tree species across the width of the Delta ridge.

Table 2. Abundance of stems of all tree species at kingbird nest sites on the Delta ridge.

Variable	T. tyrannus		T. verticalis	
	1976 (N=27)	1977 (N=31)	1976 (N=12)	1977 (N=10)
Number of stems per nest site	75.4±7.2	75.1±4.4	48.2±4.7	59.0±6.4
Total basal area per nest site (m^2)	1.33±0.1	1.35±0.1	1.51±0.2	1.76±0.2

[1] Mean ±SE

more mature stands is even more apparent in the frequency distribution of trees according to diameter size class at nest sites (Fig. 4). As stem size increases, the proportion in a given size class becomes greater at verticalis sites than at tyrannus sites. An examination of the distribution of stems (Fig. 5) and the distribution of basal area of stems (Fig. 6) across the width of the ridge (random data) indicates fewer but larger stems on the north half of the ridge. Thus the structural composition of verticalis sites reflects the structural composition of the vegetation on the north half of the ridge, whereas the structural composition of tyrannus sites more accurately reflects that of the ridge in general.

A comparison of the variables associated with the nest trees of each species lends further support to the tendency of verticalis nests to be located in more mature stands (Fig. 7). The nest trees of verticalis were taller and larger in diameter than those of tyrannus. The latter selected nest trees from virtually the entire range of tree sizes, whereas 80% of verticalis nest trees were selected from size classes which represented only 4.4% of the available trees.

Ash and peach-leaved willow were selected most frequently as nest trees by both kingbirds, although they were selected with different frequencies in each year (Table 3). However, consistent with the established pattern, tyrannus showed a broader range of species selection than verticalis. A comparison with availability data on the major tree species indicates a disproportionate selection frequency of ash and peach-leaved willow by both species and a disproportionate rejection frequency of maple and sandbar willow by both species. It is uncertain however, whether the basis of this differential selection is floristic or structural or in fact, merely an artifact of distribution.

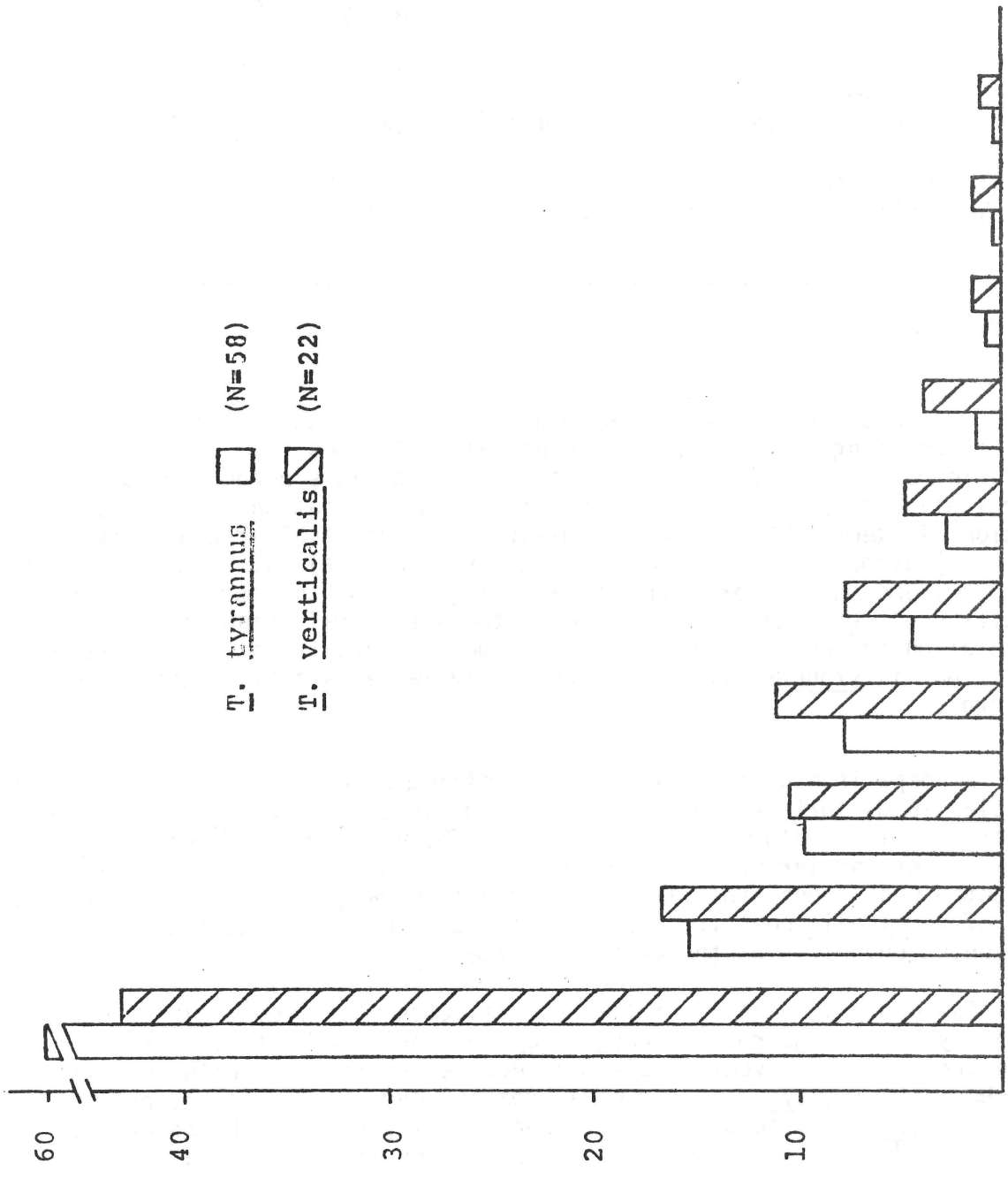

Fig. 4. Frequency distribution of tree diameter size classes at kingbird nest sites on the Delta ridge.

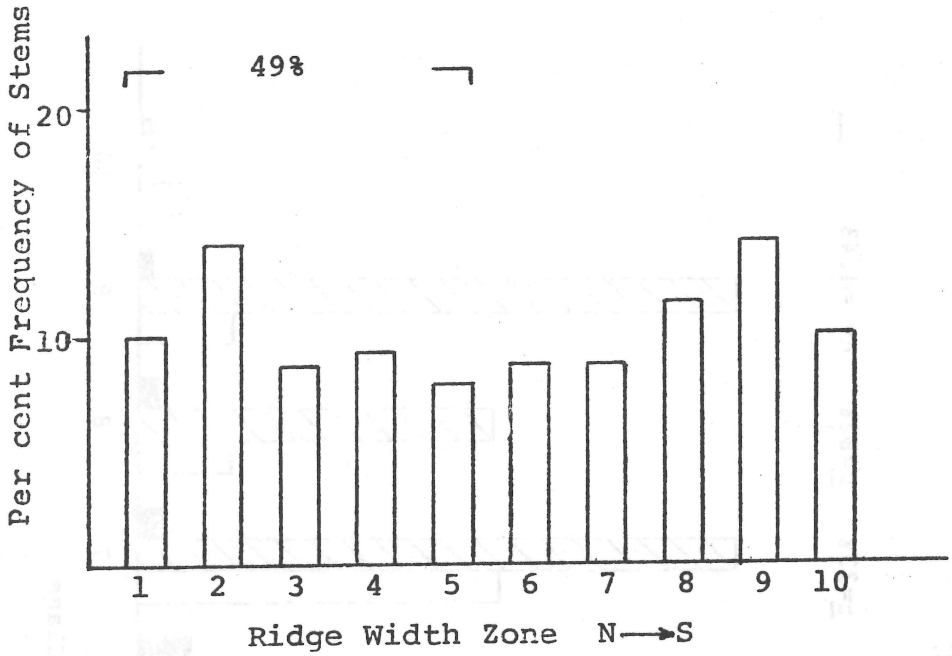

Fig. 5. Frequency distribution of tree stems across the width of the Delta ridge.

