VEGETATIONAL CHANGES AS RELATED TO WATERFOWL HABITAT IN ARTIFICIAL LAKES OF SOUTHWESTERN SASKATCHEWAN, CANADA

By

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CANADA

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PREFACE

Southwestern Saskatchewan is situated in a semi-arid region where heavy demands are placed on the water supply. For this reason the Canadian government has built, and continues to build, many water reservoirs. As these reservoirs become waterfowl habitats, it is desirable to learn the rate at which aquatic plant succession occurs, and, therefore, how quickly they become suitable for these birds.

In order to solve this problem, the writer spent the summer of 1957 making a botanical and ecological study in this area, the results of which are presented here.

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INTRODUCTION

The agricultural development of the prairie provinces is dependent upon water supply. Farmers are confronted with the problems of either too much or too little water. The Federal Government, through the Prairie Farm Rehabilitation Act, is carrying out extensive water control programs. Drainage destroys waterfowl habitats; storage creates new waterfowl habitat. Water storage reservoirs may take the form of dugouts, stock-watering ponds or lakes, and storage reservoirs for irrigation purposes. Considerable research has been conducted on vegetation and waterfowl production under natural conditions, but little information is available on man-made habitats in this area. It is important to determine the establishment of vegetation and successional changes in water impoundment projects and their relation to waterfowl.

During the summer of 1957, the author made an ecological survey of nine artificial lakes in extreme southwestern Saskatchewan (See Figure 1). He made collections of plants, took photographs, drew maps, and compiled detailed notes on the plant succession, present flora and fauna, and apparent ecological processes which were seen to be taking place.

The following text presents detailed information on each individual area studied, and the Appendices contain

