Canadian Wildlife Service

Prairie Migratory Bird Research Centre

ANNUAL PROGRESS REPORT 1969-70

Project Title: Ecological Evaluation of the Peace-Athabasca Delta

Project Code: 374-4518

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Cooperating Agencies:

Water Survey of Canada
Inland Waters Branch
Dept. of Energy, Mines and Resources

National Parks Service
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1. INTRODUCTION

This project is designed to determine the effects of the Bennett Dam on the Peace River near Hudson Hope, British Columbia, on water regime, vegetation pattern, and waterfowl use of the Peace-Athabasca Delta. This extensive delta region is maintained through inundation by silt-laden waters, silt deposition, and water retention in shallow basins. The resurgence and retention of water on the delta depends upon the spring and summer flood levels of the Peace, Athabasca, and Birch rivers. Since the filling of the reservoir behind Bennett Dam was begun in spring, 1968, flows in the Peace River have remained quite low. Although the total annual flow will slightly increase as full operation of the hydro-electric system is approached, the discharge pattern will follow the seasonal requirements for electricity in British Columbia. Thus we can expect low discharge in the summer and high flow in the winter - a reversal of the natural water regime. It has been estimated that the mean level of Lake Athabasca and the contiguous marshes may drop by three feet (Water Resources Branch 1962), exposing large areas of level silt which until now have remained more or less continuously submersed. This reduction in water area and the concomitant lowering of the water table is expected to cause significant changes in the vegetation pattern, such as encroachment of willows into sedge meadows, and to have detrimental effects on waterfowl and muskrat habitat.

The Peace-Athabasca Delta is important for waterfowl production, but is particularly renowned as a moulting area and as a staging area for the fall migration of ducks and geese. It has also been a significant producer of muskrats and other furbearers - an important source of income for the approximately 1,500 Indian and Metis residents of Fort Chipewyan and vicinity.

Thus any changes in the ecology of the delta, resulting from damming the Peace River may have serious repercussions in terms of income opportunities for the regional human population. It is, therefore, important to investigate what changes are likely to occur, and to determine what management would be required to maintain sustained production of the wildlife resources for the economic benefit of the local residents and, as far as waterfowl is concerned, for the recreational benefit of North American hunters and bird watchers, while at the same time maintaining this interesting area in as natural a state as feasible.

Specifically, the objectives of the project are:

(1) To determine the relationships between vegetational patterns and physical environmental features, particularly the water regime, and to develop a vegetation/environment classification of the delta's landscape.

(2) To map the delta according to the above classification through interpretation of recent air photos.

(3) To determine use of various habitat types by waterfowl populations for breeding, nesting, brood rearing, moulting, and spring and fall staging.

(4) To predict the long-term effects of the Bennett Dam on the Peace River on the landscape and the waterfowl capability of the delta, and to recommend remedial actions to maintain desirable waterfowl populations.

2. THE AREA

2.1 Location and administrative divisions

The Peace-Athabasca Delta is situated in northeastern Alberta, adjacent to the western extremity of Lake Athabasca. It lies between 58°15' and 58°50'N and between 110°40' and 112°30'W, covering an area of about 2,300 square miles (ca. 6,000 km^2) of which more than half is open water (Fig. 1). Three main rivers affect water levels in the delta:

(1) The Peace River, which bypasses it on the north but, when in flood, passes water through the Chenal des Quatre Fourches and the Rivière des Rochers into Mamawi Lake and Lake Athabasca;

(2) The Athabasca River which enters the west end of Lake Athabasca from the south; and

(3) The Birch River which originates in the Birch Mountains, enters Lake Claire from the west, and flows directly through the delta.

The Lake Claire-Mamawi Lake section of the delta is now part of Wood Buffalo National Park (see Fig. 1), whereas the eastern portion, including Richardson Lake and the mouth of the Athabasca River are administered by the Province of Alberta.

2.2 Glacial history and surface geology

The Peace-Athabasca Delta lies in the Peace River Lowlands at the confluence of the Athabasca, Peace, and Slave river drainage basins (Hardy et al. 1967:85) between the Birch and Caribou mountains on the southwest and the edge of the Precambrian Shield on the northeast.

Regional bedrock is variable, ranging from Precambrian granites and gneisses to unconsolidated Cretaceous sandstones and shales.

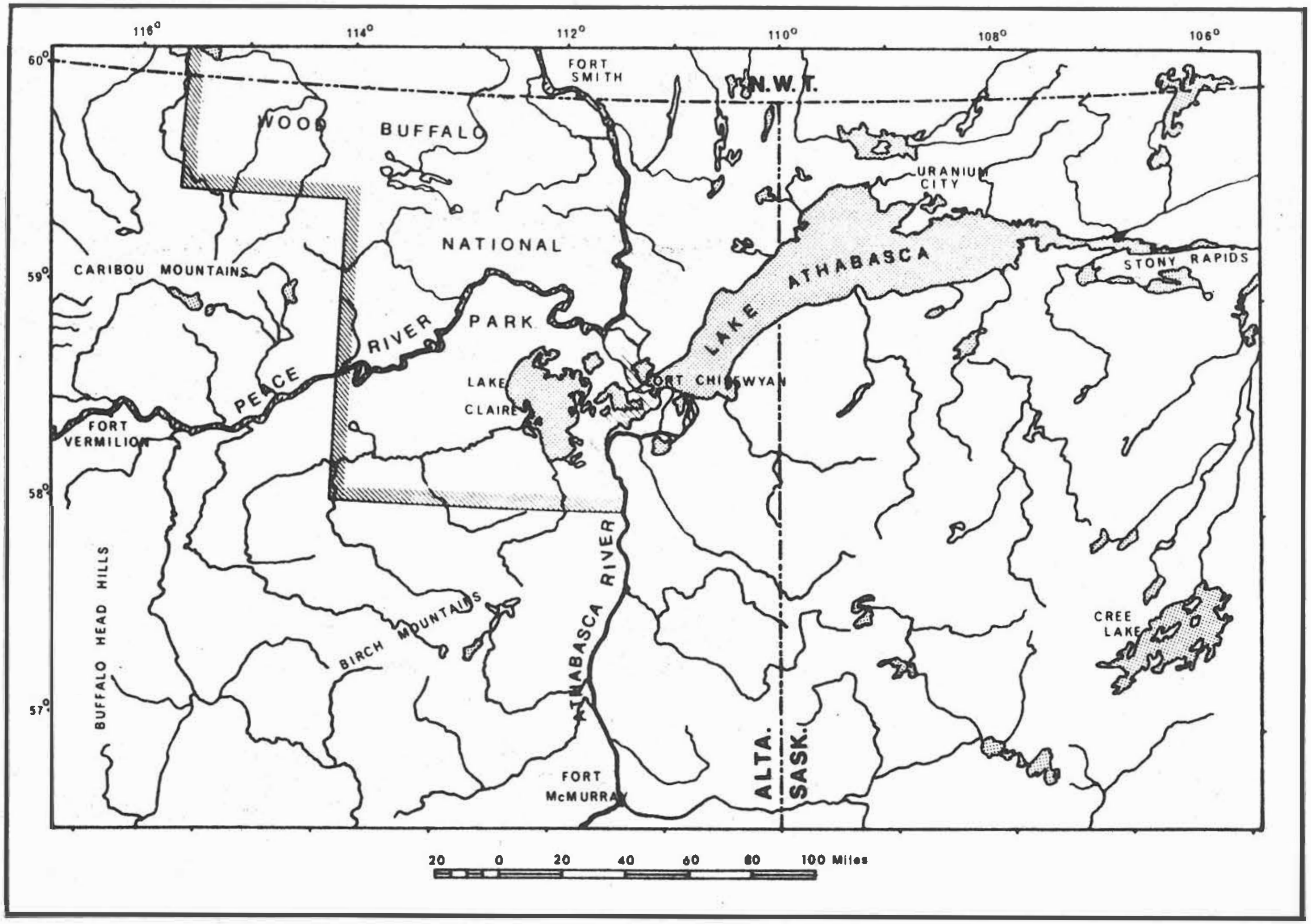


Figure 1. Geographic location of the Peace-Athabasca Delta.

Precambrian rocks underly the eastern half of the study region, whereas the lowlands north of the Birch Mountains are underlain by Devonian gypsum, limestones, and shales (Bayrock 1961).

The Keewatin sheet of the Wisconsin glacier (ca. 31,000 years ago) covered the area with ice up to 1 mile (1.6 km) in thickness (Bayrock 1962). Large ice-marginal lakes formed as the ice sheet gradually retreated. Glacial Lake Tyrrell covered the Peace River Lowlands, south and west of the present town of Peace River, extended up the Athabasca River basin to Lac La Biche, and included all of Lake Athabasca and its surrounding lowlands (Taylor 1958). The retreat of the ice from the present delta area was complete approximately 10,500 years ago.

Following deglaciation, Lake Athabasca was probably about 100 feet (ca. 30 m) higher than at present (Bayrock 1962). The Peace and Athabasca rivers probably had a steeper gradient than at present because they deposited extensive areas of coarse sands and gravels. Subsequent lowering of the level of Lake Athabasca resulted in a reduction of the base level for the two major rivers and in laying down of silt and clay deposits on top of the older, coarser materials (Bayrock 1962). Filling of closed depressions with silt, clay, muck, and fibrous organic matter has proceeded since that time.

2.3 Climate

Most of the northern Alberta has a short, cool summer according to the Köppen classification. The flow of low pressure systems over northeastern Alberta in the summer results in a mean wind direction in the delta from the northwest (Odynsky 1958).

The following climatic data are taken from Longley (1968). Mean April temperature in the study area is 28 to 30°F (-2.2 to -1.2°C), mean July temperature is 60 to 62°F (15.6 to 16.7°C), mean October temperature is 34 to 36°F (1.1 to 2.2°C), and mean January temperature is -10 to -12°F (-23.3 to -24.4°C). The moderating influence of the large water bodies extends the frost-free period to 100 days, i.e., 20 days longer than in the surrounding uplands. The last spring frost normally occurs between 1-15 June, while the first fall frost takes place between 1-15 September.

Mean annual precipitation in the area is 16 inches (406 mm) of which 9-10 inches (229-254 mm) falls between 1 April and 30 September.

2.4 The present landscape

Present landform and vegetation patterns of the Peace-Athabasca Delta have been discussed in detail by Raup (1935) from whom the following brief description is abstracted.

The lacustrine-alluvial plain is very flat with the only relief afforded by granite outliers of the Precambrian rocks to the eastward. These are rounded hills standing like islands in the flats and having little soil on them. The lakes, although of large area, average only 4 to 5 feet (1.2-1.5 m) in depth. Their shores are very marshy, but in places where they are exposed to the action of waves they are cut back and comparatively dry. Abandoned channels of the streams, and the ponds formed by the cutting-off of sections of the lakes are in all stages of filling, in general being drier toward the outer margins of the basin.

Although the differences in the elevation of the plain above the water table are slight, they are enough to determine the arrangement of the plant cover. Lands subject to inundation have a herbaceous vegetation ranging from semi-floating aquatic plants to sedges and grasses. Large areas are covered by almost pure stands of awned sedge (*Carex atherodes*) or blue-joint grass (*Calamagrostis* spp.). On the slightly elevated margins of stream channels, abandoned or otherwise, are long lines of willows (*Salix* spp.). Shrub and tree growth increases toward the margins of the plain, so that the upper (and older) part of the delta and the banks of the larger channels support a forest of white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*). The granite hills have a scrubby timber of white spruce, jackpine (*Pinus banksiana*), and white birch (*Betula papyrifera* var. *neoalaskana*).

3. ORGANIZATION AND PHASING OF THE PROJECT

This project has been planned to be carried out over a five-year period, consisting of fiscal years 1969-70 through 1973-74. Technical field work has been divided into three sub-projects, followed by a final phase in which all available information will be collated and a completion report prepared (see Dirschl 1968).

These sub-projects are:

Sub-project 01 - Ecological classification and mapping.

Sub-project 02 - Evaluation of waterfowl use.

Sub-project 03 - Topographical mapping, hydrological and meteorological records.

Phasing of individual aspects of the study is given in Table 1. Objectives, methods, and progress to date for each of the sub-projects are described in sections 6-8 of this progress report.

4. STAFF

During fiscal year 1969-70, supporting staff for the project consisted of one permanent Technician 2 (G. C. Gentle) and two graduate assistants (D. L. Dabbs and D. J. Nieman) on contract and term employment. G. C. Gentle assumed charge of the Fort Chipewyan field station during H. J. Dirschl's absence; D. L. Dabbs concentrated on sub-project 01, while D. J. Nieman was mainly engaged in sub-project 02.

In addition, an undergraduate student and a part-time typist-radio operator were stationed at Fort Chipewyan during the field season. The superintendent of Wood Buffalo National Park kindly made available Patrolman R. Fraser for three weeks in June, to help familiarize the crew with the delta's geography.

5. ESTABLISHMENT OF FIELD STATION FACILITIES

The 114 x 200 ft. lot at Fort Chipewyan, leased from the Hudson's Bay Company in 1968, was developed into a suitable base camp for the project (Fig. 2). Three trailer units, providing accommodation for a crew of eight as well as office, laboratory, and darkroom facilities (Fig. 3) were rented from ATCO Leasing Ltd. and placed on the site in March, 1969. Later a 20 x 36 ft. frame building, containing a workshop and storage space for airboats and other motorized equipment was constructed (Fig. 4). A water system and sewage disposal facilities were also established in the early part of the field season. Finally, the

Table 1. Phasing of the project and summary of major activities.