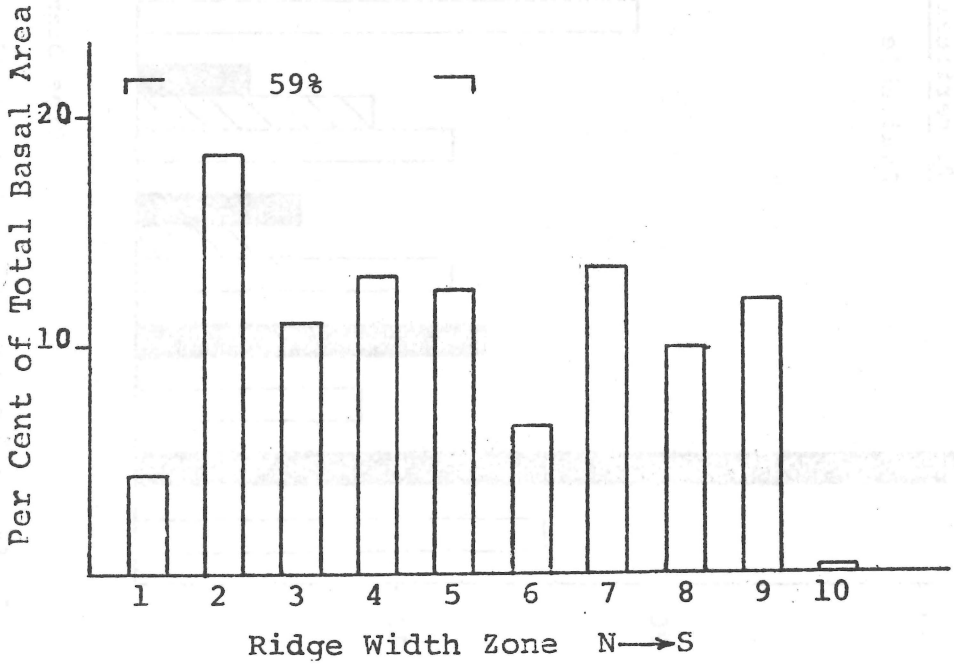

Fig. 6. Frequency distribution of tree basal area across the width of Delta ridge.

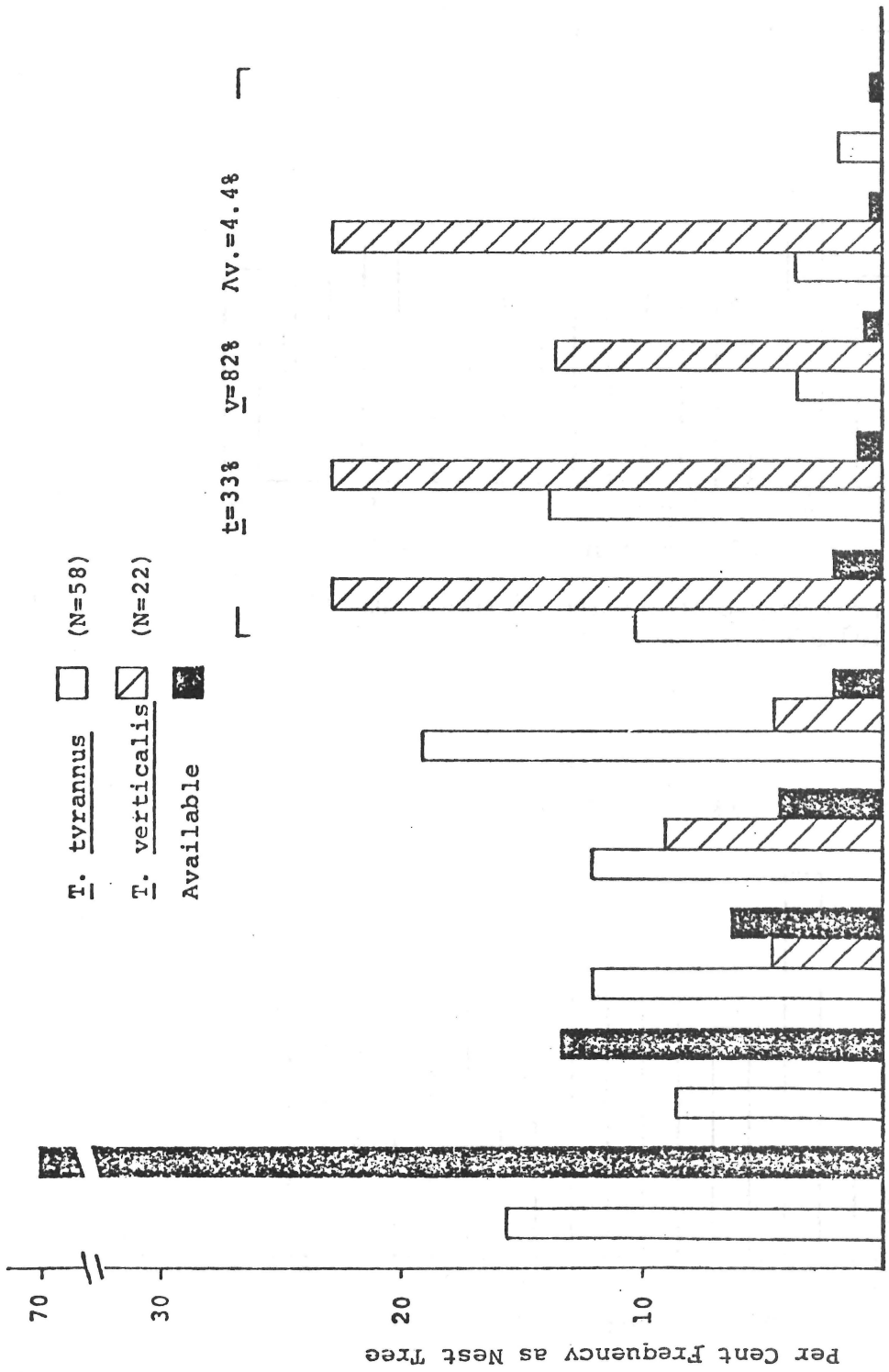

Fig. 7. Frequency distribution of tree size classes (all species) as kingbird nest trees on the Delta ridge.

Table 3. Frequency of tree species used as kingbird nest trees in relation to availability on the Delta ridge

Tree species	T. tyrannus		T. verticalis		Ridge
	1976 (N-27)	1977 (N-31)	1976 (N-12)	1977 (N-10)	
Acer negundo	7.4%	12.9%	8.3%	0%	24.6%
Fraxinus pennsylvanica	59.3	35.5	58.3	40	16.9
Populus deltoides	7.4	3.2	0	0	0.9
Prunus spp.	0	0	0	0	2.2
Salis amygdaloides	25.9	32.3	33.3	60	25.6
Salix interior	0	16.1	0	0	29.8

The pattern that has emerged consistently in both seasons is one of a difference in the range of selection of nest sites between the two kingbird species. In most respects, the range of selection by verticalis appears to be merely a subset of that of tyrannus. This may be a function of the much smaller population of verticalis, which allows it to be more selective or conversely, this narrow range of response may be in part responsible for the failure of the verticalis population to reach the density of that of tyrannus.

ACKNOWLEDGEMENTS

This project was supported by the National Research Council through a grant to Dr. S. G. Sealy and a postgraduate scholarship to the author.

The capable field assistance of Len Brownlie and also of Glenn Sutherland is gratefully acknowledged.

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The Parasite Fauna of the Muskrat, Ondatra zibethica (Linnaeus 1766) Miller 1912, in Manitoba

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INTRODUCTION

Notwithstanding the twenty-two published and at least four unpublished surveys already made of muskrat parasites in North America, the central prairies have been largely ignored. The majority of surveys (15 of 26) have been done in the Great Lakes region and eastern United States. Ten were conducted in southern and western areas of the muskrat's range and one in Alaska.

The objectives of this study were: (i) to determine the prevalence and intensity of parasites of muskrats in Manitoba, (ii) to examine the effect of host age and sex on the parasitic fauna and to observe any obvious pathology.