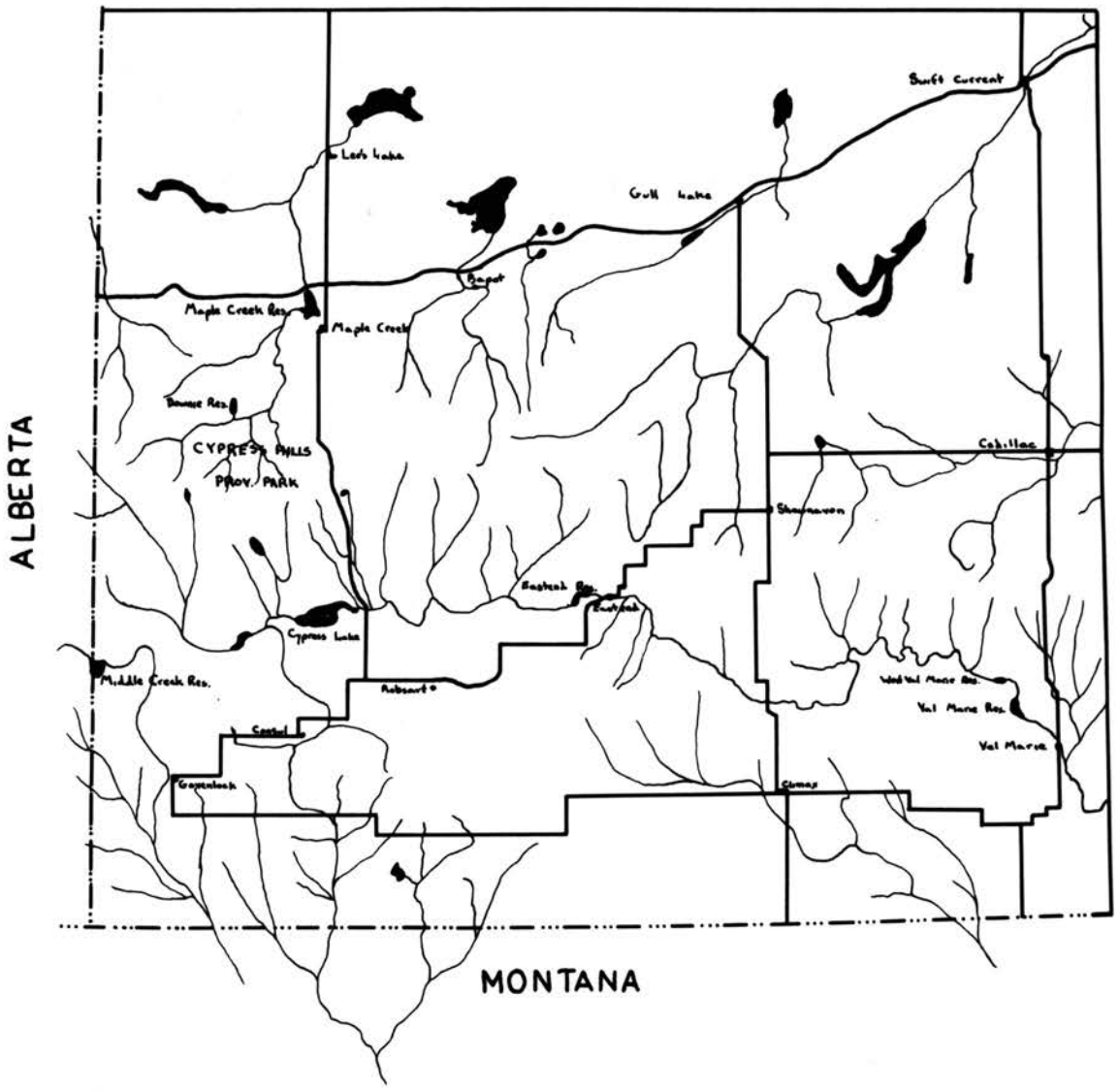


Figure 1. Map of extreme south-western Saskatchewan.
(108 miles by 96 miles)

annotated lists of the recorded flora and fauna as well as a table summarizing data obtained on the aquatic and marginal aquatic plants.

Statement of Aims and Objectives

The aims and objectives of this study were:

1. To determine the successionary changes which have occurred in the aquatic vegetation of nine artificial water bodies since their establishment.
2. To describe the aquatic communities with reference to environmental factors.
3. To assess their value as waterfowl habitats.
4. To briefly describe the non-aquatic communities.

Methods of Study

The methods of study included:

1. Visitation of the areas at appropriate times in order to obtain comparable records with previous observations of Cameron (1946) and Soper (1942, 1948) and to collect plant material at the correct stage for identification. Table I shows the itinerary.
2. Collection of all aquatic and most terrestrial vascular plants.

3. Compilation of data on plant species in relation to their surroundings and their place in succession.

TABLE I

ITINERARY

Reservoir	June	July	August	September
West Val Marie	3-6	8-13		2
Val Marie	7-10	15-20		2
Eastend	11-14	22-27		2
Cypress Lake	15-20	29-31	1-7	1
Middle Creek	22-25		9-15	
Lee's Lake	27-29		19-22	
Piapot	30	1-4	22-27	
Maple Creek		4	27-29	
Downie		5	29-31	

SUMMARY OF PREVIOUS OR RELATED WORK

No major research has been devoted to plant succession in water impoundments in Saskatchewan. Information relating to the problem in other areas is found in Johnsgard (1955, 1956), Keith (1955, 1958), and Leitch (1951). Reconnaissance surveys by members of the Canadian Wildlife Service (Soper, 1942, 1948; Cameron, 1946) have assessed the value of some of the larger impoundments as waterfowl habitat. Their data cast some light on plant succession. The writer examined the nine areas studied by Cameron (some of which Soper also reported on) and endeavored to use Cameron's notes as a basis for determining the succession which had occurred in the intervening period.

Rawson and Ruttan (1952) have examined many reservoirs in the plains area of Saskatchewan while determining limnological conditions in relation to fish production.

General works on the ecology of the area have been compiled by Clarke (1930); Clarke and Tisdale (1936); Clarke and Campbell (1942); Clarke, Tisdale, and Skoglund (1943); Coupland (1950), Coupland and Brayshaw (1953); Hubbard (1950); and Mozley (1936, 1938).

Floras of the province are found in Fraser and Russell (1937, 1944, 1954) and Breitung (1957) and more generally in

Budd (1952), Fernald (1950), Hitchcock (1950), and Rydberg (1922, 1932).

THE VEGETATION OF EXTREME SOUTHWESTERN SASKATCHEWAN

The vegetation of the area consists mainly of grassland, although shrub and forest communities occur in the Cypress Hills which are to be found near the middle of the area. Though three main types of grassland, namely Shortgrass Prairie, Mixed Prairie, and Fescue Grassland, occur in the area, only Shortgrass Prairie and small areas of Mixed Prairie are found in the vicinity of the study areas.

The Shortgrass Prairie association occupies the most arid situations found in the area. It is associated with the Brown Soil zone. Five grasses (Bouteloua gracilis, Agropyron smithii, Koeleria cristata, Stipa comata, and Poa secunda) and two sedges (Carex eleocharis and C. filifolia) provide the major vegetative cover.

In moister areas of the Shortgrass Prairie, small areas of Mixed Prairie are found. In these areas Stipa viridula and Agropyron dasystachyum are common.

Along the river valleys and in protected coulees or ravines often are found groups of shrubs and occasional trees. These communities are composed of Salix spp., Rosa spp., Shepherdia argentea, Symphoricarpos occidentalis, Elaeagnus commutata, Amelanchier alnifolia, and Prunus virginiana.

In many places, low lying areas in association with river bottoms contain extensive stands of sagebrush where Artemesia cana is dominant; where there is a mixture of two dominants, Artemesia cana and Sarcobatus vermiculatus; or where Sarcobatus vermiculatus alone is dominant. These areas are called sagebrush, sagebrush-greasewood, or greasewood flats.