	Fiscal 1969-70		Fiscal 1970-71		Fiscal 1971-72		Fiscal 1972-73		Fiscal 1973-74	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Sub-project 01 Ecological classification and mapping	Field work: strip photography, ground checks, establish permanent transects	Photo interpretation	Field work: some strip photography, ground checks	Photo interpretation	Field work: ground checks, some strip photography	Photo interpretation	Checking of permanent transects Preparation of ecological map and completion report		Continuing checking of permanent transects	--
Sub-project 02 Evaluation of waterfowl use	Field work: census and nest search	Tabulation of data	Field work: census and nest search	Tabulation of data	Field work: census and nest search	Tabulation of data	Field work: census and nest search	Tabulation & analysis of data	Completion report preparation	--
Sub-project 03 Topographical mapping, hydrological and meteorological records	Setting up water table gauges and lake level gauges, met. instruments periodic reading	Tabulation of data	Periodic reading of instruments, high level photography at high and low water levels	Telluro-meter survey of bench marks & other land marks Preparation of a contour map from the high level photos	Periodic reading of instruments	Tabulation of data	Periodic reading of instruments	Tabulation and analysis of data	Preparation of completion report	--
Final analysis and report	--	--	--	--	--	--	--	--	Collating of all data and preparation of final report	

Figure 2. View of Canadian Wildlife Service field station at Fort Chipewyan.

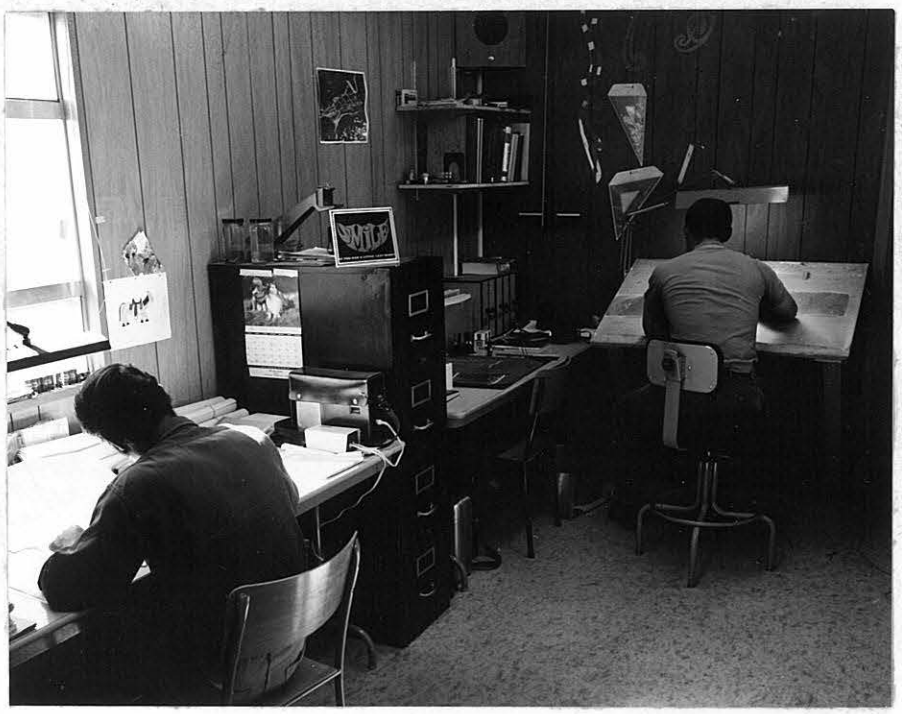


Figure 3. Interior of the office and laboratory trailer unit.

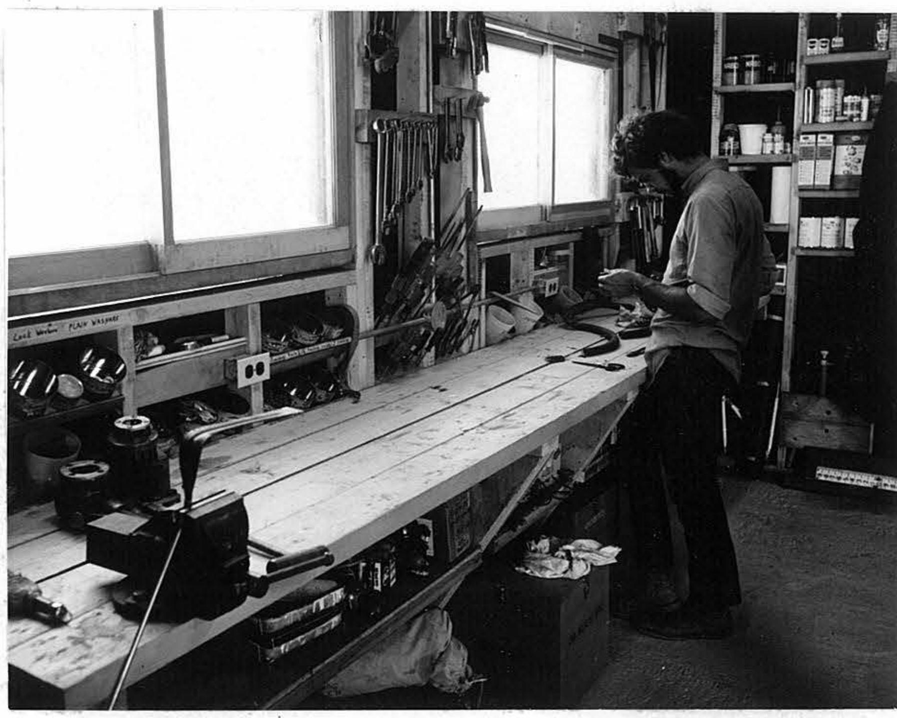


Figure 4. Workshop facilities.

lot was fenced and a harbour for the two airboats was dug with the help of Alberta New Start.

Major equipment transported to Fort Chipewyan for use in the project included an International Travelall motor vehicle, two airboats for travel in the shallow marshes and lakes of the delta, a 16-ft. fiberglass boat with twin 33 hp outboard motors for river travel, and an 18-ft. freight canoe with 9.5 hp motor for the establishment of gasoline caches within the delta. A VHF radio system, consisting of a base station and four portable sets was rented from Alberta Government Telephones to permit communication between field parties and the base camp.

6. SUB-PROJECT 01: ECOLOGICAL CLASSIFICATION AND MAPPING

6.1 Specific objectives

(1) To classify the landscape of the delta into units, homogeneous according to vegetation pattern (cover and composition), principal geomorphological features, and developmental processes; to investigate relationships of these main landscape units to the moisture regime;

(2) To produce a physiognomic-ecological map of the entire delta, according to the above classification, in order to determine the spatial relationships of the recognized landscape units;

(3) To determine the rate and nature of changes in vegetation pattern and terrain features through the normal ongoing delta-building processes and through the recent artificial alteration in water regime; and

(4) To predict the long-term effects of damming the Peace River on the landscape of the delta, and to indicate steps that would alleviate those effects.

6.2 Methods

Methods adopted in this study were chosen with two factors in mind:

(a) The vast extent of the marshes and shallow lakes, silt flats, sedge and reed meadows, and meandering stream channels make ground travel to study sites very time-consuming, and sometimes hazardous.

(b) As the filling of the upstream reservoir on the Peace River had already begun, rapid changes in the vegetation of the delta were expected. In order to assess these changes, it was essential to obtain an efficient and accurate means of monitoring vegetation changes as they occur.

It was evident that complete reliance on traditional methods of ground sampling, such as quadrat or line-transect techniques, would be too inefficient for the recognition and evaluation of vegetational adjustments on such a large scale. A system of aerial photographic sampling was, therefore, adopted since it allows monitoring of changes in the landscape over extensive areas, and thus permits considerable reduction in the required amount of ground sampling.

6.2.1 Mosaic mapping

Prior to the 1969 field season, air photo mosaics of three large representative portions of the delta were prepared from existing (1955-56) coverage of the area. The military grid lines on topographic maps of the area were used as means of control in mosaic construction.

Reconaissance maps were then prepared on acetate overlays through identification and tracing of the following broad vegetation-landform categories:

A - open lake water

B - water with emergent vegetation

C - mudflat (exposed silt or sparsely vegetated)

D - fen

E - tall shrub on alluvial levees or other high ground

F - forest on alluvial levees

G - forest on rock outcrops

H - rivers and streams

Whiteprints prepared from the acetate originals served as field maps for use in selecting study locations, field-transects, etc., for both the landscape-ecological and the waterfowl-use (sub-project 02) aspects of the study.

6.2.2 Large-scale strip photography

Fifteen transect lines with a total length of 42 miles (68 km), considered representative of the various predominant landscape features of the delta, were selected in early June by means of the above field maps and aerial inspection (Fig. 5). They were marked on the ground with blaze-orange coloured, 2 x 2 ft., plyboards nailed to posts to facilitate repeated low-level aerial strip photography along the transect lines.

Vertical stereo photography was carried out with a Hasselblad 500 EL/70 mm camera and Planar 1:2.8 f = 80 mm lens from a Piper "Apache" twin-engine aircraft flying at an altitude of approximately 1,500

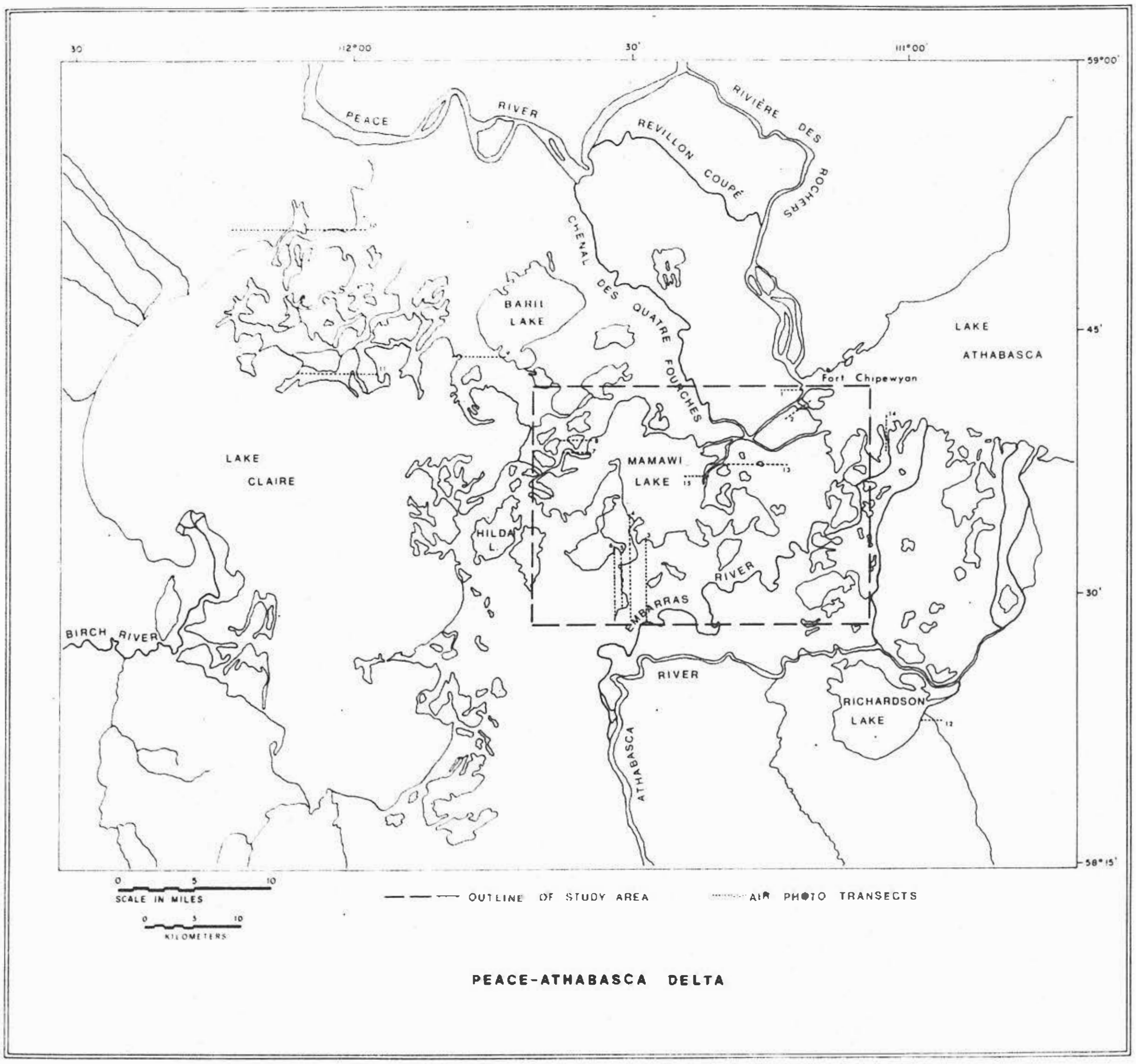


Figure 5. Study block for landscape-ecological study (sub-project 01) and location of photo transects.

feet (ca. 460 m) above mean ground level. The camera was purposely not mounted to the airplane but was hand-held with a Hasselblad double hand-grip by the operator sitting over the camera hatch in a specially installed seat. This arrangement was necessary to permit the cameraman to quickly compensate for small, rapid changes in aircraft attitude that are caused by prevalent air turbulence at this low altitude.

In order to evaluate seasonal differences in the appearance of existing plant community-types, and to monitor surface water level changes and colonization of newly exposed silt surfaces, three coverages were made in the course of the growing season:

(1) a few weeks after growth began (16-21 June),

(2) at the height of the growing season (22-24 July), and

(3) at the end of the growing season (17-19 September).

On each occasion, the transects were photographed with three types of film:

(1) Kodak Double-X Aerographic/Type 2405 (Ester Base), black and white,

(2) Kodak Ektachrome Aero/Type 8442, and

(3) Kodak Ektachrome Infrared Aero/Type 8443.

Exposed films were immediately processed at the field station by a member of the research staff (D. L. Dabbs) to ensure (1) that possible mistakes in coverage or exposure or defects in the camera equipment could be detected while the plane remained on location and (2) that the processing controls specified by the manufacturer were strictly followed in order to ensure reproducible results.