MATERIALS AND METHODS

The parasites of 171 muskrats, Ondatra zibethica (Linnaeus, 1766) Miller 1912, from four regions of Manitoba were examined to determine the prevalence and incidence of parasitism. The four regions surveyed were Delta Marsh, Oak Hammock Marsh, Duck Mountain and The Pas, including Saskeram Marsh. Muskrats were acquired frozen from trappers via the Department of Renewable Resources, or live trapped at Delta Marsh. Complete examinations for both endoparasites and ectoparasites were performed for 29 muskrats, while 31 were examined only for ectoparasites and 111 were necropsied only for endoparasites.

RESULTS

Seventeen species of parasites were recovered, including 7 trematodes, 3 nematodes, 2 cestodes, 1 acanthocephalan, 3 mites and a protozoan. The most prevalent species was Quinqueserialis quinqueserialis (Barker and Laughlin 1911) Harwood 1939 (Table 1) which has been widely reported in North America. Two new host records were noted, Plagiorchis noblei Park 1936 and Heligmosomum carolinensis (Dikmans 1940) Skrjabin 1971. No blood protozoa were found in fifty-three animals so examined.

The three mites recovered, Laelaps multispinosus Banks 1909, Listrophorus americanus Radford 1944 and Dermacarus ondatrae Rupes and Whitaker 1968, were found at both Delta and Oak Hammock Marshes, which were the two areas surveyed for ectoparasites.

DISCUSSION

There were no significant differences in parasite fauna between the four regions surveyed; possibly due to the excellent drainage network in Manitoba and the autumn dispersal of the host. Capillaria michiganensis Read 1949, and Hymenolepis sp. were significantly more prevalent in female muskrats than in males. This difference is probably due to host (hormonal) factors. Young muskrats were found to be parasitized shortly after weaning, with the most prevalent forms being acquired first.

The condition of the frozen carcasses would have obscured minor pathology and no gross pathology was observed. This suggests that under normal conditions the muskrat is capable of supporting a large population of its usual parasites without appreciable harm. One muskrat had over 2,000 trematodes (1856 Quinqueserialis quinqueserialis) but showed no ill affects.

Table 1. Prevalence and intensity of endoparasites from the muskrat in Manitoba.

	Prevalence			Intensity		
	male n=81	female n=59	Total n=140	mean	SE	Range
Trematoda						
Quinqueserialis quinqueserialis	93.8	91.5	92.9	121	±24.6	1-1856
Plagiorchis noblei	83.9	84.7	84.2	97	±17.7	1-880
Echinostoma revolutum	23.5	27.1	25.0	27	±10.5	1-264
Notocotylus filamentis	14.8	15.2	15.0	35	±12.9	1-232
Wardius zibethicus	16.0	6.8	12.1	8	± 1.6	1-29
Alaria mustelae	2.5	1.7	2.1	17	±15.3	2-48
Schistosomatium douthitti (eggs in liver)	1.2	0	.7	-	-	-
Schistosomatium douthitti (immature in spleen)	3.7	0	2.1	4	± 3.0	1-10
Cestoda						
Hymenolepis sp.	21.0	47.5	32.1	2	± 0.38	1-16
Hydatigera taeniaformis (cysticercus)	1.2	0	.7	27	-	27
Nematoda						
Capillaria michiganensis	4.9	8.5	6.4	11	± 4.7	1-38
Capillaria hepatica	1.2	0	.7	7	-	7
Heligmosomum carolinensis	0	1.7	.7	35	-	35
Acanthocephala						
Polymorphus sp.	2.5	3.4	2.9	13	± 9.1	1-40
Protozoa						
Unidentified	1.2	1.7	1.4	-	-	-

Parasitism of Lake Manitoba Fish by *Ergasilus* Spp.

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INTRODUCTION

Studies of parasitic copepods in Lake Manitoba have thus far concentrated on sauger, *Stizostedion canadense* (Smith) and walleye, *Stizostedion vitreum* (Mitchill). The present study was intended to continue examination of these hosts and expand examination of yellow perch, *Perca flavescens* (Mitchill) and lake cisco, *Coregonus artedi* Lesueur. Seasonal developmental variations of *E. nerkae*, infecting cisco, are not recorded in the literature. Clearly delimiting this aspect of its biology was a prime objective of this study. Relationships between extent of ergasilid infestation and size of hosts, which have been reported (Noble *et al.* 1963, Tedla and Fernando 1970), were also investigated.

MATERIALS AND METHODS

Sampling was conducted at biweekly intervals from late May to late August using a trawl net, approximately ½ to 1½ miles from the southern shore of Lake Manitoba. Host examination in the laboratory, included weight, operculum and fork length measurements and sex determination. Age will be determined by analysis of scale samples. Excised gills placed in a petri dish with water, were examined under a dissecting microscope and the number, stage of development and attachment site of ergasilids evaluated. Specimens were removed randomly and preserved in 10% formalin for species identification. Tracings of gills were made on graph paper via overlying sheets of plastic and carbon paper. Gill surface area is the number of mm. squares included in the tracing.

RESULTS

The sample of fish included 63 sauger, 29 walleye, 100 yellow perch, 41 lake cisco, 7 northern pike (*Esox lucius* L.) 18 white suckers (*Catostomus commersonii* Lacepede) and 22 trout-perch (*Percopsis omiscomaycus* (Walbaum)). The *Ergasilus* infestations as in 1976, were host-specific at the family level (Table 1).

Table 1. Ergasilids infecting Lake Manitoba hosts.

Ergasilus luciopercarum	
Family Percidae	
Walleye	*Stizostedion vitreum* (Mitchill)
Sauger	*Stizostedion canadense* (Smith)
Yellow perch	*Perca flavescens* (Mitchill)
Family Percopsidae	
Trout-perch	*Percopsis omiscomaycus* (Walbaum)
Ergasilus nerkae	
Family Salmonidae	
Lake cisco	*Coregonus artedi* Lesueur
Ergasilus versicolor	
Family Catostomidae	
White sucker	*Catostomus commersonii* (Lacepede)

Parasite distribution among the gills varied between hosts (Table 2). The second arch had the greatest infestation in both walleye and sauger, but no other common pattern was observed between them. Yellow perch had significantly more ergasilids on the third and fourth arches and significantly fewer on the first. Cisco also showed low first arch infestation and significantly higher levels on the second and third arches. Distribution between anterior and posterior gill surfaces and right and left sides were not significantly different. No correlation of infection with host sex was apparent. The mean infestation levels were different from 1976 values, except in sauger. Ergasilid density was 3 times greater in walleye, but was only ½ 1976 densities in yellow perch and cisco.

Table 2. Distribution of ergasilids between gill arches

Host	*S. canadense*	*S. vitreum*	*P. flavescens*	*C. artedi*
Parasite		*E. luciopercarum*		*E. nerkae*
No. of hosts	63	29	100	41
Gill 1				
No.	620	390	102	309
%	22.7	24.3	14.2	11.3
Gill 2				
No.	783	456	189	854
%	28.6	28.4	26.4	31.3
Gill 3				
No.	645	392	210	887
%	23.6	24.4	29.3	32.6
Gill 4				
No.	687	368	216	675
%	25.1	22.9	30.1	24.8
Mean	43.4	55.4	7.2	66.5

Developmental stages of adult female ergasilids were as follows:

Stage 1. Developed uterine processes absent
Stage 2. Uterine processes present, but lacking ovisacs
Stage 3. White ovisacs apparent
Stage 4. Mature eggs present in blue ovisacs

Seasonal fluctuation of *E. luciopercarum* stages was similar among the hosts (Fig. 1). Stage 3 predominated in early samples, when peak infestations generally occurred. Levels declined rapidly and remained low until late August. During the decline proportions of the stages were stable, but stage 1 densities began increasing in late July and completely dominated later samples. The single sample of trout-perch in late August revealed stage proportions similar to the spring condition in the other hosts. Host infection was 60% and averaged 1 ergasilid per fish.