Marginal aquatic communities other than shrubs and trees typically are composed of more or less dense stands of grasses (such as Deschampsia caespitosa, Puccinellia nuttalliana, Hordeum jubatum, and Distichlis stricta), sedges (such as Carex aquatilis and C. lanuginosa), Juncus, and Eleocharis.

In the aquatic communities the wholly submersed species generally are Potamogeton pectinatus, P. richardsonii, Ranunculus subrigidus, and Myriophyllum exalbescens. The most common partially submersed aquatic with floating leaves is Polygonum coccineum. Floating plants are represented very poorly with Lemna minor as the most common example. The partially submersed aquatics with aerial leafy stems include Typha latifolia, Beckmannia syzigachne, and Scirpus validus var. creber.

INDIVIDUAL AREA DESCRIPTIONS

In this section each of the nine areas is discussed as to location, history, description of the surrounding area, reservoir description, vegetation, plant succession, and waterfowl history and potentialities. Much of the information presented on history and description has been taken from the writings of Soper (1942, 1948) and Cameron (1946). The data found in these papers were presented here, in some cases, word for word, but in most cases minor or major changes have been made so that the data are either enlarged, corrected, or made more nearly exact.

West Val Marie Reservoir

Location

West Val Marie Reservoir (see Figure 2) may be reached by following Highway No. 4 for 11 miles north of the town of Val Marie and then by traveling along a gravelled prairie trail for seven miles west-southwest to the dam.

The dam is located in Section 12, Township 5, Range 15 west of the third Meridian. It is about 14 miles north-northwest of Val Marie and 25 miles north of the International boundary. Eastend, at the southern slope of the Cypress Hills, is approximately 50 miles upstream to the