6.2.3 Ground sampling

Because of the apparent rapid colonization of exposed mudflats by fen vegetation, ground sampling was restricted to fen and mudflat communities. A total of 22 stands were sampled during August, including re-sampling of those studied in 1968 (see Dirschl 1968).

Two sampling techniques were employed: (1) a cover-class quadrat sampling system using a 1/2 m^2 quadrat. A modified Braun-Blanquet scale was used to rate ground cover:

Cover class	Range of cover (%)	Mid-point (%)
1	1-5	3
2	6-25	16
3	26-50	38
4	51-75	63
5	76-100	88
+	present but rare	

(2) A modified line-intercept technique. In selected upper-shoreline communities, where visually distinct boundaries between herbaceous communities occurred, a line transverse to the vegetation boundaries was marked with poles driven into the ground, and the position of existing boundaries was recorded. Five of these lines were established around the perimeter of Mamawi Lake.

6.3 Results

6.3.1 Large-scale strip photography

Strip mosaics of the three seasonal 70 mm black and white coverages have been constructed for several of the photo-transects as a means of facilitating accurate mapping and evaluation of seasonal and annual changes in the vegetation. Colour and infrared colour transparencies of those transects were also stereoscopically examined to provide information on density and composition of common plant communities.

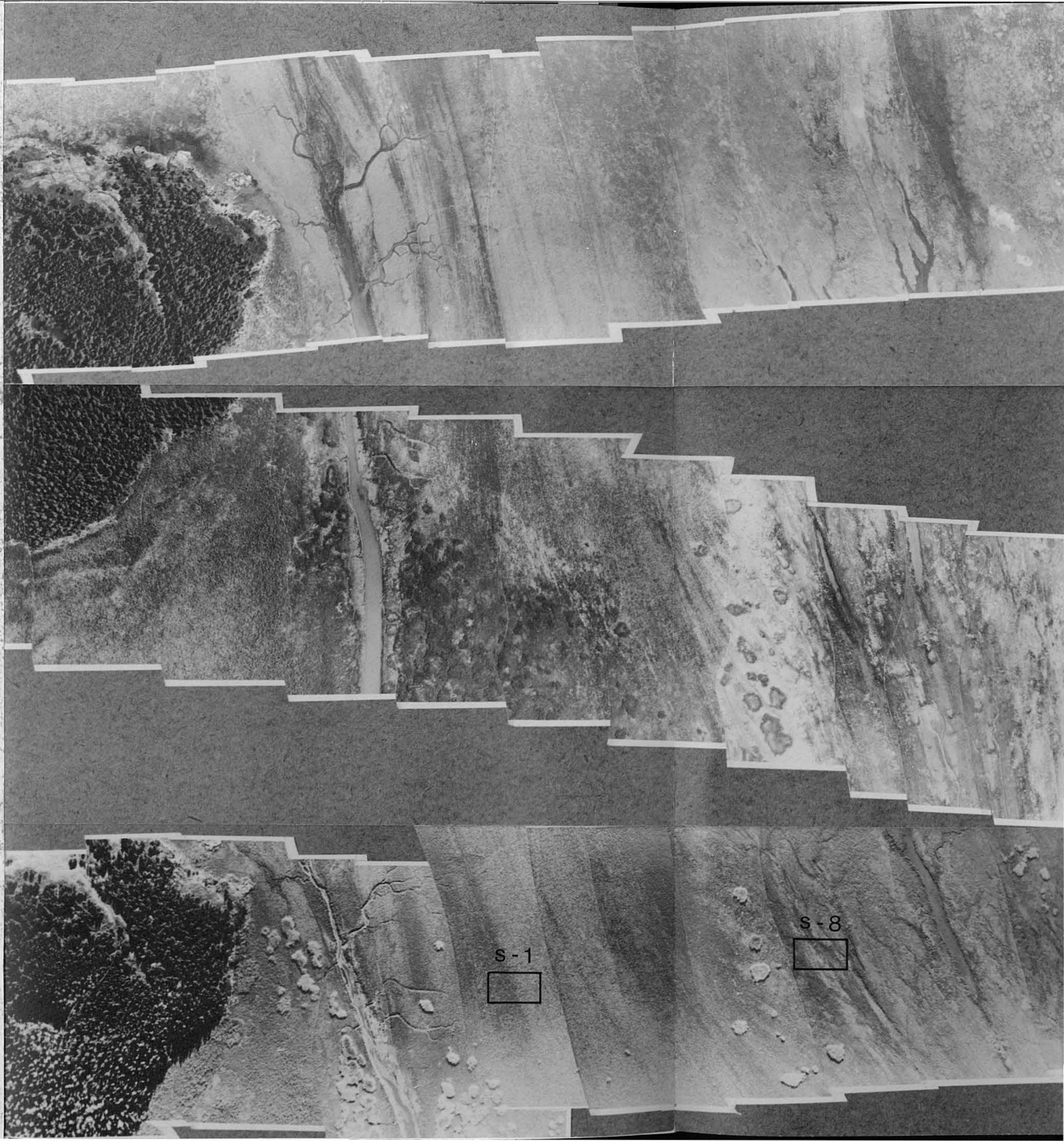
It is premature to report in detail on this aspect of the study. However, the sensitivity of the photographic method in detecting the invasion of exposed mudflats by the vegetation may be illustrated. Fig. 6a shows Transect 2 on 16 June 1969, i.e., shortly after growth of wetland vegetation began. On that date, very little of the silt surface was vegetated. Although it is difficult to detect the scattered occurrence of living plants on the black and white photos, the colour and infrared colour photos (Fig. 7) clearly show the extent of vegetative cover.

Figs. 6b and 8 were taken of the same transect on 22 July. Note how much of the open areas has become vegetated since the earlier coverage. By 19 September, the invasion has become even more obvious (Figs. 6c and 9).

Preparation of strip mosaics, corrected to a standard scale, for the remaining photo-transects is under way. By means of acetate overlays, areas differing in tone, hue, and stereo-appearance will be delineated and coded to facilitate subsequent ground checks.

6.3.2 Vegetational changes observed

The immediate results of the reduction in summer flow of the Peace River on the Peace-Athabasca Delta are illustrated by Figs. 10 and 11. In 1969, lake basins in the delta were filled by normal spring runoff and by flooding caused by ice blockage of the Embarras Channel



a

b

c

Fig. 6

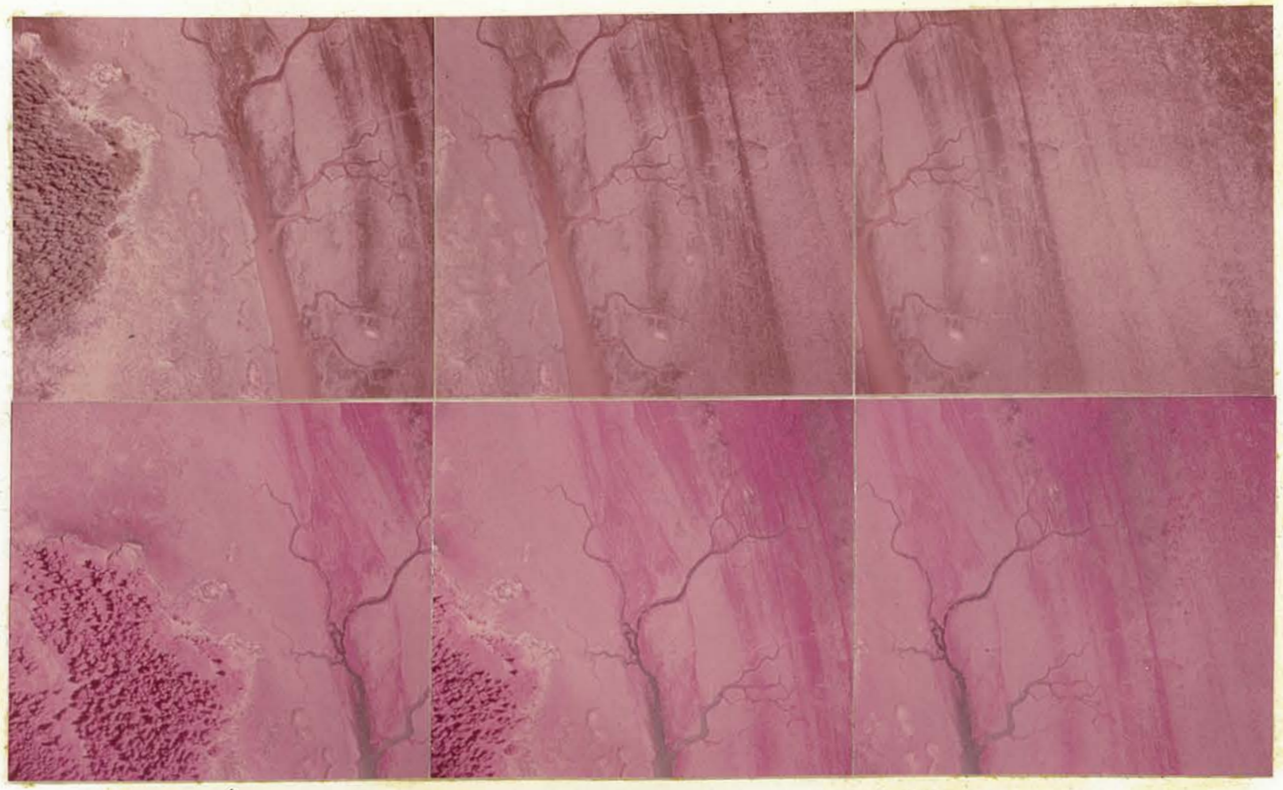


Figure 7. Stereograms of a portion of Transect 2 (see Fig. 5) taken in June 1969.
Approximate scale = 1:6,000.
Top: Ektachrome Aero Film.
Bottom: Ektachrome Infrared Aero Film.

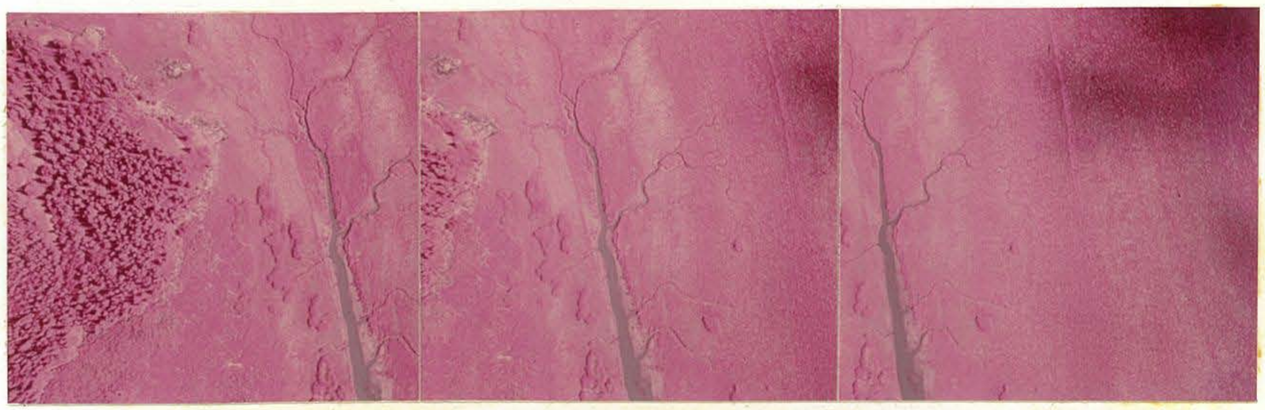


Figure 8. Infrared color stereograms of a portion of Transect 2, taken in July 1969.

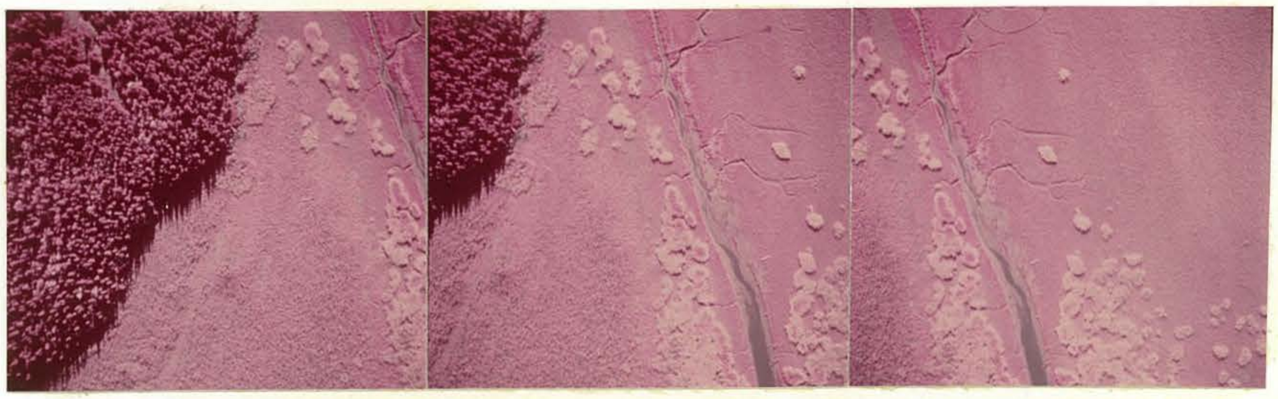


Figure 9. Infrared color stereograms of a portion of Transect 2, taken in September 1969.