Population fluctuations of *E. nerkae* followed a different pattern. Although stage 3 dominated the first sample, mean infection was at the observed seasonal minimum. Density of stages 2 and 3 then rose sharply followed by appearance of mature females in late June. Infections peaked

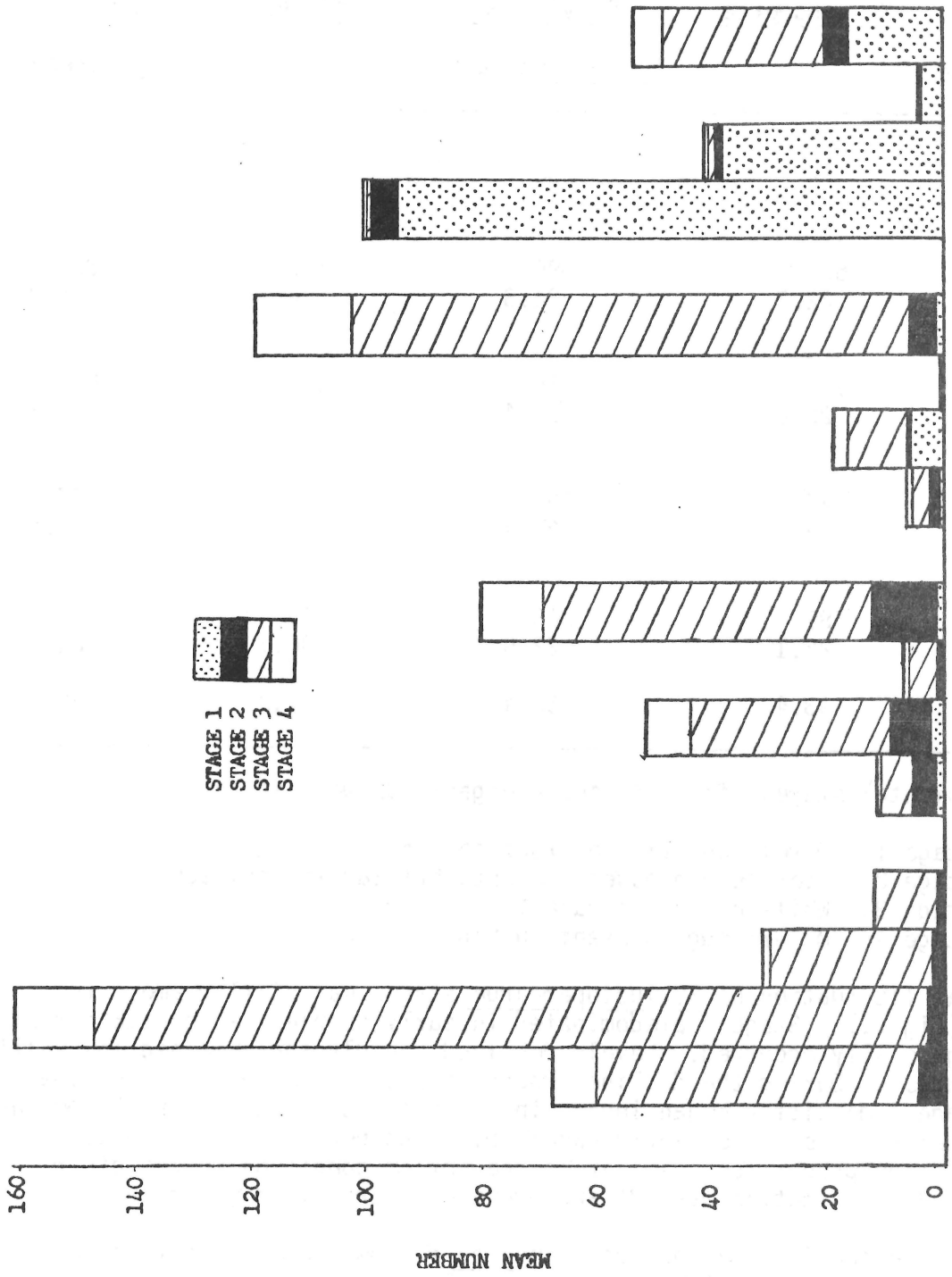

FIG. 1. Seasonal changes in the populations of Ergasilus: SC Stizostedion canadense; SV S. vitreum; PF Perca flavescens; CA Coregonus artedi.

in late July, coinciding with stage 4 maximum levels and a marked increase in stage 2 numbers. Levels declined rapidly by 50%, followed by increasing trends due to stage 1 females. A major difference between the two cycles was appearance of stage 1 E. nerkae at the time of peak density. E. luciopercarum stage 1 females reached appreciable levels only after density had been low for two months.

Parasitism by E. versicolor was observed in only 2 hosts in an early sample and all specimens were stage 3 females.

Gill surface area decreased linearly between arches 1 and 4, although the extent of the difference was less apparent as average gill size declined (Table 3). Surface area was directly related to body size as expected. However, no correlation between area and extent of infestation was apparent. The average gill area of sauger was 25% greater than that of walleye observed, but mean infestation was 25% greater in walleye.

Table 3. Gill surface area in a sample of Lake Manitoba fish

	Mean Size $(cm)^2$			
Host	Gill 1	Gill 2	Gill 3	Gill 4
Sauger	6.28	6.18	5.10	3.79
Walleye	4.60	4.59	3.76	2.85
Yellow perch	3.25	2.99	2.56	2.22
Lake cisco	1.91	1.70	1.49	1.17

Similarly, area for yellow perch was 40% less than the average for Stizostedion spp., but average parasite density was 85% lower. The greatest deviation from a random distribution of parasites occurred in cisco, in which gill surface area varied least.

DISCUSSION

Different host species occurred in the same sample, indicating habitat overlap, but ergasilid infection was host-specific. If parasite habitat overlap is also assumed in the free-swimming stages, a particular host would be expected to encounter the range of parasite species. Thus host specificity is due to characteristics of the host species which make it suitable. These features must be shared by all species infected by a particular parasite, as in the case of E. luciopercarum, observed in 4 host species. Host location merely by physical contact, as reported for E. sieboldi Nordmann (Gnadenburg 1949), cannot account for this host-specificity. Chance host encounter also predicts a correlation between level of parasitism and host size. This relation was shown not to occur,

on the basis of both body measurements and gill surface area. The possibility exists that at very high parasite densities, size would be a physical limitation to density. Infestation of this magnitude would cause sufficient impairment of gill function to cause mortality, thereby eliminating such infections. Lower level infections are consequently size-independent. Size dependency at low densities has been reported for E. confusus Bere, 1931 (synonym of E. luciopercarum, vide Roberts 1970) on yellow perch (Tedla and Fernando 1970) and for E. auritus on longjaw mudsuckers (Noble et al. 1963). The fact that both of these studies were conducted in fairly restricted areas likely has some bearing on this question.

Parasite distribution among the gills does not appear to be random, despite variation between years and investigators. Tedla and Fernando (1970) reported maximal infection on the third arches of yellow perch, while our study showed the third and fourth arches to be heavily infected. Minimum infection on the first arch of perch occurred in both studies. Sauger and walleye ergasilid distribution varies yearly, but involves either the first and/or second arch in terms of maximal infection. In 1975, numbers were equal between the two. In 1976 infection was greatest on the first arch and in 1977 on the second. The features functioning in host specificity must be distributed equally between the first two arches of these fish.

Ergasilid females overwinter as stage 2, maturing and producing eggs in spring. This production is shifted towards the summer in E. nerkae, whose host spawns in fall with declining water temperatures (Scott and Crossman 1973). The 6-7 week period from egg to infective stage 1 female, could bring about synchronization of the infestation period with spawning or pre-spawning periods. The hosts are likely to be in peak condition at this time, providing an optimal environment for establishing females. The lack of a low density period in E. nerkae also suggests a continuous breeding cycle, which would help ensure peak numbers in late summer.