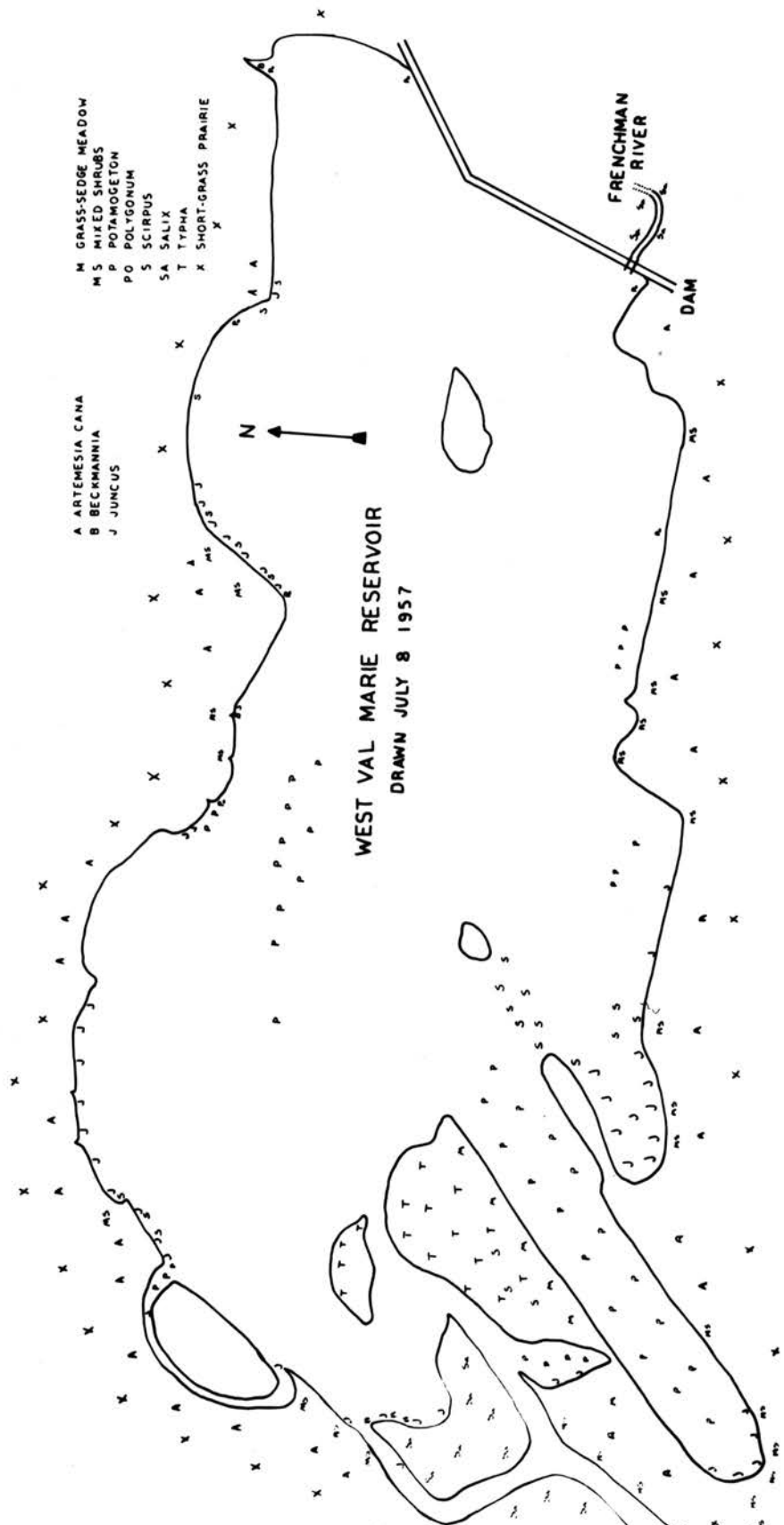


Figure 2. Map of West Val Marie Reservoir. ($1\frac{1}{2}$ by $\frac{1}{2}$ miles)

west-northwest. The sister P.F.R.A. project, Val Marie, is located about eight miles downstream or around six miles in a straight line to the southeast.

History

The reservoir was created by impounding the Frenchman River which constitutes a part of the Missouri drainage system. The project is composed of a dam (see Figure 3b) and spillway completed in 1941 by the Department of Agriculture, working under authority of the Prairie Farm Rehabilitation Act.

Description of the Surrounding Area

The Frenchman valley at this point varies from about 150 to 200 feet deep, although this is somewhat exceeded in a few places. Average width close to the reservoir is about three-quarters of a mile, but downstream it is over a mile with the terrain being flat and interlaced with irrigation canals. In some sections of the bottomlands the terrain is rough, broken, and hilly, and the soil is impregnated with stones and boulders. Commonly there are one or more benches between the reservoir and river and the base of the valley walls. These are bisected at frequent intervals by deeply cut washes, or gullies.

The main slopes of the valley are often extremely rugged and precipitous. Atmospheric erosion has carved out deep ravines which frequently extend into the high plains for a distance of a few hundred yards or even up to one-half

mile or more in length. The gradient is acute, and the terrain is rendered very irregular and broken by the action of erosion. Not infrequently true badlands have been sculptured in local areas, introducing arid slopes and benches of naked hard-packed clayey soil surmounted by steep, flat-topped, or conical buttes of equal aridity.

Reservoir Description

West Val Marie Reservoir has a water area of 400 acres with a storage capacity of 4,000 acre-feet. The reservoir serves to irrigate 3,416 acres of land on which cereal and legume crops are grown as supplementary food for livestock. The project is dependent upon the P.F.R.A. Cypress Lake Reservoir at the source of the river.

At average capacity the waters of the reservoir lie at an elevation of 2,648 feet above sea level. The drainage basin area tributary to Frenchman River above the dam is approximately 1,650 square miles.

The outline is irregular with frequent small bays (see Figure 3c), especially in the west end. Although the average width appears to be only 400 to 500 yards, the broadest parts are nearly one-half mile, while the length is about one and one-half miles. In a relatively large area above the dam, the water is quite deep, but most of the reservoir is only three or four feet, or even less. The deepest parts, of course, are located in the well-submerged old river channel. Water is fresh, of a brownish tint, and

generally opaque, the latter becoming much more pronounced during periods of high winds and rough water. Erosion is relatively rapid on vertical dirt banks at various places along the shores (see Figure 3d). A low island about one acre in size occurs a few hundred yards above the dam, and a much smaller one is found in the west end.

The pH readings taken at the reservoir were around 8.2, indicating that it is mildly saline.

The water level apparently fluctuated less than one foot between the three visits made to the area.

The Vegetation of the Area

a. Aquatic Communities. Aquatics were represented very poorly in the eastern half of the lake; however, they were well represented locally in shallow quiet areas close to the river channel in the west end (see Figure 3a).

1. Wholly submersed: Represented by only Potamogeton pectinatus and P. richardsonii with the first being most common. The plants were found in scattered to relatively large beds in water one and one-half to three feet deep. They were especially prominent in the bay in the southwest end. Waterfowl were frequently seen feeding in association with these plants.

a b

Top left: Marginal vegetation and shallow beds of Potamogeton, July 12, 1957.

Top right: Spillway and dam, east end of the reservoir, July 6, 1957.

c d

Bottom left: The north-east corner of the reservoir, July 9, 1957.

Bottom right: Rapid erosion on a cut-bank in the south-east corner of the reservoir, July 9, 1957.

Figure 3. Photographs of West Val Marie Reservoir.

2. Partially submersed with floating leaves: Represented by Alopecurus aequalis and Polygonum coccineum with the second being most common. P. coccineum was scattered fairly evenly throughout the water body and was the only aquatic found close to the dam. This ability to withstand turbidity and wave action indicates that it is apparently one of the first pioneer plants in such situations.
3. Partially submersed with aerial leafy stems: Typha latifolia was restricted to two thick stands at the west end close to the river channel. If the lake level becomes relatively stabilized in the future, it is probable that this plant will greatly extend its range.