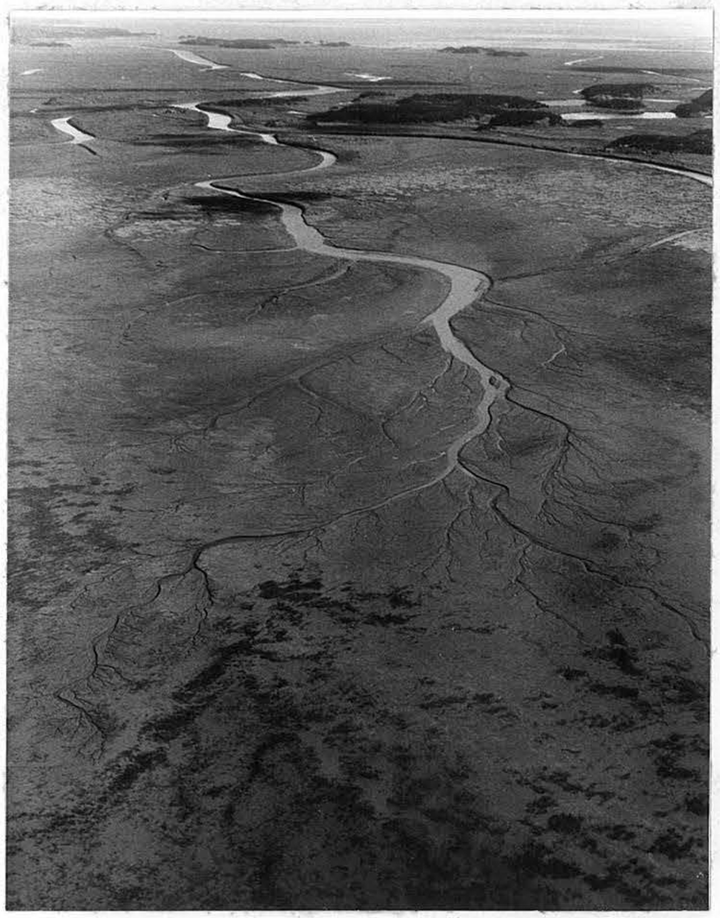


Figure 10. High oblique of northeast side of Mamawi Lake, taken in September 1969.

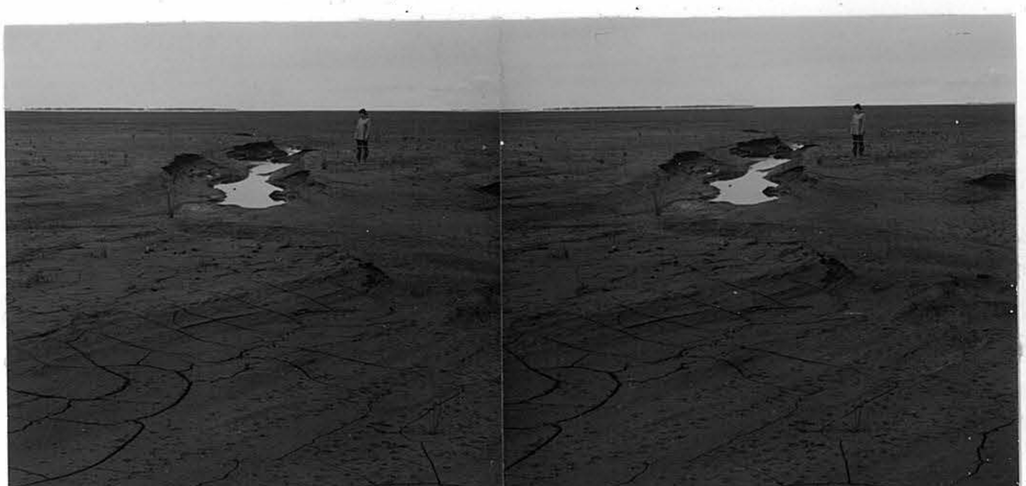


Figure 11. Ground stereogram of basin of Mamawi Lake in September 1969.

of the Athabasca River, but, through the entire growing season, water levels continued to drop in apparent synchrony with the fall in the mean level of Lake Athabasca (see sub-project 03). Silt flats which had been exposed and colonized by vegetation in 1968 were re-exposed in May 1969, and the extent of exposed surfaces continued to increase week by week (Fig. 12). The last flight over the study area on 19 September 1969 showed that in Mamawi Lake only the centre of the basin held water.

Rapid colonization of the exposed silt flats occurred. Table 2 compares the vegetative cover of five stands that were sampled in July 1968 and again in August 1969. It is evident that invasion by fen vegetation has been quick and that, in the short span of one year, a relatively complex community structure and composition has come into existence (Figs. 13-15). The sparse ground cover that characterized the stands in 1968, by August 1969 had become quite dense and continuous. On the average, the number of species tripled in the interval. Slough grass (Beckmannia syzigachne), scarce in 1968, was dominant in most of the 22 stands sampled in 1969.

The mechanism of this rapid colonization is not fully understood, but is at present under investigation through germination trials of silt sediments collected during the 1969 field season. The question to be answered is whether the seeds of the colonizing plants were flushed-in during the preceding spring or whether they had remained ~~dominant~~ dormant in the silt for a prolonged period until suitable growing conditions occurred. Knowledge of this mechanism will be of aid in predicting the vegetation adjustments that will take place in the delta.

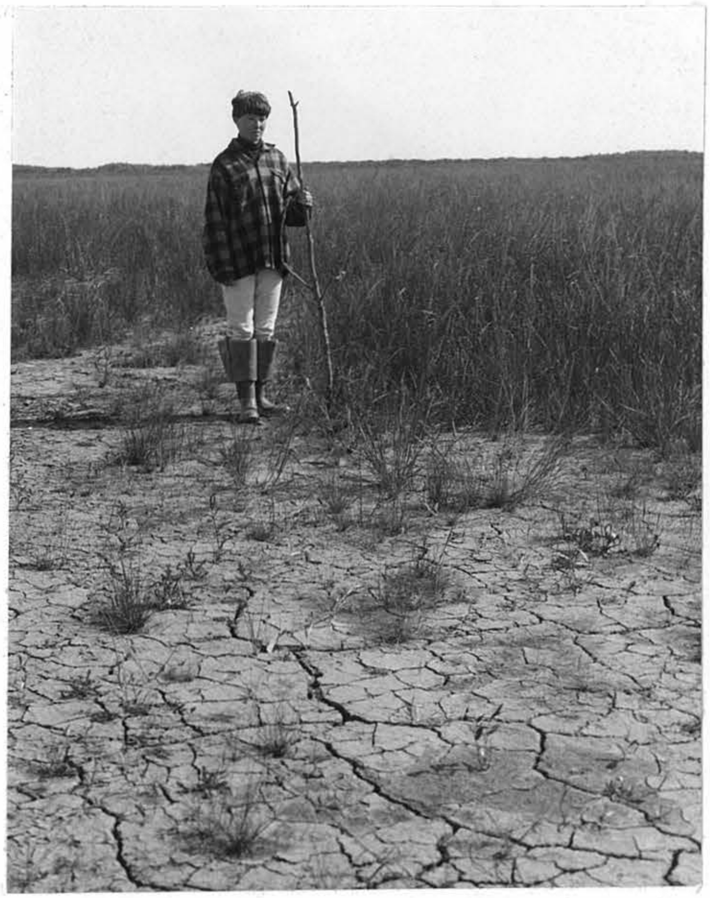


Figure 12. East shore of Mamawi Lake, showing progressive decline of water levels. Photo taken in August 1969.

Foreground. Sparsely vegetated mudflat exposed in late June 1969.

Background. Dense fen community developed on lake deposit that has been exposed since August 1968.

Table 2. Comparison of vegetative cover in 1968 and 1969 on seven exposed silt flats.

	1968			1969			
					Percent of ground covered		
Stand No.	No. of synusiae	Percent of ground covered	No. of species	No. of synusiae	1st syn.	2nd syn.	No. of species
1	1	10.5	7	2	15.7	64.0	23
2	1	36.9	7	2	57.1	52.5	19
3	1	31.5	5	1		75.5	15
4	1	4.3	5	2	11.7	34.8	18
5	1	2.2	4	Marker removed			
6	1	16.1	7	1		60.6	19
7	1	15.3		Unable to reach in 1969			

Figure 13. Views of Stand 1, southwest of Potato Island.

Top. Sparse plant cover in July 1968, soon after the lake receded.

Bottom. Dense plant cover developed by July 1969.

Figure 14. Views of Stand 3, north of English Island, showing the difference in vegetative development between the summers of 1968 (top) and 1969 (bottom).

Figure 15. Views of Stand 6 on southeast shore of Mamawi Lake, showing the difference in vegetative development between the summers of 1968 (top) and 1969 (bottom).

Unidentified willow (Salix spp.) seedlings were found in 17 of the 22 stands (Fig. 16). They ranged in height from 5 to 75 cm, and their abundance was similarly variable from stand to stand. If water levels, as expected, continue to remain low, these areas will probably, in a few years, develop into very dense willow carr communities, similar to one situated near Transect 2 that was studied for the purpose of later comparison (Fig. 17). That community was dominated by pussy willow (S. discolor), forming an almost impenetrable thicket, 3 to 4 meters tall, with a scattered understory layer of sedges (mainly Carex atherodes) and grasses (predominantly Calamagrostis inexpansa).

Previous research in the Saskatchewan River Delta (Dirschl, unpubl.) has shown that young willow seedlings are easily killed by submergence, but that well-established willow communities can withstand flooding for many years. The observed colonization of exposed silt deposits by fen vegetation, has probably occurred previously in years of low runoff but has been halted when high water levels returned. Under present circumstances, however, re-flooding of the colonized silt flats is not to be expected and, therefore, plant succession will continue unimpeded. It is, as yet, too early to predict the ultimate results of these large-scale vegetational adjustments.

6.4 Plans for 1970 field season

6.4.1 Small-scale photography

Through the Interdepartmental Committee for Air Surveys, the delta will be photographed in July at a scale of 1 inch = 1,000 feet. This coverage will be used to prepare (1) semi-controlled mosaics, (2) base maps and, after a satisfactory classification has been evolved, (3) an

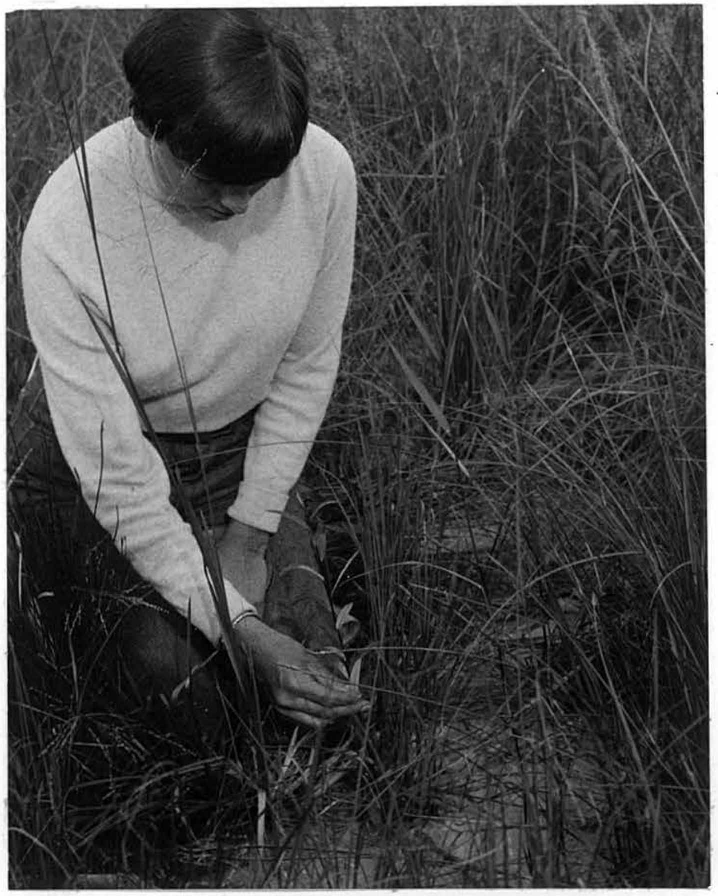


Figure 16. Willow seedlings occurred in most of the newly established fen communities.

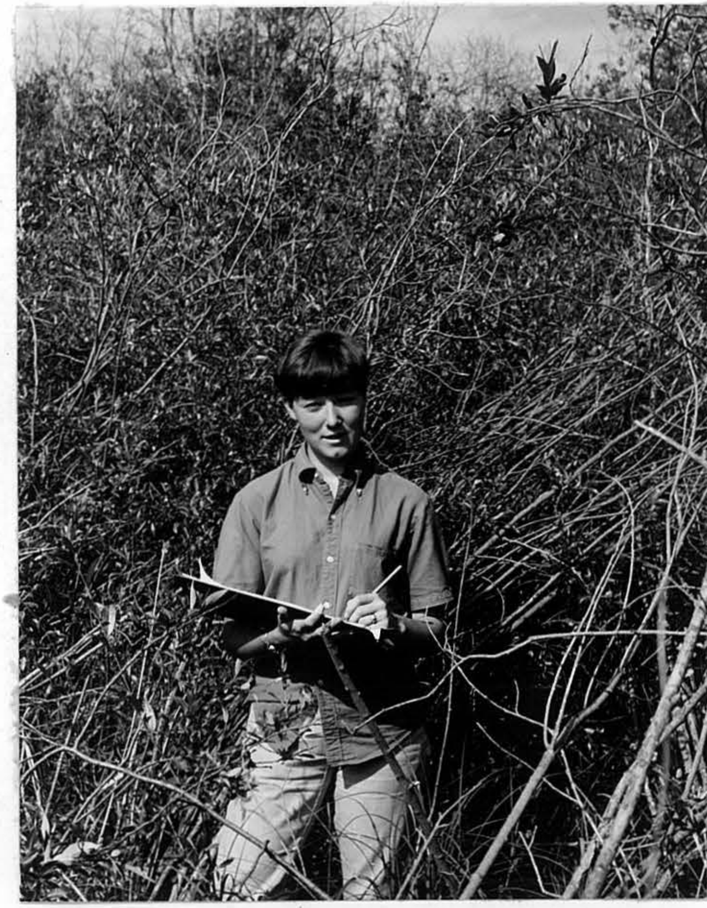


Figure 17. Willow thicket developed on an older site, similar to that of Fig. 16.

ecological map of the entire delta.