The host reaction to infection includes mucous and epithelial cell proliferation, necrosis and bleeding (Rogers 1969). Bleeding was not observed, but extensive mucous accumulation in some cases occluded normal gill structure from view. The gills appeared stuck together, reducing the number of functional gaseous exchange surfaces. This coupled with low oxygen levels was responsible for mass cisco mortality in an Alberta lake (Paetz and Nelson 1970). The commercial and recreational value of the concerned host species in Lake Manitoba, warrants further investigation of host pathology resulting from heavy parasite loads.

ACKNOWLEDGEMENTS

Thanks are due to Messrs. C. E. McKenzie and D. Klippenstein for aid in collection and examination of hosts and to the staff of the University Field Station for their co-operation and assistance. This research was supported by N.R.C. grant #A2914 to Dr. H. E. Welch.

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Population Biology of the Northern Oriole

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Field work was continued in 1977 on aspects of the population biology of the Northern (Baltimore) Oriole (Icterus galbula) on the Delta Beach Ridge, Manitoba. This project is part of a long-term effort to examine factors which influence the nesting densities of birds on the Ridge.

The objectives of the oriole project remained essentially unchanged from those of 1976. They were: (1) to continue banding and colour-marking adult males and females and subadult (first-year) males on the study area, (2) to band a large sample of nestlings and newly fledged young (to provide known-age birds for study in successive years) and (3) to locate nests where information on the timing of breeding, clutch size and productivity, parental care and nesting habitat use may be studied. In addition, plumage variation in females captured in mist nets was studied quantitatively. The variation found may be related to age therefore permitting one-year-old individual breeding females to be distinguished from older birds. This will facilitate aging of both parents and thus productivity according to age may be examined over several years.

A few major findings in 1977 were:

(1) Yearling males and females, reared on the study area in 1976, returned to breed on the study area in 1977.

(2) Clutch size was similar to that in 1976 but productivity per nest was lower.

(3) The nesting density on the study area was twice that of 1976.

My data are unanalysed at this point. After continued work in the summer of 1978, I will work up some of the information while away on sabbatical leave.

Dendrochronological Reconstruction of Water Levels for Lake Manitoba: A Preliminary Report

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INTRODUCTION

The Delta Marsh has always been dependent upon the fluctuating waters of Lake Manitoba. The recent (1961) regulation of lake water at a fixed level has thus aroused concern regarding the consequences for the marsh environment, such as increased beach erosion and disruption of natural fluctuations in marsh water levels.

Many management problems of the Delta Marsh are related to the amount and periodicity of fluctuations in water level, which can be examined for the period of continuous lake level records, 1914-1977. However, no data are available before 1914 which makes it difficult to determine whether the period of record is representative or is either anomalously high or low in relation to past water levels. One possible means to extend the hydrological record back in time is to examine tree-ring variability from trees in the marsh system.

Several studies have successfully correlated tree-ring widths with hydrological records (Schulman 1945, 1947, Gatewood et. al. 1964, Julian and Fritts 1968, Stockton 1971, Stockton and Fritts 1971). More recently, techniques have been refined for reconstructing hydrological records from tree-ring data at the Laboratory of Tree-Ring Research in Tucson, Arizona (Fritts 1976). The procedure initially requires multivariate analysis to calibrate tree-ring widths with water runoff for periods coinciding with existing hydrologic records. These relationships are then applied to estimated runoff using tree-ring data for years in which no direct measurements of runoff are available.

Using these techniques, Stockton and Fritts (1971) have extended the water level record for Lake Athabasca back to 1810. Water levels in channels and sloughs of the Peace-Athabasca Delta were directly related to the water level in the lake, which enabled the ring widths of white spruce (Picea glauca) on the adjacent levees to be calibrated with records of Lake Athabasca water levels. These calibrations were then used to reconstruct the water levels prior to 1935, the year in which records were initiated. Variations in water levels were considerably higher in the reconstructed period than in the period of record. Management considerations

would have been seriously affected if the long-term variance had been estimated from the short period of record, because such projected lake-level fluctuations had only one-third the variance represented by the actual reconstructed data for the period 1810-1967.

Because the short-term historic record for Lake Manitoba may not be representative of the long-term variability, a longer-term record of such fluctuations would be valuable for management of the Delta Marsh. If tree growth becomes sufficiently limited by soil moisture conditions, then ring-width series from selected locations along the margin of the marsh might serve as records of water levels. They could then be used to reconstruct the long-term changes in water levels of Lake Manitoba. The objective of this study, therefore, was to examine the feasibility of using annual tree-ring widths for a long-term reconstruction of water-level changes of Lake Manitoba.

Successful recovery of information from tree rings usually involves more than a random sampling and counting of rings. Not all woody plant species or individuals of a species produce ring-width sequences that are datable and suitable for dendrochronological investigations. A tree growing on an optimum site produces uniform annual rings which compose a complacent ring series (Stokes and Smiley 1968). A sensitive ring series contains rings that are not uniform, resulting from the effect of limiting environmental factors on tree growth. The investigator therefore tries to maximize ring-width variability by choosing samples and sites that will maximize the variability of the factor being investigated.

Bur oak (Quercus macrocarpa) was chosen for this investigation because it has exhibited sensitive ring series in other dendrochronological investigations (Estes 1970, Fritts 1976) and grows on natural levees of the Blind Channel in the Oxbow Wood, Delta Marsh. It was noted that the largest, oldest and most vigorous oak trees were located on well-drained sites on the tops of levees. There appears to be a deterioration in growth of bur oak and an invasion of species typical of wetter habitats such as green ash (Fraxinus pennsylvanica) on old levees that have been cut off from the Blind Channel. It is therefore suggested that some factor related to the presence of the existing Blind Channel may be affecting the growth of oak on the levees.

METHODS

Cores were collected from bur oak on the Blind Channel levee at the southern end of Oxbow Wood, west of the Inkster farm buildings, between 22 October and 6 November 1977. The major criterion governing site selection was the location of large, old and open-grown individuals. Such trees are more apt to be growing under conditions that would minimize intra- and interspecific competition, thus maximizing sensitivity.

A Swedish increment borer was used to obtain two cores from each of 10 trees at 1.4 m above the ground (D.B.H.). These were collected from

opposite sides of the tree, perpendicular to the prevailing NW-SE wind axis. The tree-ring record from a replicated sample of two cores from each of 10 trees has been found to accurately assess the response of a particular species to its environment (Fritts 1966). Small holes made by the increment borer were plugged to reduce the possibility of damage by insects and decay-causing organisms.

After collection, increment cores were glued into 1 x 1 x 40 cm wood mounting trays. When the glue had set, the surface of the core was prepared for cross-dating and measuring. Cores were shaved, sanded and polished using the techniques of Tande (1977).

Standard dendrochronological procedures were used to age the specimens and measure ring widths (Stokes and Smiley 1968). Ring widths were measured to the nearest 0.01 mm by means of an Addo-X, which automatically records the distance a specimen has been moved across a microscope stage. Magnifications of 40x were satisfactory for making all of the measurements.

Ring widths were plotted on graph paper and the points marking the amount of growth for each year were joined to form a "growth curve". A mean growth curve or "trend line" was computed and plotted for each specimen using the methods of Stokes and Smiley (1968). A trend line is necessary because a tree adds wider rings when it is young and the stem is small, but radial growth slows as the tree ages and the stem enlarges.

PRELIMINARY RESULTS

Ages of bur oak from the study area range from 85 to 154 years at D.B.H. The largest sampled tree was 76 cm D.B.H. and was 120 years old. Larger (148 cm D.B.H.) and perhaps older individuals were located but coring was unsuccessful because of rotting interiors.

The annual ring widths from a subsample of 12 specimens have been measured and plotted and trend lines fitted to the chronologies. The data have not been analyzed fully but the subsample indicates that bur oak from the Delta Marsh can provide a sensitive ring series.

The dendrochronological analysis of increment cores must be completed before a test of sensitivity and water-level fluctuations can be made. Over the next few months, remaining increment cores will be measured, plotted and fitted with trend lines. The completed series must then be cross-dated to establish precise time control.