Scirpus validus var. creber was found scattered in small clumps along the western shoreline with some moderate sized groups in the southwest corner (see Figure 4c).

Alisma gramineum, A. subcordatum, and Sagittaria cuneata were found in small numbers in sheltered areas of the west end.

Rumex maritimus and Cicuta maculata were of spotty and irregular occurrence.

Small scattered stands of Beckmannia syzigachne were located all around the reservoir while a moderate stand was found in

the small bay in the northeast corner of the lake.

b. Marginal Communities. Three grasses, Agrostis scabra, Distichlis stricta, and Puccinellia nuttalliana; two sedges, Carex aquatilis and C. lanuginosa; two spike rushes, Eleocharis acicularis and E. palustris; and one rush, Juncus balticus var. montanus, were of spotty to regular occurrence along the shoreline. Additional characteristic herbs were Rumex mexicanus, Ranunculus cymbalaria, Rorippa islandica, Potentilla anserina, Sium suave, Collomia linearis, Mentha arvensis, Stachys palustris, Plantago major, and Iva axillaris.

Salix interior was found abundantly along the river channel to the west but was represented poorly along the reservoir itself where it was restricted to occasional ravine bottoms. In 1946 extensive stands of dead willows were to be found in the west end of the reservoir (see Figure 4a), but these had disappeared by the time of observation (see Figure 4b).

c. Dry-land Communities.

1. Sagebrush flats: Stands of Artemesia cana were found in the vicinity of the southern shoreline and in scattered places along the north side. On the south side the plant was

a

West end of the reservoir as photographed by Cameron on July 9, 1946.

b

c

Bottom left: The same view as above, July 9, 1957.

Bottom right: West end of the reservoir taken from the south shore, July 11, 1957.

Figure 4. Photographs of West Val Marie Reservoir.

quite abundant and formed what might be called a true sagebrush flat.

2. Mixed grass prairie: True mixed grass prairie was found only in ravines and along the northern sides of the escarpment.
3. Ravine Communities: Dense thickets of buffalo berry (Shepherdia argentea), roses (Rosa spp.), and snowberry (Symphoricarpos occidentalis) with scattered clumps or patches of creeping juniper (Juniperus horizontalis), wolf-willow (Elaeagnus commutata), saskatoon (Amelanchier alnifolia), and chokecherry (Prunus virginiana) are found in the ravines.
4. Shortgrass prairie: The dominant vegetation of the entire dryland area except the ravine and river bottom communities belonged to this category.

Plant Succession

The building of the dam and spillway was completed in 1941. In the summer of 1942, Soper (1942) visited the area and made the following comments on the plant succession to that date:

Practically no emergent growth in the form of bullrush or cattail has developed up to the present time. Such may gradually take place, in wetter years, as the reservoir becomes older and more stabilized. As yet, subaquatic flora is also very scarce or wanting in the main body of water, but small quantities of duckweeds are to be found in the

river and contiguous flooded areas. As time goes on, we may expect this to be slowly augmented.

In the summer of 1946 Cameron (1946) made his study of the area. From his general descriptions it is apparent that by that time the vegetation had come close to reaching the level of stabilization as when studied by the writer. It is apparent, however, that a few minor changes have occurred in the interval.

Cameron commented that "There are a few isolated stands of [Typha latifolia], but in general it is rather uncommon." Present observations indicated that, though the plant was restricted to two stands, these stands were of an extensive nature and that the plant should be classified as something more than "rather uncommon."

Cameron noted Myriophyllum as uncommon "but a few stands are present at isolated points." This plant never was observed by the writer which indicated that it either has disappeared from the area or else it was inconspicuous enough to escape observation.

Speaking of Potamogeton pectinatus, Cameron said that "profuse beds fill the small inlets." The writer's observations would indicate that this plant now has extended its range into the western half of the main water body. Moderate numbers of Potamogeton richardsonnii were observed, but these were not recorded by Cameron which indicates that they are recent invaders or, more likely, that Cameron had not distinguished them from the other pondweed.

Cameron made no mention of Alopecurus aequalis and Beckmannia syzigachne, while the writer observed that these were represented by small stands.

Cameron recorded Sagittaria latifolia from a few isolated beds at the northern end of the reservoir. The writer examined this area in detail and recorded two species of Alisma and Sagittaria cuneata. Sagittaria latifolia never was found, and it would appear that this should have been identified as S. cuneata, although possibly the plant has disappeared and is replaced now by three other species of the same family.