6.4.2 Large-scale photography

Air photo-sampling will be restricted from 15 to 8 transects which experience has shown to be representative of the major existing landscape features and ecological processes. Reduction in the number of transects will permit improved marking of the transect positions on the ground, and thus help to reduce the navigational difficulties encountered in attempting to fly repeatedly over the same strip of ground.

Three-film coverage will again be used, but preliminary scrutiny of 1969 data suggests that the fall coverage may not be required, at least as far as interpretation of vegetation patterns is concerned.

6.4.3 Ground study

Ground sampling of vegetation, soils, and other features of the physical environment will be of primary importance during the 1970 field season. All stands sampled in 1969 will be re-examined to obtain comparative data. Examples of vegetation units delineated on 70 mm photographs of 1969 will be visisted in the field to determine their exact vegetational structure and composition.

Intensive investigation of vegetation/environment relationships will be conducted on the following four field transects (see Fig. 5): Transects 1 and 2 on the west shore of Lake Athabasca, and transects 4 and 15 on the south and east sides of Mamawi Lake, respectively.

Initially, black and white strip mosaics of those transects will be prepared and intensive interpretation of the available three seasonal coverages and three film types will be undertaken. Areas of relatively uniform tone, colour, and stereo characteristics will be mapped on acetate overlays. Stands, representing the various recognized mapping categories will be sampled in the field. Cover ratings (see section 6.2.4) will be measured separately for the main layers of the vegetation by means of nested quadrats. Tentatively, quadrat sizes will be as follows:

1/2 m^2 for herbaceous ground vegetation,
2 m^2 for shrubs (1-3 m tall), and
8 m^2 for tall shrub and trees (> 3 m tall).

The presence of additional species, not recorded in the sampling procedure, will be noted so that complete species lists may be derived for all stands. For trees, bole diameter and height will also be determined. Increment bores will be taken from several selected trees in each stand to determine their age in an attempt to back-date the stand and place it on the time-scale of landscape development.

Measurements of ground water levels will be obtained at regular intervals along the transects. Stations to measure water table levels will be established in June by placing four-inch diameter perforated P.V.C. pipe vertically into the ground to a depth below the expected autumn water table position. Water table levels will be measured at two-week intervals in conjunction with lake water level readings (sub-project 03).

Compound soil samples will be taken at regular intervals along the transects for chemical and gravimetric moisture analysis. Moisture content, pH, and electrical conductivity will be determined at the field station. Chemical analysis will be performed at the Saskatchewan Soil Testing Laboratory at Saskatoon.

Soil pits will be dug near each of the stand pipes to examine the stratigraphy of the substrate. Depth and type of surface organic matter, profile development, presence or absence of clay or frost pans and, possibly, rooting depths will be examined. The feasibility of using C^{14} - dating of organic soil matter as a means of determining relative rate of deltaic development will be evaluated in cooperation with the Department of Soil Science at the University of Saskatchewan. If successful, this technique will allow back-dating of rates of silt deposition and successional development in the delta much farther than can be accomplished by comparing the several existing air photo coverages taken since 1927.

7. SUB-PROJECT 02: EVALUATION OF WATERFOWL USE

7.1 Specific objectives

(1) To determine distribution and size of waterfowl spring and fall populations;

(2) To determine habitat preferences of breeding populations of abundant species with respect to:

(a) distribution of breeding pairs,

(b) use of nesting habitat, and

(c) brood distribution;

(3) To evaluate use of the area for moulting; and

(4) To evaluate the effects of the water regime changes on the features of the waterfowl habitat.

7.2 Selection of study areas

Because the large size of the Peace-Athabasca Delta creates transportation and other logistical problems not found in more accessible wetlands, the adopted approach was to select several representative study blocks for detailed field work.

The selected study blocks (Fig. 18) contain examples of large and small lakes, rivers, streams and potholes, the predominant shoreline types and the immediately adjacent higher ground. Island complexes and peninsulas were also included.

7.3 Waterfowl spring census

7.3.1 Method

Field work began on 5 May 1969, when most water bodies (except Lake Athabasca and Lake Claire) were already ice-free. Only small numbers of waterfowl were present on that date but, within the next several days, a marked ingress of birds occurred.

Two aerial counts were conducted on 8-10 May and on 14-16 May to determine the spring distribution and population size of the abundant species. Twenty-three evenly spaced line-transects within the three study blocks were censused by a single observer in a Champion Citabria aircraft at an altitude of 50-100 feet (17-34 m) above ground level at an approximate air speed of 60 mph (96 km/hr). All waterfowl within 400 yards (366 m) from the right side of the aircraft were counted and, as much as possible, identified to species. The parallel transects varied in length but consistently were one mile (1.6 km) apart.

7.3.2 Results

The geographic distribution of waterfowl was closely similar for both counts, but total numbers tripled in the interval (Table 3). A pronounced change in species composition also occurred in the interval

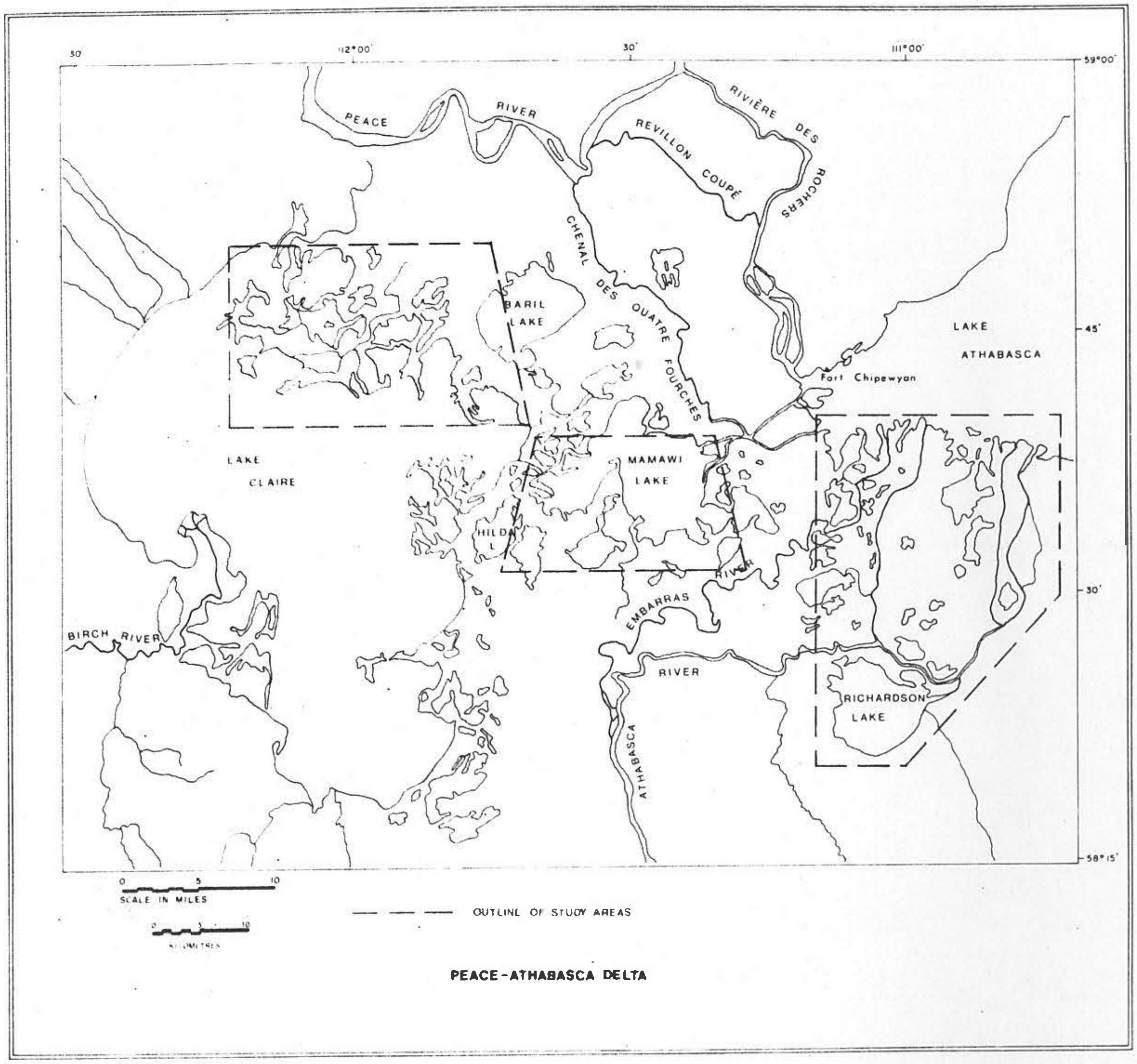


Figure 18. Study blocks used in 1969 for waterfowl investigations.

Table 3. Species composition and distribution during the spring waterfowl census - 1969. (Census 1: 8-10 May; Census 2: 14-16 May.)

	Transects 1-6 (Lake Claire)		Transects 7-11 (Hilda-Welstead)		Transects 12-23 (Athabasca Delta area)		Species Totals	
Species	C1	C2	C1	C2	C1	C2	C1	C2
Canada Goose	90	613	0	115	114	2,395	204	3,123
Snow Goose	85	2,721	0	0	0	25	85	2,746
Whistling Swan	0	16	0	20	346	224	346	260
Ruddy Duck	0	2	0	24	5	20	5	46
Dabblers								
Mallard	120	90	91	57	151	145	362	292
Pintail	13	115	101	108	332	328	446	551
Widgeon	15	63	69	46	219	157	303	266
Blue-winged Teal	2	23	17	44	27	78	46	145
Shoveler	18	15	33	35	42	29	93	79
Gadwall	17	14	0	21	2	44	19	79
Green-winged Teal	0	0	0	0	3	0	3	0
Divers								
Lesser Scaup	151	165	81	274	392	452	624	891
Canvasback	4	88	21	35	155	152	180	275
Ring-necked	17	60	34	63	23	69	74	192
Goldeneye	20	38	29	24	85	92	134	154
Redhead	29	9	17	58	43	35	89	102
Bufflehead	7	16	14	15	23	28	44	59
White-winged Scoter	0	2	0	2	0	0	0	4
Total	588	4,050	507	941	1,962	4,273	3,057	9,264
Birds/mile	6.4	44.5	5.0	9.2	8.4	18.3	6.9	20.7

between the two counts. In particular, large numbers of migrant geese and swans were present during the second census. Lesser Scaup, Pintail, Mallard, American Widgeon, and Canvasback were the predominant ducks in both counts. Ducks seemed to prefer smaller lakes and ponds, whereas geese and swans were present in large open bodies of water.

Areas of high spring population densities were:

(a) The recent delta deposits of the Athabasca River between Richardson Lake and Lake Athabasca, especially the area immediately south of the latter, and

(b) the extensive marsh area on the north end of Lake Claire.

Further study throughout the remainder of the reproductive and post-reproductive period showed that the number of the predominant species of waterfowl remained essentially unchanged. However, the distribution of the birds on the delta in the breeding and post-breeding seasons showed little correlation with the pre-breeding spring concentrations.

7.4 Breeding pair census

7.4.1 Methods and procedure

The distribution of breeding pairs in relation to habitat types was determined by three closely spaced aerial counts on 28-29 May, 30-31 May, and 1-2 June with a Champion Citabria aircraft at approximately 60 mph (96 km/hr) and an altitude of 100 feet (34 m) above ground level. All birds between the aircraft and the shore - about 400 yards (366 m) distant - were counted and identified.

The census was undertaken on 64 representative habitat units, one mile (1.6 km) in length, previously marked with coloured plastic tape by means of an airboat. The counts were made from 0800 to 1000 hours, and from 1600 to 1800 hours, periods when waterfowl are believed most visible during feeding (Bennett 1938).

In the data tabulation, all pairs, all lone drakes, and groups of less than five drakes were considered indicative of dabbler pairs. Lone hens were omitted since their drakes were probably already counted as pairs, and groups of drakes over five are most likely non-breeders in the area (Dzubin 1967).

With respect to divers, "indicated pairs" were derived from observed pairs plus lone hens associated with two drakes. "Non-paired birds" were lone drakes, groups of drakes, one of the males from each heterogeneous group consisting of two drakes and one hen, and any larger heterogeneous group (Goodman 1967).

7.4.2 Results

The breeding pair counts are believed to have been reasonably accurate because of the tendency of the drakes to display, the sparse cover, and the scattered distribution of the birds. The counts are assumed to give a reliable indication of breeding pairs present since by this procedure relatively few birds are duplicated or deleted by movements of pairs between different water areas.

Table 4 indicates the presence of 14 species of ducks breeding in the area in spring 1969. Although Canada Geese nested on the delta, none were encountered in the breeding pair census.

The predominant nesting species on the Peace-Athabasca Delta in 1969 were the four dabblers, Mallard, Pintail, American Widgeon, and Shoveler, followed by the divers, Lesser Scaup and Canvasback. The

Table 4. Results of waterfowl breeding pair census on 64 one-mile long shoreline segments.

Species	Total	Mean	May 28,29	May 30,31	June 1,2
Mallard	298	99	64	100	134
Pintail	143	48	47	54	42
Widgeon	114	38	42	38	34
Shoveler	94	31	17	21	56
Lesser scaup	78	26	35	29	14
Canvasback	56	19	28	10	18
Blue-winged Teal	43	14	7	24	12
Ring-necked	40	13	21	11	8
Goldeneye	40	13	13	21	6
Gadwall	20	7	8	4	8
Redhead	17	6	5	7	5
Bufflehead	6	2	1	4	1
Ruddy	3	1	1	1	1
Green-winged Teal	2	1	0	1	1
Total		318	289	325	340

progressive increase in the breeding pair totals for the three replicate counts is mainly accounted for by ingress of Mallard pairs.