The next major step is then to construct a master chronology. Initially, ring-width values are converted to ring-width indices. These indices, unlike ring-widths, range from 0-2 and have an expected mean of one, with a variance that is homogeneous through time (Fritts 1971). The indices from all rings in each year are then averaged to obtain a mean ring-width chronology, or master chronology for all trees. These methods are standard procedures at the Laboratory of Tree-Ring Research and are described in detail by Stokes and Smiley (1968).

Various analytical techniques may be used to assess the correlation of ring-width indices with environmental factors (Fritts 1971, 1976). The master chronology will dictate the method of analysis.

ACKNOWLEDGEMENTS

We would like to extend our appreciation to the Canadian Forestry Service, Northern Forest Research Centre, Edmonton for making the Addo-X machine available to us while in Edmonton in December 1977. Logistic support was provided by staff of University Field Station (Delta Marsh). The Department of Botany at the University of Manitoba kindly allowed us to use their increment borer.

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Proposed Development of a Fire Management Plan for Portions of Oxbow Wood, Delta Marsh

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INTRODUCTION

The forest-grassland transition zone, commonly known as the aspen parkland, is an ecotone separating forest from prairie. Within this zone, the University Field Station at Delta Marsh lies in the Aspen-Oak Section (B.16) of the Boreal Forest Region of Canada (Rowe 1972). Although trembling aspen (Populus tremuloides) is the dominant species, bur oak (Quercus macrocarpa) is conspicuous along the rivers and on suitable sites such as shallow dry soils and south or west slopes. In general, the distribution of bur oak is sporadic.

The Aspen-Oak Section is a continually changing system and at present the forest appears to be encroaching on the grassland (Bird 1961). While climatic fluctuations are probably reflected in the vegetational shift, more direct importance may be attributed to recent elimination of prairie fires and to reduction of grazing pressure (Bird 1961, Pettapiece 1969).

Stands of bur oak are found in Oxbow Wood on the property of the University Field Station. During the course of a dendrochronological study in this forest, a number of observations were made on the vegetation structure and life histories of prominent species.

Dominant tree species in the woodlot include green ash (Fraxinus pennsylvanica) and Manitoba maple (Acer negundo) in addition to oak. The shrub understory is composed predominantly of Corylus cornuta and C. americana, with Symphoricarpos occidentalis along the forest margins. The prairie which once surrounded Oxbow Wood has been developed into farmland.

In many portions of the forest there are large solitary oaks which are widely scattered even within oak-dominated areas. The low branching habits of these trees suggests that a more open parkland habitat existed in the past. Individuals of ash and oak have clumped distributions in which a group of stems arise from a root collar. This phenomenon has also been described in bur oak from oak forests of southwestern Wisconsin, which have experienced fire (Cottam 1949). In these areas, oak savanna was maintained by periodic fire which stimulated oak reproduction from root collars

and regulated encroachment of trees on grassland during dry climatic conditions. In the Oxbow Wood, fire scars have been found on both oak and ash, although only ash seedlings have been encountered.

A literature review of the forest-grassland transition zone from Wisconsin (Cottam 1949, Curtis 1959) and Minnesota (Ewing 1924, Buell and Cantlon 1951, Pelton 1953, Buell and Facey 1960, Nelson and England 1971) and past fire ecology experience in Alberta thus leads the present authors to believe that Oxbow Wood was once a more open oak parkland within a native prairie matrix. The growth habits of bur oak in this forest strongly suggest that recurring fire was the causal factor for a former parkland habitat.

Research has therefore been initiated to develop and execute a prescribed fire plan for small test plots at Oxbow Wood. The goal of prescribed burning would ultimately be to promote and maintain more natural prairie and parkland habitats. The specific research objectives are:

(1) to establish that fire has been a natural process in Oxbow Wood and its prairie margin in the past,

(2) to examine the role of prescribed fire as an effective management tool in perpetuating oak parkland and prairie habitats on the Field Station property,

(3) to determine the location and extent of suitable test burns,

(4) to assess the effects of fire on vegetation, wildlife, and selected abiotic factors in test burns,

(5) to use the information gained as a basis for fire management plans for upland habitats on the Field Station property.

As a first step, inquiries have been made to two institutions, the Cedar Creek Natural History Area, Minnesota and the University of Wisconsin Arboretum at Madison, Wisconsin. These have similar vegetation types to those of Oxbow Wood and are using prescribed fire for the maintenance of these habitats. For each area we now have information on (1) fire ecology research and prescribed burning, (2) monitoring long-term changes, (3) fire management plans.

Fire has been used on the Cedar Creek Natural History Area since 1964 to restore and maintain about 100 ha of natural habitat for scientific and educational purposes (F.D. Irving pers. comm. 15 Dec. 1977). Students of wildlife and forestry from the University of Minnesota participate in annual burning for university credit (Irving 1971). Axelrod and Irving (1976) have been studying the effects of prescribed fire on Corylus spp. and are currently looking at effects on overstory trees.

Burning has been a routine management procedure since 1941 on Curtis and Green Prairies in Madison (Anderson 1973). A long-term prairie and savanna survey involves sampling the areas every five years (Cottam and Wilson 1966, Anderson and Cottam 1968). Numerous M.Sc. and Ph.D. theses have resulted from work on the Arboretum. Green Prairie is adjacent to forest dominated by hybrid populations of Quercus ellipsoidalis and Q. velutina. The area is similar to Oxbow Wood and the plan for the area includes maintenance of an open, savanna-like edge between the woods and the prairie (V. M. Kline pers. comm. 13 Dec. 1977).

Several aspects of research are planned into the study at Oxbow Wood. A thorough phytosociological analysis will be necessary, in addition to examining a managed area such as Cedar Creek in Minnesota. Baseline data could also be gathered by other investigators on biotic and abiotic factors. The central consideration, however, will be the development of a prescribed fire plan. This plan must contain sufficiently detailed information to meet with the approval of Field Station staff and the Marsh Manager. The essential outline of a prescribed fire plan is as follows.

I. Objectives

a) Primary objectives of burn
b) Secondary objectives of burn
c) Desired results
d) Type of fire required to meet objectives
e) Policy statement on management and fire

II. Literature and historical review of area

III. Description of the study area

a) Location
b) Topography
c) Vegetation
d) Climate and local weather
e) Wildlife and abiotic factors that are to be monitored before and after burn

IV. Analysis of expected fire behavior

V. Fire prescription

a) Season
b) Pre-fire weather (i.e. number of days since rain)
c) Weather on burning day (i.e. temperature, relative humidity, fuel moisture, wind speed)
d) Fuel stage (i.e. curing stage of grass)
e) Time of day

VI. Burning procedures

a) Pre-treatment of fuels (i.e. should larger fuels be removed, or area mowed)
b) Burning stages
c) Firing pattern and methods

VII. Control and patrol provisions

a) Equipment
b) Personnel
c) Firelines
d) Communication
e) Plans for escape fires

VIII. Fire behavior and weather observations

a) Behavior in different fuels
b) Flame lengths
c) Spotting
d) Photo documentation
e) Temperature, relative humidity, wind speed

IX. Organization

a) Schematic diagram of organization
b) Duties and responsibilities of personnel

X. Safety

a) Fire itself
b) Poison ivy
c) Smoke

XI. Public relations

XII. Financial arrangements

XIII. Appraisal of burn accomplishments

a) Fire behavior
b) Investigations on fire effects (e.g. vegetation, wildlife, abiotic factors)
    1. Short-term
    2. Long-term

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Appendix I

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2. Evans, R. M. and R. W. Nero. 1967. Sight record of Green Heron at Delta, Manitoba. The Blue Jay 15: 184.

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Girman, Glen R. 1976. The effects of a number of herbicides upon photosynthesis and heterotrophy of naturally occurring algal and bacterial communities in Delta Marsh, Manitoba. M.Sc. thesis, Department of Botany, University of Manitoba 180 pp.

Phillips, Samuel Floyd. 1976. The relationship between evapotranspiration by Phragmites communis Trin. and water table fluctuations in Delta Marsh, Manitoba. Ph.D. thesis, Department of Botany, University of Manitoba 167 pp.