Waterfowl Potentialities

Table II gives the past and present waterfowl presence and abundance at the West Val Marie Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

TABLE II

WEST VAL MARIE, WATERFOWL PRESENCE AND ABUNDANCE

Species	Soper June 13-16,1942	Cameron July 8-14,1946	Bird All Visits
Canada Goose	-	-	1
Mallard	2	1	2
Gadwall	-	4	-
Pintail	-	-	5
Green-winged Teal	6	7	-
Blue-winged Teal	4	5	4
Baldpate	1	2	3
Shoveller	3	-	-
Redhead	5	6	-
Ring-necked Duck	-	3	-
Ruddy Duck	-	-	4
American Merganser	-	-	7
Totals	700	280	300

The discrepancies in the waterfowl totals recorded in different years may be explained by the following reasoning: (1) At the time of Soper's visit, surrounding water bodies generally were dried up with the result that concentrations resulted in those remaining water bodies present in the area and (2) Cameron remarked that 1946 was a poor waterfowl year.

The Canada Goose was not recorded from this reservoir by either Cameron or Soper. At the time of investigation a sizable population was found. On June 3 and 4, twenty-five adults and six goslings were seen, while, on July 8, seventy-five were counted. This would indicate the increase was due to some fifty juveniles.

On June 6, when the author was approaching the small island in the west end of the lake, a goose was flushed from a nest. This nest, in a rather open place, was composed of grass, sedge, and Scirpus culms and contained seven eggs.

When the geese were counted on July 8, they were quiet, secretive, and remained near the center of the lake which indicated that they were undergoing the summer moult.

The geese preferred the west end of the reservoir and adjoining river and often were seen feeding in beds of Potamogeton pectinatus along with other waterfowl.

Due to the age of the reservoir and to the data obtained on plant succession, it appears that the vegetation has reached a relatively stable level. Thus, it is reasonable to assume that no great changes in waterfowl abundance will occur in the following years and that changes that will result will be due to regional increases or decreases in the waterfowl population as a whole.

West Val Marie is a good habitat for land nesting species, but it is a poor one for marsh nesting birds due to

the absence of extensive growths of emergent plants for nesting sites.

Val Marie Reservoir

Location

Val Marie Reservoir (see Figure 5) may be reached by following Highway No. 4 for three miles north of the town of Val Marie and then traveling three miles northwest along a gravelled road to the dam.

The dam is situated in Sections 15 and 22, Township 4, Range 14 west of the third Meridian. Approximate latitude is 49° 18' 0" N. and longitude 107° 48' 30" W. The reservoir is located on Frenchman River approximately five and one-half airline miles northwest of the town of Val Marie; it is 30 miles south of Cadillac and 21 miles north of the International boundary.

History

Construction work conducted by P.F.R.A. at this project consisted of building a long earth and rock-fill dam across Frenchman River and much of the adjacent valley (see Figure 6). A central section is composed of reinforced concrete with control gates, sidewalls, and apron. Work was commenced in 1936 and completed in the same year.

In Soper's 1948 report are some interesting observations made on the history of the waterbody.