Assuming the 30-31 May census to be the peak of the breeding season for the majority of waterfowl on the delta, the average breeding density over the 64 one-mile habitat segments was approximately five breeding pairs per mile. Relatively high breeding concentrations were observed in association with the following habitat types:

(1) *Phragmites* in shallow water backed by *Carex* and *Calamagrostis* meadows (39.0 pairs/mile).

(2) Emergents in shallow water, shoreline of emergent *Carex* grading into dense *Calamagrostis* meadows (16.5 pairs/mile).

(3) Shallow creeks with abundant emergent vegetation. Shoreline of coniferous or deciduous forest (20 pairs/mile).

Low breeding pair concentrations were observed in association with beach ramparts (0.5 pair/mile), deep channels lacking emergent vegetation (1.0 pair/mile), and exposed shorelines of large lakes such as Lake Claire and Mamawi Lake (1.5 pairs/mile).

It thus appeared that breeding ducks were essentially attracted to shallow marshy habitats and thus to locations which because of rapidly falling water levels later in the season became unsuitable for nesting and brood-rearing.

7.5 Nest search

To determine nesting habitat preferences of the major species, nest searches were conducted on foot over representative areas of various habitat types by two observers walking 10 paces (6 m) apart, and creating additional noise-disturbance with tin cans and sticks.

Segments searched included 100 yards (92 m) of shoreline and extended 400 yards (366 m) inland from the water's edge. Bennett (1938) has shown that 95 percent of nests are located within 220 yards of the shoreline.

Thirty-four segments, representing a total area of 1,360,000 square yards (1,137,100 m^2) of possible nesting habitat were searched in this manner, but only three nests were discovered. This poor success was undoubtedly due to the scattered distribution of breeding pairs in this vast marsh complex. It was, therefore, decided to rely entirely on brood observations for information on nesting chronology and, hopefully, through observations of very young (Class Ia) broods, on relative use of various habitats for nesting.

7.6 Nesting chronology

Brood observations (see section 7.7.1 for procedure) were used to determine nesting chronology on the delta. Hatching and nest initiation features of the nesting cycle were examined by means of the brood-back-dating method of Gollop and Marshall (1954).

The initiation - hatch curves presented for Mallard and Canvasback (Fig. 19) are based on back-dating of all Class I broods sighted during census. To facilitate comparisons, the combined egg laying and incubation period was assumed to equal 35 days (Townsend 1966).

These weekly interval curves are only estimates and are subject to some bias in that they represent successful nests only and not initiation of all nests. This bias could be sufficient to alter the position of the peaks somewhat due to the small sample size and nest failure or high early brood mortality resulting from rapidly declining

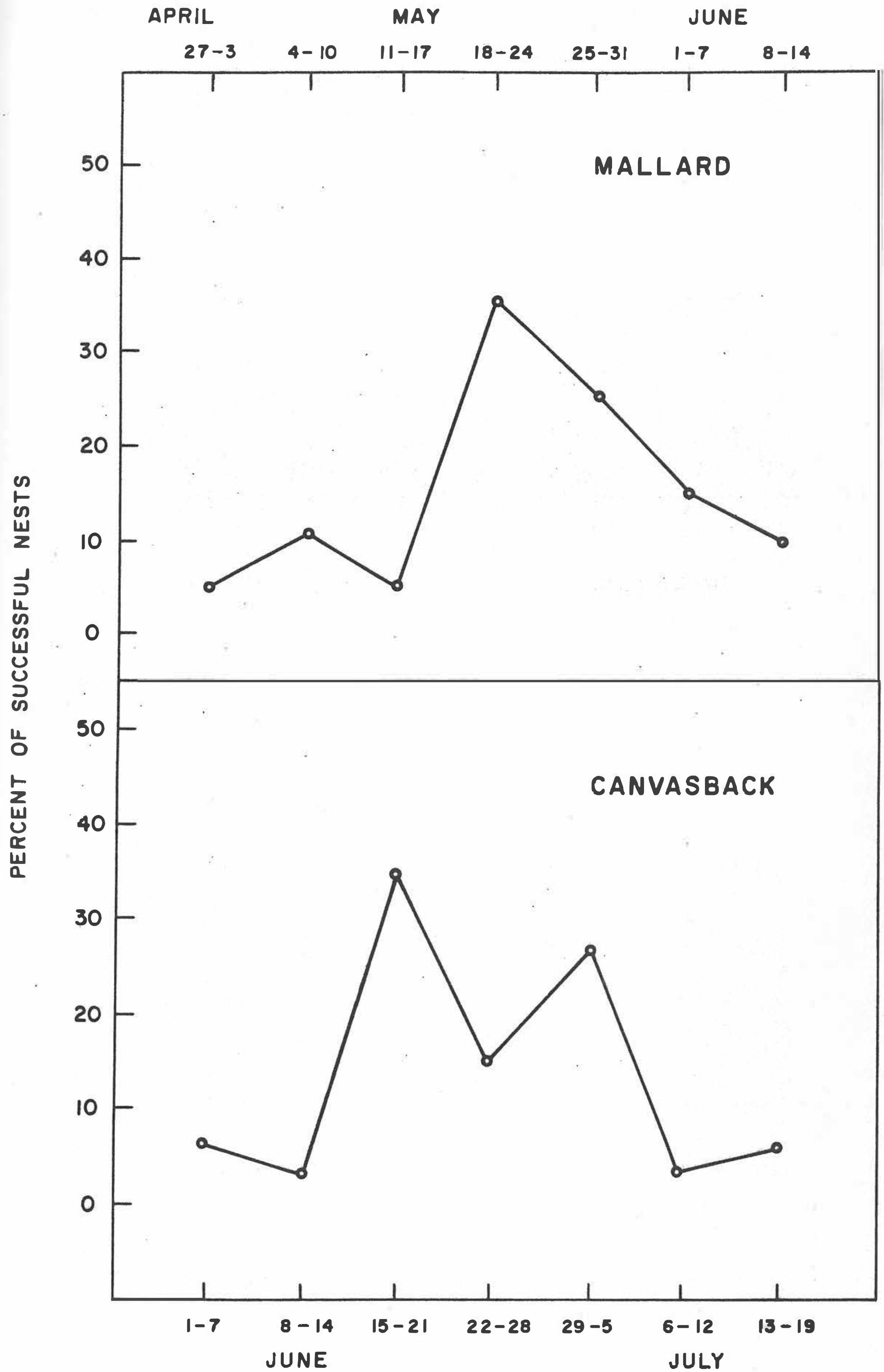


Figure 19. Nest initiation-hatching curves for Mallard and Canvasback ducks in the Peace-Athabasca Delta, 1969.

water levels.

The graphs indicate that peak hatching, for successful Canvasback and Mallard nests, occurred approximately during the third and fourth weeks of June 1969, respectively. The peaks in nest initiation were 11-17 May for Canvasback and 18-24 May for Mallard. There was no appreciable amount of renesting activity evident for Mallard. Canvasback, however, showed an apparent renesting activity peak during the last week of May. This suggests that much of the nesting activity that began early in the season was unsuccessful. Although it was not possible to continue replicate brood counts into August owing to low water levels, it is entirely possible that this could have revealed a renesting peak for Mallard as well.

The peak in nest initiation (18-24 May) for Mallard corresponds closely to the sex ratio changes observed for this species during the breeding pair census. This effect appears less pronounced for Canvasback.

Evaluation of clutch size, nesting success, and nest habitat was, of course, impossible with the small number (3) of nests found. The poor nest construction, small clutch size (2, 4, 6), and lateness of the season (3-6 June) seems to indicate that the three nests discovered were renesting attempts.

7.7 Brood distribution and brood habitat preferences

Brood distribution in relation to habitat types was evaluated by census conducted from an airboat. Habitat types similar to those used in the breeding pair census and nest search were censused in 129 one-mile segments representative of various habitat types.

7.7.1 Procedure

The airboat was driven approximately 100 yards (92 m) from, and parallel to, the shoreline and an observer recorded broods seen on magnetic recording tape. Ducklings were identified as to species, and the size and age class of the broods was recorded. Females that succeeded in hiding all but one or two of their brood, and apparently unaccompanied hens that exhibited maternal behaviour were tallied as maternal ducks and later assigned the average number of young as determined by averaging the brood counts. Brood identification by age class was carried out by means of Gollop and Marshall's (1954) plumage method.

Four replicate counts were made of each habitat segment to determine the degree of brood movement, and to record early, intermediate, and late hatches. Repeated census also aided in determining mean brood size per age class since realized production of waterfowl depends on the number of young surviving to the flight stage (Goodman 1967).

The four counts were taken: (1) on 3-7 July, (2) on 8-11 July, (3) on 17-18 July, and (4) on 30 July-1 August. Greatly reduced water levels prevented further replicate counts.

7.7.2 Results

In the first count (3-7 July) of 129 miles of shoreline censused, only 20 supported broods, conforming to the results of the breeding pair counts and the nest searching, all of which indicated that 1969 was a year of very low waterfowl production in the Peace-Athabasca Delta.

A total of 45 broods were observed and identified for an average of 0.36 broods per mile. In the 20 one-mile segments that had broods, there was an average of 2.3 broods per mile. Most observed broods belonged to Age Class I.

The final brood count (30 July-1 August) involved census of 129 miles of shoreline, 18 of which supported broods. A total of 46 broods were observed and identified, giving an average of 0.35 broods per mile. In the 18 one-mile segments that held broods, the average was 2.5 broods per mile. Average brood size was 5.6 ducklings, most in age classes II and III.

The majority of the broods on the delta in 1969 were of four species, Mallard, Canvasback, American Goldeneye, and Lesser Scaup. Table 5 gives the calculated number of broods per mile, and the mean brood size, for all habitat segments censused. Expected broods per mile was calculated by multiplying the mean number of indicated pairs of a species per mile by the percentage nesting success of that species (Townsend 1966).

Table 5. Brood size and concentration per mile (means).

Species	Total number broods	Observed per mile	Expected per mile	Brood size 3 July	Brood size 1 Aug	Brood size Mean
Mallard	14	0.13	0.87	7.0	5.8	6.3
Canvasback	11	0.10	0.10	4.0	3.7	3.9
Goldeneye	9	0.08	0.22	6.8	2.0	4.4
Lesser Scaup	7	0.06	0.03	5.5	4.4	4.9
Average	10.2	0.09	0.30	5.8	3.9	4.8

The observed number of Mallard and American Goldeneye broods, when compared to the expected brood production is low, whereas Canvasback and Lesser Scaup broods observed agree well with the expected number.

Habitat types associated with the highest brood concentrations were as follows:

(a) Segment 4: deep narrow creek, connecting large, shallow marsh to Lake Mamawi. Shoreline of dense, mature, tall *Calamagrostis* with scattered clumps of medium *Salix*. No emergent or submergent aquatics.

(b) Segments 100-101, 124-125: deep wide river channel bordered by shoreline of *Carex* and heavy dense stands of *Phragmites communis* on one side, tall, dense *Salix* on the opposite shore. Few emergent or submergent aquatics.

(c) Segments 106-110, 119-120: protected bays on Richardson Lake. Shoreline of *Carex* meadows with scattered, low *Salix*. Emergents (*Phragmites*, *Scirpus*) and submergents relatively dense.

(d) Segments 89-97: very shallow protected lake, extremely dense emergent, and submergent aquatics. Shoreline of mud-bars with vegetation composed of *Carex* and low to medium *Salix*.

Table 6 compares the observed number of Mallard, Canvasback, and American Goldeneye broods with the expected number of broods for corresponding habitat segments (Goodman 1967). It is apparent that the observed number of broods in segments 4, 100-101, and 124-125 is considerably greater than the number expected according to breeding pair abundances and percent nesting success. This strongly suggests brood movement by the three species to these permanent, deep creek and river channels.