Mutch, Graham P. 1976. Aspects of winter dormancy in the striped skunk (Mephitis mephitis). M.Sc. thesis, Department of Zoology, University of Manitoba. 89 pp.

Hood, Deborah E. 1977. A study of the parasites, nest fauna and selected endocrin parameters of the Red-winged Blackbird. M.Sc. thesis, Department of Zoology, University of Manitoba. 239 pp.

MacArthur, Robert Arthur. 1977. Behavioral and physiological aspects of temperature regulation in the muskrat (Ondatra zibethicus). Ph.D. thesis, Department of Zoology, University of Manitoba. 168 pp.

Pip, Eva. 1977. The study of aquatic plant-snail association. Ph.D. thesis, Department of Botany, University of Manitoba. 503 pp.

Appendix III

UNIVERSITY FIELD STATION (DELTA MARSH)

RESEARCH 1977

INTRODUCTION

The number of weekend programs that occurred in the early part of the year emphasized the value of the year-round activity of the Field Station. Several summer and early September courses are scheduled in various areas of field biology. Information can be obtained from the Departmental or Field Station offices.

We look forward in June to welcoming Marianne See and Jerry Tande who will be resident ecologists at the Station for the next year. They will undertake both teaching and research responsibilities and will organize a High School Ecology program in the fall. This will be on an experimental basis for we wish to determine whether schools will find field trips in September and October as attractive as they have been, for the past four years, in May and June.

RESEARCH

A number of graduate students are completing their data analysis and thesis writing, among them are Jo Anderson, Susan Cosens, Nina Hooper, Eva Pip, Marilyn Rayner, Dan Busby, Paul Goossen and Chris McKenzie.

David MacKenzie will be expanding his study of the Eastern and Western Kingbirds and George Kgoroba his research on ticks. Mike McKernan will undertake some preliminary work on the role of the genus Potamogeton in the marsh. Among the faculty Drs. Sealy and Welch will be pursuing their on-going oriole and parasite projects and Drs. Booth and Robinson plan to initiate new studies of fungi and algae at Delta.

A brief outline of research projects follows:

Zoology

Ectoparasites and Endoparasites of Blackbirds in Delta Marsh, Manitoba.

Brian O'Malley (4th year student)
Supervisor Dr. H. E. Welch

This summer the survey initiated in 1976, of ecto- and endoparasites of the Red-winged Blackbird, Agelaius phoeniceus L., the Yellow-headed Blackbird, Xanthocephalus xanthocephalus (Bonaparte), the Common Grackle, Quiscalus quiscula (L.) and the Brown-headed Cowbird, Molothrus ater (Boddaert) will be continued. The objective will be to identify the parasites in each host, to compare the parasitic fauna of the birds and to determine if any the differences and similarities which can be related to host habits and feeding. Ten males and ten females of each host will be shot, blood samples taken, feathers inspected for ectoparasites and digestive, respiratory and urogenital tracts as well as the body cavity examined for helminth parasites.

Funded by the National Research Council of Canada.

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Infestation of Lake Manitoba Fishes with two Parasitic Copepods, Ergasilus sp.

Brian O'Malley (4th year student)
Supervisor Dr. H. E. Welch

Last summer three parasitic copepods of the genus Ergasilus were found: E. nerkae Roberts, 1963 in cisco; E. luciopercarum Henderson in walleye, sauger, perch, trout perch and Johnny Darter; and E. versicolor Wilson, 1911 in suckers. This summer effort will be concentrated on determining more accurately the seasonal pattern of the first two Ergasilus spp. as well as patterns of distribution on the gill arches and the pathology of the parasite on the host.

Funded in part by the Department of Renewable Resources and by the National Research Council of Canada.

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Parasitic Fauna of the Muskrat (Ondatra zibethica, Linnaeus) in Southern Manitoba

Chris McKenzie (M.Sc. Candidate)
Supervisor Dr. H. E. Welch

Over 150 animals taken not only at Delta, but also at Oak Hammock Marsh and other points in southern Manitoba have been examined. So far six trematode species and four mites appear to be the dominant parasites. This spring and early summer efforts will be concentrated on the trematode and mite fauna. Early indications suggest that the muskrat populations suffered severe winter-kill, but collections will be made and autopsies carried out on specimens captured at Delta.

Funded by the National Research Council of Canada.

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A Study of Ticks

George Kgoroba (M.Sc. Candidate)
Supervisors Dr. H. E. Welch and Dr. T. Dick

A few general features of the life cycle and habits of our native ticks are known but no detailed information on ticks of southern Manitoba is available. This study will establish new and authenticate known intermediate and definitive hosts for the larval, nymphal and adult stages of ticks. Studies of the distribution and numbers of the various growth stages of ticks will aid in determining how many generations occur per year, as well as which macro- and microclimatic factors are related to the initiation, optima and cessation of tick activity in the spring, summer and fall. Rearing of adult ticks on several hosts, both natural and experimental, should indicate their fecundity and longevity.

Funded by a C.I.D.A. Scholarship to Mr. G. Kgoroba and by the National Research Council of Canada.

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Mating System and Population Structure of the Northern Oriole

Dr. S. G. Sealy (Department of Zoology)

Banding of Northern Orioles (Icterus galbula) on the Delta Marsh ridge in 1974, 1975 and 1976 has revealed a dense population and a preponderance of males. Continued banding in 1977 will permit additional information to be obtained on the population of this species. The status (i.e. breeding, non-breeding) of the one-year old males is being examined.

As part of a long-term study of the niche relationship of insectivorous birds on the Delta Marsh ridge, aspects of the foraging ecology of the Northern Oriole and nest site selection will be studied in 1977.

Funded by the National Research Council of Canada and the University of Manitoba Research Board.

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Temporal Patterns and Spatial Relationships in the Breeding Ecology of Eastern and Western Kingbirds at Delta, Manitoba.

David MacKenzie (M.Sc. Candidate)
Supervisor Dr. S. G. Sealy

The study will comprise of an investigation of the temporal and spatial factors that would tend to mitigate competition between the two co-existing Kingbird species. In particular an attempt will be made to delineate territories and to correlate changes in territory size with stages in the breeding cycle. Foraging,niche segregation and nest site selection will also be examined.

Funded by the National Research Council of Canada.

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Biology Teaching Unit

The Ecology and Distribution of Mustela freneta in Manitoba

Lloyd Gamble (M.Sc. Candidate)
Supervisor Dr. R. Riewe

Concern has been expressed as to the status of the longtail weasel (Mustela freneta) in Manitoba. Trapping records have shown a marked decline in this plains species.

The purpose of this study is to examine the range and status of the longtail weasel in Manitoba and to study its ecology including the life history, food habits, home ranges and habitat utilization. Ecological studies will be accomplished by means of winter track surveys, stomach and scat analyses, examination of carcasses, live trapping and radio telemetry techniques. Due to the diversity of habitats present in the Delta marshes and the relative abundance of the species there, it has been selected as one of the sites for intensive study.

Funded in part by the Department of Renewable Resources and by the Canadian Wildlife Service.

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Botany

The Autecology of the Genus Potamogeton in the Central Unit of the Delta Marsh

Mike McKernan (M.Sc. Candidate)
Supervisor Dr. J. M. Shay

The study will examine the environmental factors affecting the growth, distribution and propogation of the various species of Potamogeton found in the Centre Marsh. That the study focuses only on the Potamogeton component of the phytocenosis is due to three principal reasons:

a) the considerable ecological significance of Potamogeton spp. in the marsh for the provision of food and protection for waterfowl, fish and invertebrates.

b) the paucity of information on submerged aquatics at Delta.

c) the potential use of submerged hydrophytes for wastewater reclamation, in particular the relationship between Potamogeton growth and distribution and ambient nutrient regimes.