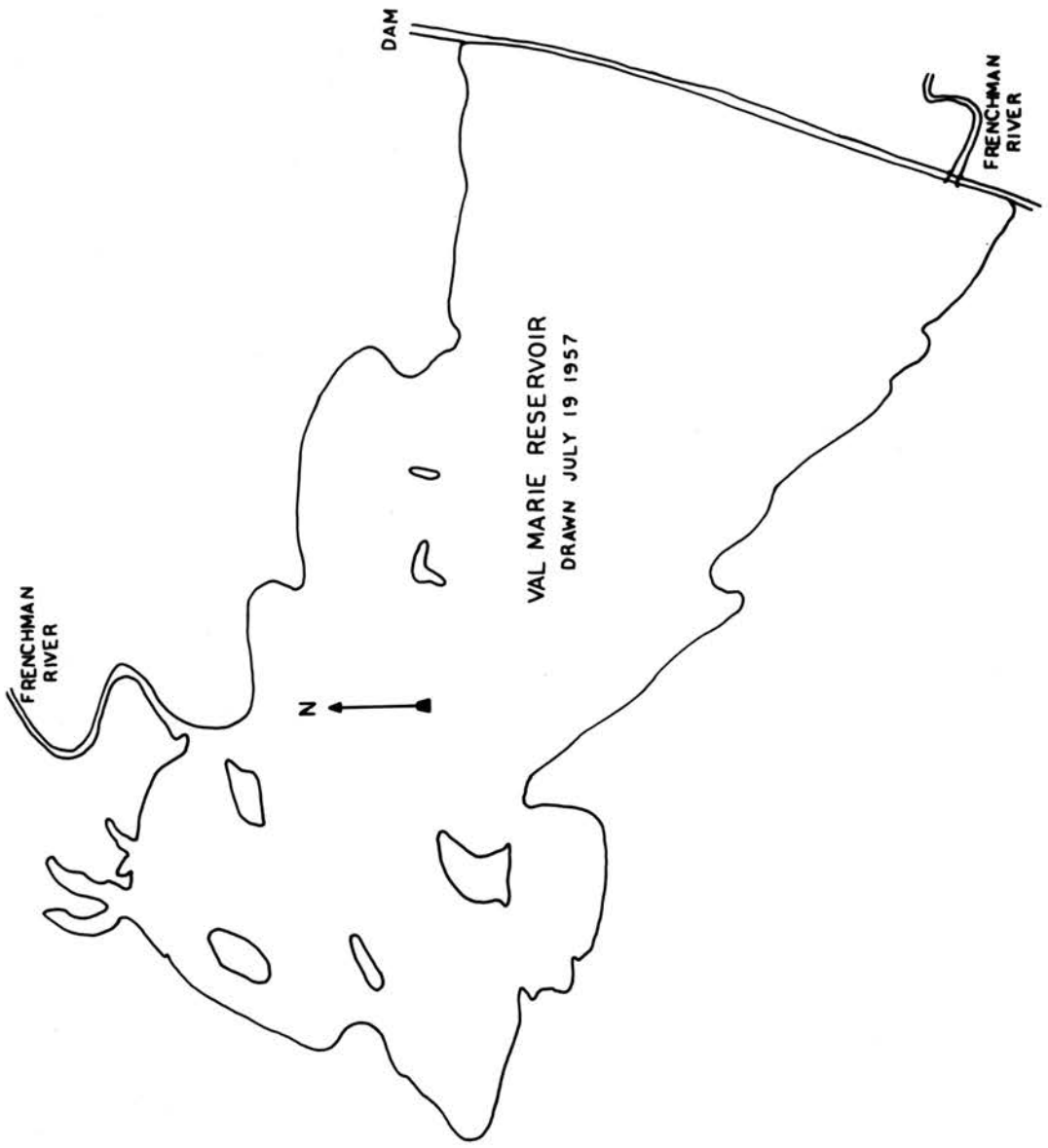


Figure 5. Map of Val Marie Reservoir. (3 by ½ miles)

a

View of the southern end of the reservoir as taken by Soper on July 6, 1937 (Soper 1942).

b

c

Bottom left: The same view as above, July 17, 1957.

Bottom right: View of the dam and spillway, July 17, 1957.

Figure 6. Photographs of Val Marie Reservoir.

At the time of inspections (July 6, 1937) a very respectable body of water had been empounded. It was several feet deep in the vicinity of the dam and shallower toward the sides and up the river. Considering the comparatively light run-off during the past spring and the successive years of recent drought (with the most marked deficiencies in the summer of 1937), the amount of water present appealed to me as quite extraordinary.

Description of the Surrounding Area

The Frenchman Valley at this point is about a mile in width with nearly flat bottomlands rising gently to the westward. Its depth is apparently 150 to 175 feet. Eastward the valley deepens again to introduce acutely trenched badlands and rugged coulees. There is comparatively little of the spectacular in the walls of the valley at the Val Marie Reservoir as compared with some sections to the northwest and southeast. However, marked erosion and the presence of minor buttes and arid benches on the acclivities lend a certain amount of ruggedness to the landscape.

Reservoir Description

Val Marie Reservoir has a water area of 2,140 acres and a storage capacity of 6,000 acre feet. The primary purpose of this undertaking was to irrigate an area of 6,049 acres of river-bottom flats below the dam. The project went into operation in 1938.

At average capacity the reservoir waters will reach an elevation of 2,634 feet above sea level; the top of the dam is 2,639. The drainage basin area tributary to the point of diversion at the dam is 1,660 square miles.

At maximum capacity, it would appear that the reservoir would have a length of two to three miles. The width of the lake averages about one-half mile. The lake is fairly shallow, and as the water is withdrawn, large mud-flats soon begin to appear (see Figure 7b). The areas immediately before the dam and in the old river channel are fairly deep. Water is fresh and generally opaque. Due to the shallow water, wave action very quickly churns up the bottom sediments, and the water color takes on a milky-brown cast. Erosion is relatively rapid on vertical soil banks at various places along the shores. Two fair sized islands are found in the western part of the lake (see Figure 7a).

No pH readings were taken here, but in all likelihood it is mildly alkaline.

At the second visit to the area (July 15), the water level had dropped about one foot. By the third visit (September 2), the water had dropped another two feet and left broad mud-flats which showed surprisingly little aquatic growth.

The Vegetation of the Area

a. Aquatic Communities.

1. Wholly submersed: The only plant of this category was Potamogeton pectinatus. This occurred in sparse beds throughout the lake; however, the greatest amount was centered in the west end.

2. Partially submersed with floating leaves: Polygonum coccineum was encountered fairly regularly close to the southern and western shorelines.

3. Partially submersed with aerial leafy stems: Alisma gramineum, Beckmannia syzigachne, and Rumex maritimus var. fueginus were scattered along the southern and western shorelines. Stands of Scirpus validus var. creber were found along the river channel close to the mouth.

b. Marginal Communities. One grass, Deschampsia caespitosa; two spike rushes, Eleocharis acicularis and E. palustris; and one rush, Scirpus paludosus, were found fairly regularly along the water's edge. Additional herbs were Alisma triviale, Polygonum lapathifolium, Rumex mexicanus, Ranunculus cymbalaria, Rorippa islandica, Potentilla anserina, Collomia linearis, Plagiobotrys scopulorum, Mentha arvensis, and Plantago major.