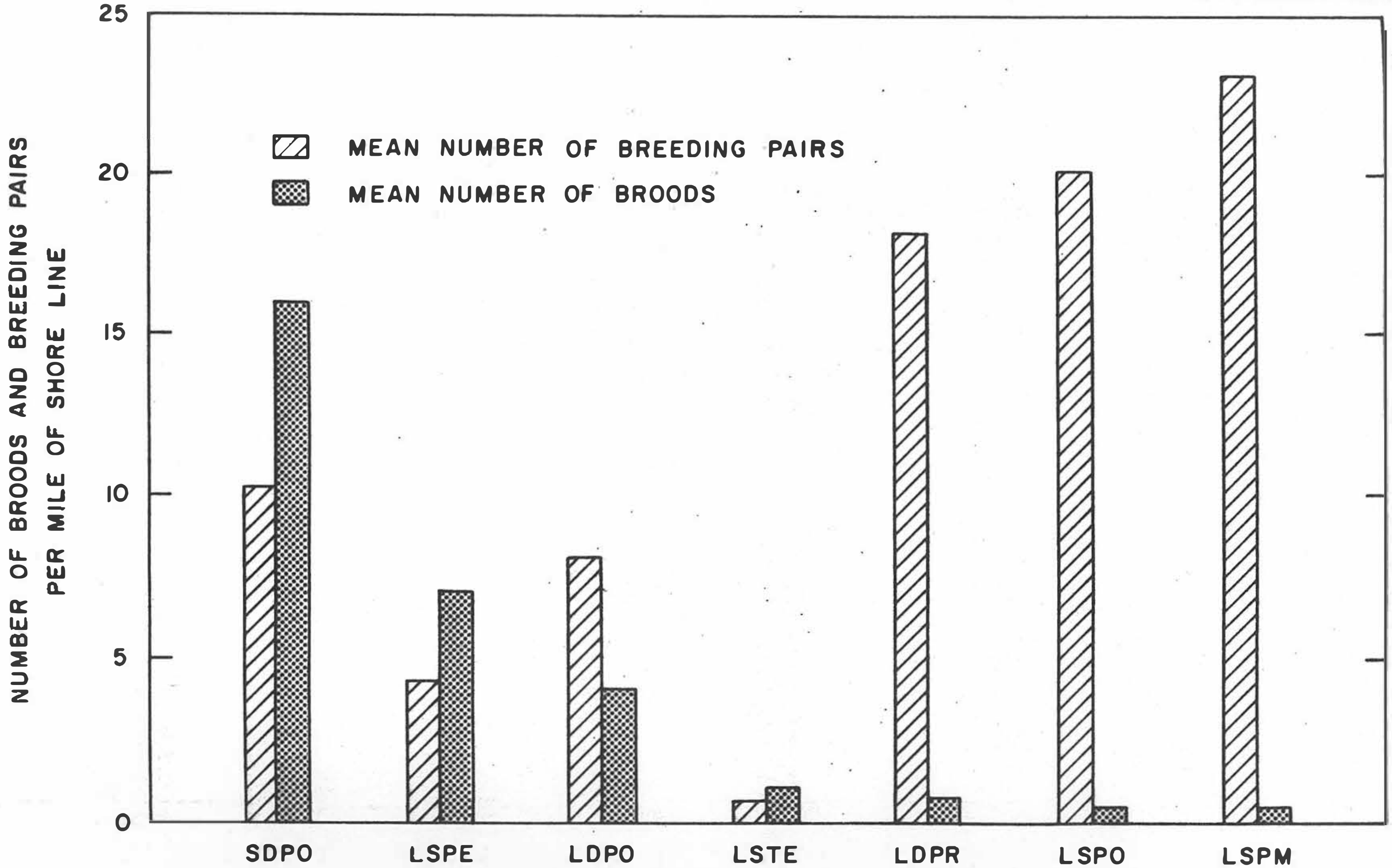
Conversely, the figures for segments 119-120, 89-97, and 106-110 suggest brood movement away from these shallow water bodies to more optimal rearing habitat. It must be noted, however, that these segments still show relatively high brood use compared to other areas

Table 6. Comparison of observed Mallard, Canvasback, and American Goldeneye broods.

	Broods			
Segment	Observed number	Observed per mile	Expected per mile	Observed: expected
4	5	5	0.56	8.8:1
100-101	10	5	0.76	6.5:1
124-125	6	3	0.76	3.9:1
119-120	4	2	3.4	0.58:1
89-97	8	1	1.7	0.58:1
106-110	5	1	11.2	0.08:1

on the delta. Presence of dense stands of emergent and submergent aquatics providing good cover for the broods, and open shorelines attractive as waiting and resting sites may have served to retain broods in spite of very low water levels.

The distribution of broods and breeding pairs in 1969 in relation to the main water body types on the delta is presented in Fig. 20. The apparent inverse relationship between breeding pair and brood usage mainly reflects differences in water levels and in abundance of emergent cover.



SDPO - stream or river, water deep and permanent, aquatic vegetation sparse.
LSPE - lake, shallow but permanent. Dense emergent, submergent cover.
LDPO - lake, deep and permanent. Emergent and submergent aquatics sparse.
LSTE - lake, shallow and temporary. Dense submergent and emergent cover.
LDPR - lake, deep and permanent, but turbid and rough.
LSPO - lake, shallow but permanent. No emergent cover.
LSPM - lake, shallow and permanent, forming extensive mudflats at peripheries late in brood season. No emergent cover.

Figure 20. Brood and breeding pair distribution in relation to water depth and cover, Peace-Athabasca Delta, 1969.

Unprotected water bodies, lacking emergent cover receive high breeding pair utilization (LDPR, LSPO, LSPM) but few broods remained associated with them. Lakes that remained uniformly shallow (4-8 inches = 10-20 cm deep) throughout the brood rearing season were well utilized by ducklings if emergent cover was present (LSPE). Since brood concentrations exceeded those expected according to the breeding pair census, movement of broods to those areas presumably occurred. Brood movement to deep, permanent streams and rivers is also evident from Fig. 20. Despite the absence of emergent cover, channels receive the highest utilization by broods, particularly late in the season.

7.8 Moulting areas

7.8.1 Procedure

The location of major moulting areas and the size and species composition of moulting flocks was determined through aerial reconnaissance from 20 to 24 July 1969.

Moulting waterfowl were counted on 20 miles (32 km) of stream habitat and on 69 lakes, bays, and potholes. The census was carried out by means of a Champion Citabria aircraft flown parallel to, and 400 yards (366 m) from, the shoreline at an altitude of 150 feet (46 m) and at an airspeed of 60 mph (96 km/hr). The entire shoreline of lakes was censused. Numbers and species composition of moulting flocks was determined and recorded on magnetic tape.

7.8.2 Population sizes

A total of 39,600 moulting waterfowl were identified, giving an average of 41.5 ducks and geese per mile (26 per km) of shoreline on the 41 lakes with known shoreline lengths.

Areas of high moulting waterfowl concentration were Welstead Lake (6,060), Lake B-4 (5,600), Hilda Lake (5,500), Sonny's Lake (2,700), Otter Lake (2,200), Blanche Lake (1,500), Lake B-21 (1,300), and Lake B-8 (1,250).

Most of the moulting areas (Welstead, B-4, Hilda, and Otter lakes) were located along the east shore of Lake Claire north to Hilda and Mamawi lakes, and south to Welstead Lake. Moulting waterfowl north of Lake Claire were concentrated on Lake B-21. The main moulting areas on the Athabasca River Delta were Blanche and B-8 lakes.

7.8.3 Species composition and habitat features

Table 7 presents the numerically dominant species on some of the major moulting lakes in order to illustrate species preferences for

Table 7. Predominant species on major moulting areas.

Moulting area	Total water-fowl	Pre-dominant species	Number	Percent of total
Welstead Lake	6,050	Pintail	1,700	28.0
Lake B-4	5,540	Widgeon	885	15.9
Hilda Lake	5,040	Mallard	1,600	31.7
Sonny's Lake	2,740	Shoveler	660	24.0
Blanche Lake	1,470	Lesser Scaup	740	50.3
Blanche Lake	1,470	Ring-necked	160	10.8
Lake A-82	360	Canvasback	170	47.2

certain areas on the delta.

Marked preference of most species for certain moulting areas on the delta is apparent.

Welstead Lake, Lake B-4, and Hilda Lake contained moulting flocks in which Pintail, American Widgeon and Mallard predominated. Hilda Lake which, in addition, had a high density of Shovelers, differs from the other two water bodies in having a rather heterogenous shoreline of low willows, Carex and Calamagrostis, and an abundance of submergent aquatics and emergent Carex and Typha. Welstead Lake and Lake B-4, on the other hand, have very open shorelines of mud-bars with sparse growth of Senecio and Carex. The water appeared clear with very little submergent gorwth and lacked emergent cover. All three lakes were relatively deep.

Sonny's Lake, which receives the highest Shoveler use of any water body on the delta, is a fairly deep, turbid lake with a shoreline of Carex, Calamagrostis, and flooded dead Salix. Only small stands of emergent vegetation occur, but submergent growth is fairly dense over a large part of the lake.

Blanche Lake received high diver use; the majority of the moulting waterfowl consisted of Lesser Scaup and Ring-necked Ducks. Of moderate depth, Blanche Lake has dense stands of emergent cover of Phragmites communis and Typha latifolia and adjacent Carex and Salix fens. Submergent vegetation is present in the bays and inlets of the lake.

Canvasback were most numerous on Lake A-82, where they comprised 47 percent of all moulting waterfowl observed. A-82 is deeper than most other lakes in the delta and is open, rough, and turbid. There is abundant submergent aquatic growth, but the lake is essentially void of emergent vegetation.

It appears, therefore, that moulting dabbling ducks prefer shallow, protected water bodies, whereas divers are attracted to deeper water containing an abundance of submerged aquatic vegetation. Isolation from human disturbance may also be important in the choice of particular moulting lakes, since very few moulters were present on lakes in the vicinity of the navigable channels of the Athabasca River along which several Indian settlements are located.

The requisite for isolation during moulting is also believed to be reflected in the distribution of Canada Geese which were observed moulting only on the east and west shores of Lake Claire, Blanche Lake, and B-3 and B-4 lakes. Ninety-two geese (13 adults and 79 goslings) were banded by a joint Canadian Wildlife Service-Ducks Unlimited team on 16 July 1969 on the west shore of Lake Claire. On the basis of colour and measurements, these birds are believed to be Giant Canada Geese (Branta canadensis maxima) or an, as yet, undescribed race of large Canada Geese (A. Dzubin, pers. comm.).

The large concentration of moulting ducks that utilized the delta in comparison to the small breeding population, and the observed influx of Mallard and Pintail drakes in full breeding plumage between mid-May and early June (i.e., while the resident birds were still engaged in breeding activities) suggests that the Peace-Athabasca Delta is an important moulting area for post-breeding drakes from more southerly marshes and the prairie pothole region.

7.9 Waterfowl fall census

Aerial census of fall populations was carried out from 8 to 12 September to determine population levels, species composition, and relative use of major habitat types. Fig. 21 illustrates the shoreline habitat censused. Owing to the extremely low water levels at that time, length of the shorelines could not be determined with reasonable accuracy from existing maps and, therefore, waterfowl numbers per mile could not be computed.

Observed species composition is given in Table 7. Eighteen species of waterfowl were recorded, five of which (Mallard, Shoveler, American Widgeon, Canada Goose, and Pintail) comprised over 78 percent of identified individuals. More than 143,600 birds were observed.

Table 8 lists the water areas censused which harboured more than 1,000 waterfowl. Hilda Lake, Lake B-4, Welstead Lake, Lake B-21, and Blanche Lake had populations of the same order as during the moulting season. In all portions of the delta, the birds were distributed on rather large, open lakes with gravel or mud shorelines. Harassment by hunters is believed to have been inconsequential in causing this distributional preference.

Lake Claire received high fall use when compared to the corresponding breeding and moulting populations. The majority of the birds were concentrated in the large bays and lakes of the north shore (1,550) and the west shore in the vicinity of the Birch River Delta (5,890). Large numbers of ducks, and the majority of the geese, were associated with the south shore of Lake Athabasca from the Chenal des Quatre Fourches to Old Fort Point. More than 27,000 waterfowl were observed in this area which had supported very low populations during

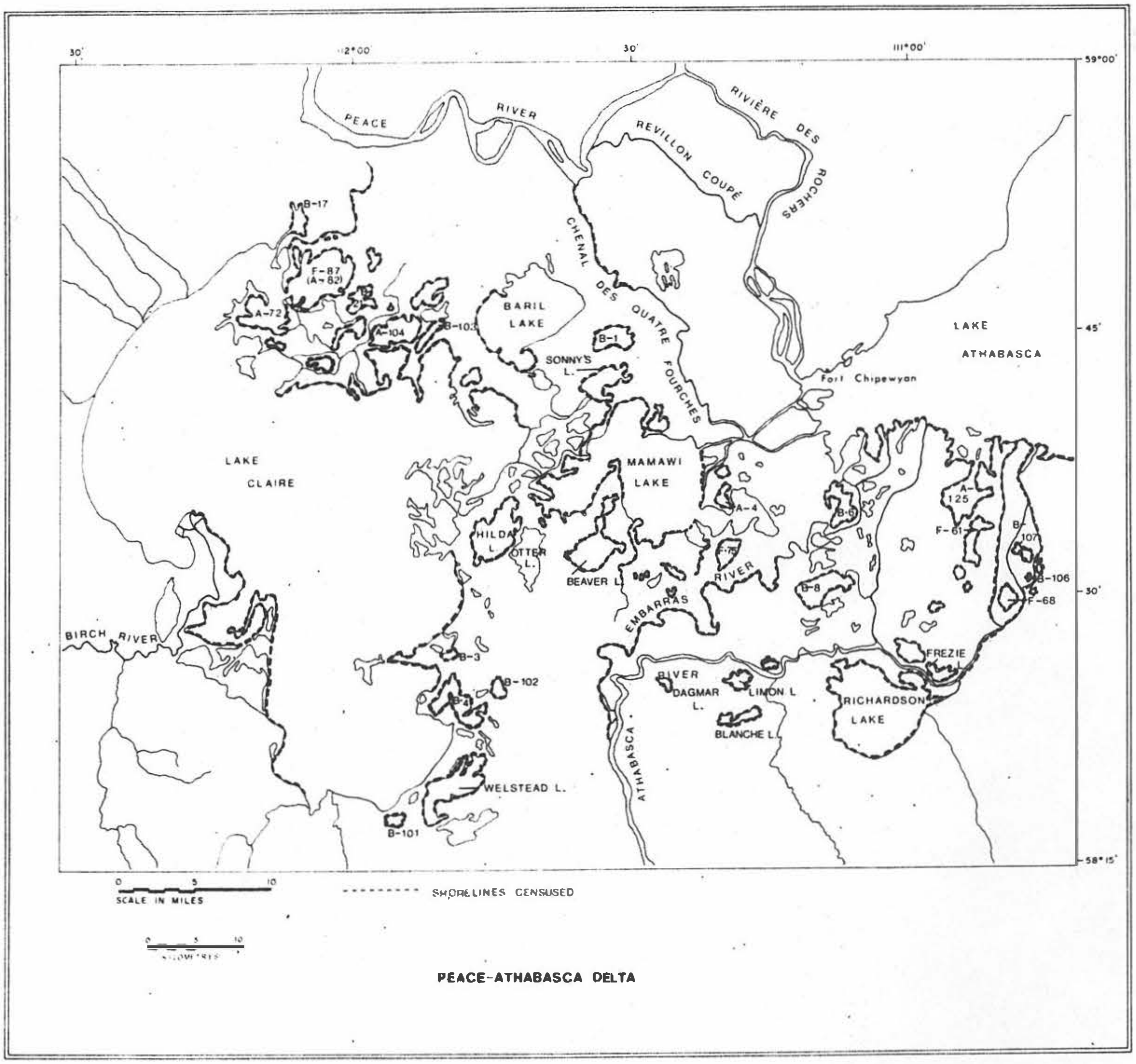


Figure 21. Shorelines censused in waterfowl census, 1969.