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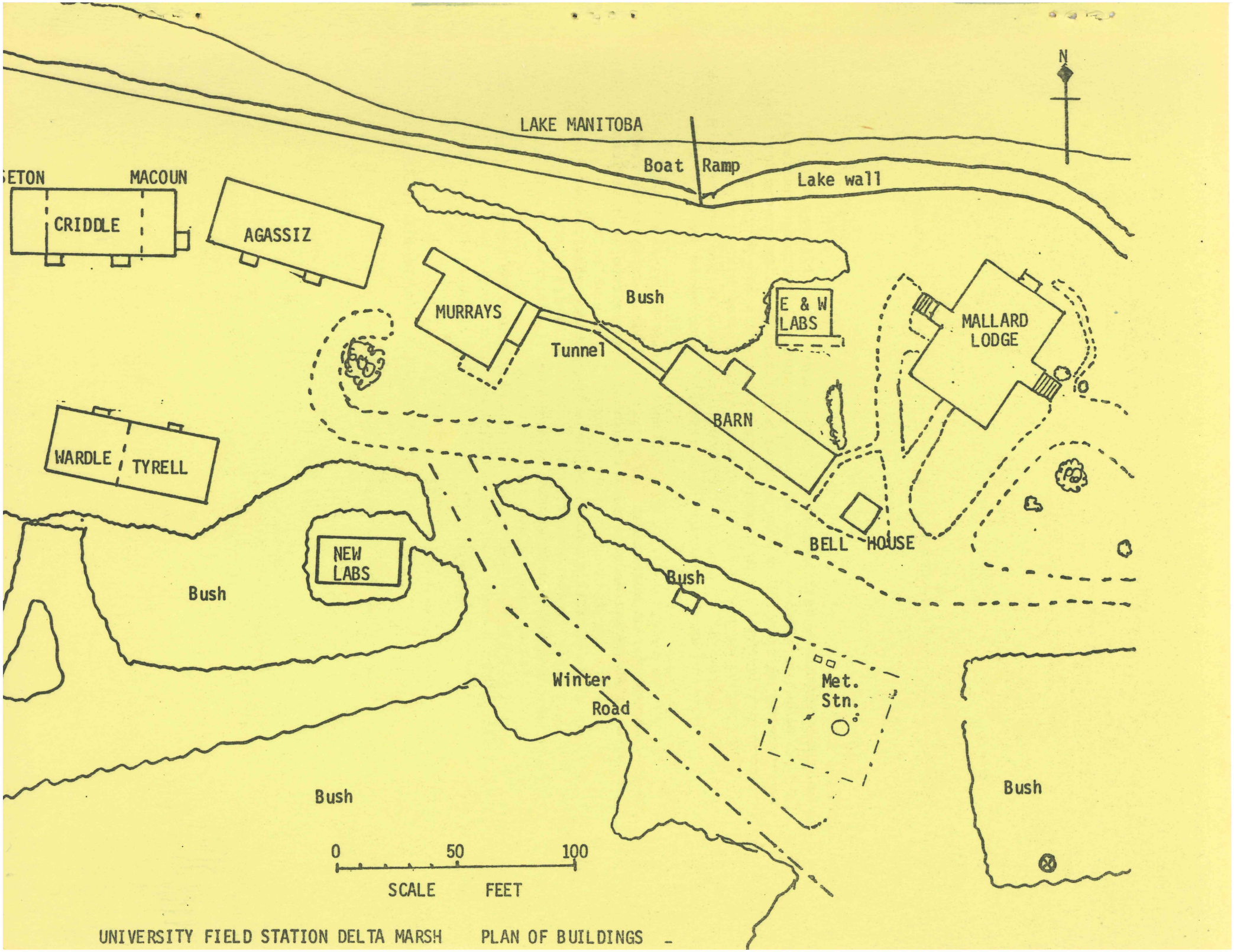
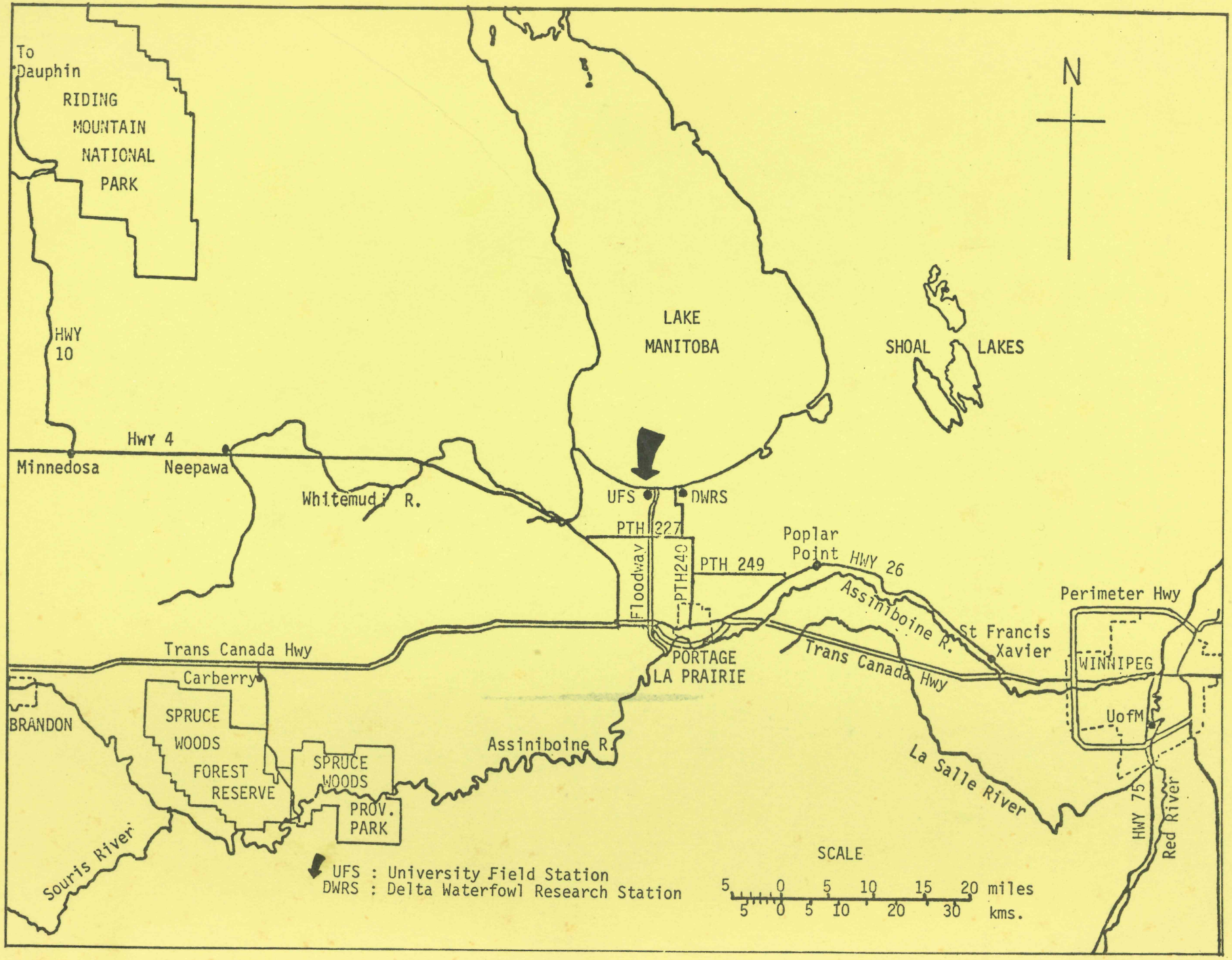


UNIVERSITY FIELD STATION DELTA MARSH PLAN OF BUILDINGS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Floodway
PTH240
PTH 249
Poplar Point
HWY 26
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St Francis Xavier
Perimeter Hwy
WINNIPEG
Trans Canada Hwy
PORTAGE LA PRAIRIE
Trans Canada Hwy
Carberry
BRANDON
SPRUCE WOODS FOREST RESERVE
SPRUCE WOODS PROV. PARK
Assiniboine R.
La Salle River
UofM
HWY 75
Red River
Souris River
UFS : University Field Station
DWRS : Delta Waterfowl Research Station
SCALE
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