Table 7. Species composition of fall waterfowl populations, Peace-Athabasca Delta, 1969.

Species	Number	Species	Number
Mallard	25,400	Ring-necked Duck	2,200
Shoveler	20,600	Blue-winged Teal	1,550
Widgeon	19,800	Snow Goose (incl. Ross' Goose)	1,100
Canada Goose	19,000	Goldeneye	170
Pintail	15,700	Redhead	115
Lesser Scaup	7,450	Ruddy Duck	25
Gadwall	5,800	Swan	11
Green-winged Teal	4,000	Bufflehead	7
Canvasback	2,350		
White-fronted Goose	2,300	Unidentified	15,700
		Total	143,600

Table 8. Waterfowl fall population size associated with major water bodies, Peace-Athabasca Delta, 1969.

Water area	Number	Water area	Number
Lake Athabasca	27,000	Lake A-4	2,070
Lake Claire	24,200	Lake F-68	1,970
Hilda Lake	10,400	Lake B-103	1,970
Lake A-125	8,400	Lake F-87	1,810
Lake B-4	8,300	Frezie Lake	1,750
Welstead Lake	7,300	Lake B-106	1,720
Richardson Lake	6,850	Lake B-101	1,580
Lake B-6	4,400	Lake B-17	1,400
Lake B-21	3,300	Lake A-72	1,350
Lake F-61	3,250	Lake B-102	1,300
Lake B-1	2,750	Lake A-104	1,270
Blanche Lake	2,550	Lake F-75	1,200
Dagmar Lake	2,350	Lake B-107	1,200
Beaver Lake	2,200	Mamawi Lake	1,200

the breeding and moulting seasons.

It is unfortunate that it was not possible to continue the fall census after 12 September since it is believed that the fall migration through the delta had not yet reached its peak. This was particularly evident for White-fronted, Lesser Snow, and Ross' geese which were poorly represented in the count.

7.10 Plans for the 1970 field season

7.10.1 Section of study areas

Several changes are planned in the selection of study areas for concentrated data collection during the 1970 field season. Areas for aerial surveys of spring, moulting, and fall populations will be essentially the same as last season.

Breeding biology data will be collected on the same habitat types as in 1969, but on somewhat different areas. An effort will be made to select study blocks which will remain accessible throughout the breeding season in spite of the expected further reduction in water levels. It is also hoped that these study blocks can be located relatively near the base camp at Fort Chipewyan. Frequent crossing of wide expanses of open water by airboat and travelling considerable distances to the study areas must be avoided in the interests of safety and economics.

In 1970, transect counts will not be made. Instead, surveys around the shorelines of lakes and streams, similar to the 1969 moulting and fall population surveys, will be carried out to obtain an estimate of the migrant and paired waterfowl utilizing the delta.

An effort will also be made to determine the approximate spring arrival dates into the Peace-Athabasca Delta for as many species as possible.

7.10.2 Breeding pair census

Since smaller, more readily accessible study block will be selected for the 1970 season, more replicate counts of breeding pairs will be possible. These replicate counts will be continued well into the breeding season to obtain data on sex ratio shifts and on the distribution of breeding birds within the various habitat types.

Short reconnaissance flights over the open water of the lakes censused will be made to gain an indication of the proportion of the lake population that is present in the central portion of the lakes. The shoreline census results can then be adjusted accordingly.

Transects across several lakes in the study area will be used to determine distributional changes of breeders and non-breeders. The possible accompanying sex ratio changes between the shorelines and open water habitats may thus be investigated.

7.10.3 Brood census

Brood distribution in relation to habitat types will be evaluated as in 1969, but selection of more readily accessible study blocks will permit greater replication of counts. Brood movement within the delta, suggested by the 1969 data, can thus be verified.

More frequent counts will also aid in studying of nesting chronology. By back-dating the observed broods, it will be possible to determine quite accurately the chronology of successful nesting effort. Brood counts will be continued into August to determine the degree of renesting that may occur.

7.10.4 Waterfowl moulting and fall census

The distribution of moulting waterfowl will be determined as in the 1969 field season.

Waterfowl fall populations will also be investigated as in 1969, but it is hoped that the census can be continued at least until the end of September for the reasons previously outlined.

In addition, it is planned to employ large-scale aerial photography as a means of determining the size and, possibly, the species composition of moulting and fall populations on selected water bodies. Preliminary tests conducted in 1969 have been encouraging.

8. SUB-PROJECT 03: TOPOGRAPHICAL MAPPING, HYDROLOGICAL AND METEOROLOGICAL RECORDS

8.1 Specific objectives

(1) To produce a contour map of the delta by comparative interpretation of small-scale aerial photographs taken at high and low water levels;

(2) To obtain estimates for the major components of the water budget of the main water bodies within the delta, particularly inflow, outflow, precipitation, and evaporation; and

(3) To measure the position of the water table in selected topographical locations.

8.2 Progress in 1969

Progress in this facet of the study was retarded by transportation problems and manpower limitations.

A "Class A" evaporation pan and a 7-day recording rain gauge were received from the Meteorological Branch, Department of Transport, but could not be installed before the end of the field season owing to pressure of other work. Installation of stand pipes to monitor water table changes also had to be deferred until 1970.

Reading of water levels on five major lakes in the delta in relation to temporary bench marks, that were established in early July 1968, was continued at two-week intervals from mid-May to mid-August. Mechanical difficulties with both airboats prevented readings to be carried on beyond that date.

Fig. 22 shows the seasonal changes in the levels of Lake Athabasca, Lake Claire, and Mamawi Lake during the open water season of 1960 and for Lake Athabasca in 1968 and 1969 (data from Water Survey of Canada). Fig. 23 shows seasonal water levels for 1968 and 1969 for Lake Claire, Mamawi Lake, Hilda Lake, and Richardson Lake. (Extremely low water levels prevented continued recording of water levels in Baril Lake.)

The diagrams show that the mid-summer level of Lake Athabasca during 1968 and 1969 was approximately 6 feet lower than during the corresponding period in 1960. It is also evident from Figs. 22 and 23 that rising water levels from May until late July or August, typical prior to the damming of the Peace River, did not occur during 1968 and 1969. Instead, lake levels continued to fall throughout the open water season of both years. Since the recorded levels for 1960 and for 1968-69 are not based on the same datum, absolute elevations of the surfaces of Lake Claire, Mamawi Lake, Hilda Lake, and Richardson Lake cannot be compared. However, it is apparent that 1969 levels were lower than those for the same periods in 1968. Mamawi and Richardson

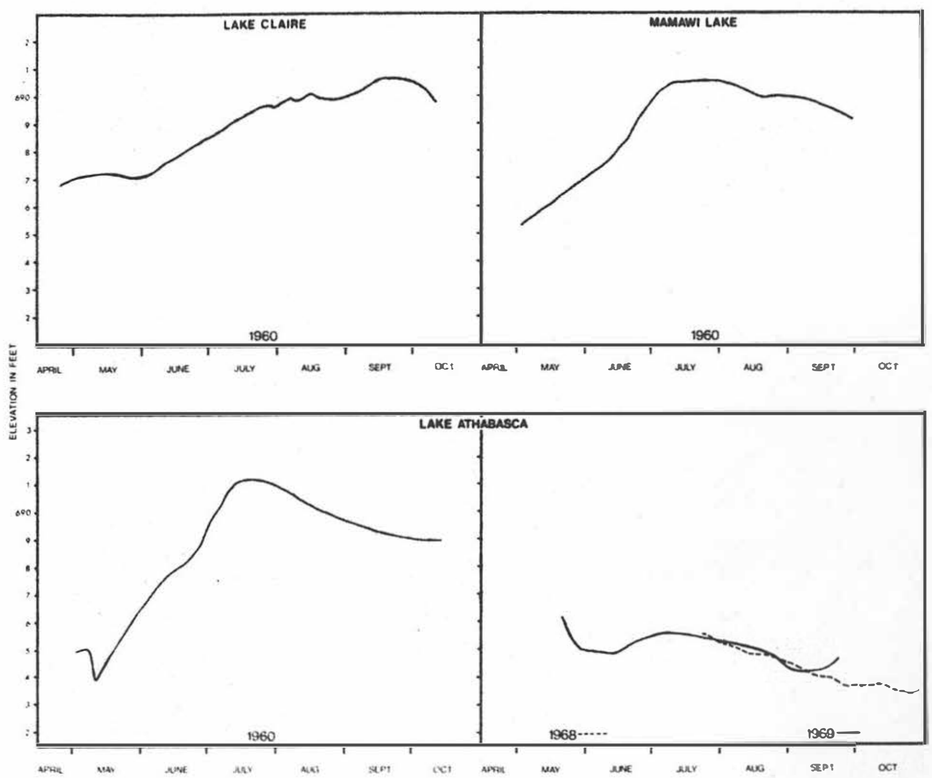


Figure 22. Seasonal changes in the levels of Lake Athabasca, Lake Claire, and Mamawi Lake during the open water season of 1960, and corresponding levels for Lake Athabasca in 1968 and 1969 (data from Water Survey of Canada).

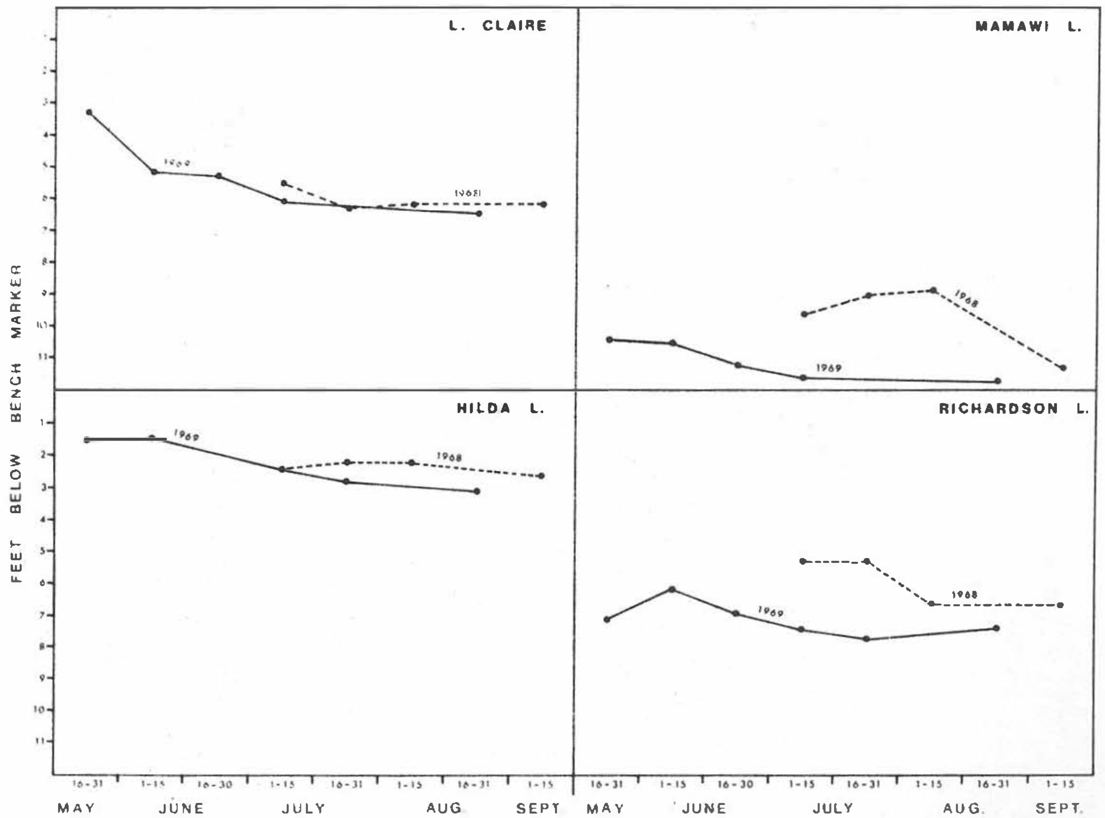


Figure 23. Seasonal changes in the levels of four major lakes in the Peace-Athabasca Delta during the open water seasons of 1968 and 1969.

lakes, in particular, on 1 July 1969 were about 2 feet lower than in the previous year.

These data indicate that the water regime has been drastically altered, and that the reduced summer flows in the Peace River during the past two years have had a cumulative effect in lowering water levels in the Peace-Athabasca Delta. It is anticipated that this trend will continue in 1970, resulting in a substantial decrease in area of the shallow delta lakes.

8.3 Plans for 1970 field season

It is planned to continue monitoring of water levels of the major delta lakes from breakup until the end of the open water season. During the winter of 1970-71, the temporary bench marks will be related to geodetic datum to permit comparison of water level changes between lakes and also with previous data in the files of the Water Survey of Canada.

Stand pipes to measure seasonal fluctuations of ground water levels will be installed along selected transects (see section 6.4.3).

A meteorological station consisting of evaporating pan, recording rain gauge, and wind recorder will be established on the east shore of Mamawi Lake.

Complete air photo coverage of the delta at a scale of 1 inch = 1,000 feet will be obtained in mid-summer through the Interdepartmental Committee for Air Surveys. This photography will be used for ecological and contour mapping for the entire delta area, and in evaluating the feasibility of artificially returning the delta to its previous water regime.

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