Salix interior was found sparsely along the reservoir and abundantly along the river channel. Moderate clumps of dead willows were present which indicated that past periods of higher water level had drowned them out and, also, indicated what is possible with stabilized water levels (see Figure 7d).

a b

Top left: Looking north at an island in the west end of the reservoir, July 18, 1957.

Top right: Large mud flats exposed by receding water level, September 2, 1957.

c d

Bottom left: Shrub-choked ravine bottom on the south side of the reservoir, June 10, 1957.

Bottom right: Dead willows and gravelly shoreline on the south side of the reservoir, June 7, 1957.

Figure 7. Photographs of Val Marie Reservoir.

c. Dry-land Communities. These communities were very similar to those of West Val Marie Reservoir and hence will not be repeated.

Large stands of Artemesia cana were common along the western and southern sides of the lake. On the north side Sarcobatus vermiculatus with some Artemesia cana formed a true greasewood flat.

Figure 7c illustrates one of the shrub-choked ravine bottoms which run into the south side of the reservoir.

Plant Succession

Work was commenced on the dam in 1936, and it was completed in the same year. On July 6, 1937, Soper (1948) visited the area and commented:

> Aquatic growth is naturally absent for the most part, due to the recency of flooding, though some native species quickly developed. This unquestionably derived from original flora which existed in the shallow margins of Frenchman River. Extensive developments may in time be anticipated; doubtless additions will accrue in the natural spread of reeds, etc., brought down by the river current from the well-established growths upstream.

When Soper (1948) next visited the area (July 18, 1941), he mentioned, "there appeared to be some improvement in this respect."

When Cameron (1946) visited the area he found "The margins of the river, the reservoir and several of the irrigation canals are overgrown with [Salix]." This was not true in 1957. Extensive groups of dead willows were present around the reservoir, but very little new growth was

present. It appears that at some time in the intervening years an extensive period of flooding or other phenomenon killed out the willows.

Cameron mentioned that "There are isolated stands of (Typha latifolia) along the margin of the reservoir." This plant was entirely absent during the summer of 1957.

Cameron recorded Myriophyllum as being present in "a few isolated beds." This plant may have been present in very small numbers but, if so, was not recorded by the writer.

Waterfowl Potentialities

Table III gives the past and present waterfowl presence and abundance at the Val Marie Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

The variance in the waterfowl totals is in line with that observed at the West Val Marie Reservoir and may be explained by the same reasoning: (1) At the time of Soper's visits surrounding water bodies generally were dried up with the result that concentrations resulted in those remaining water bodies present in the area and (2) Cameron remarked that 1946 was a poor waterfowl year.

The flora is believed to have reached a stable level, and little change in the waterfowl is expected in coming years.

TABLE III

VAL MARIE, WATERFOWL PRESENCE AND ABUNDANCE

Species	Soper June 6 1937	Soper June 8 1941	Cameron July 15-21 1947	Bird All Visits 1957
Canada Goose	-	-	7	6
Mallard	1	2	1	1
Gadwall	-	-	3	2
Pintail	3	1	-	5
Green-winged Teal	-	-	6	-
Blue-winged Teal	7	5	4	3
Baldpate	4	-	2	4
Shoveller	2	3	5	-
Canvas-back	6	-	-	-
Lesser Scaup	5	4	-	-
Ruddy Duck	8	6	-	-
American Merganser	9	-	8	-
Totals	1000-1500	1500+	400	500

The lake is a good habitat for land nesting species but a poor one for marsh nesting birds due to the absence of emergent plants for nesting sites.

Eastend Reservoir

Location

This reservoir (see Figure 8) is located on Frenchman River about one and one-half miles west of the town of Eastend in Section 25, Township 6, Range 22 west of the third Meridian. The actual flood area above the dam occupies portions of Sections 22, 23, 26, 27, and 35 in the above named township and range. Distance north of the International boundary is 35 miles.

History

The booklet, History and Reminiscences of Eastend and District (1955), contains some information of an early dam constructed on the site of the present P.F.R.A. dam. In 1904, two private citizens, Enright and Strong, hired a civil engineer to draw up plans for an irrigation dam. Plans were completed and work started in 1905. The work was completed, and water was running through the ditches by September, 1906.

This old dam was built like a weir and was able to irrigate some 500 acres. In 1918, the dam was washed out by the spring run-off and was never rebuilt.

P.F.R.A. development at this point involved the construction of a long earth-fill and rock-fill dam with concrete control gates and spillway in a southern section. Work on the dam was started in 1936 and completed in 1937,

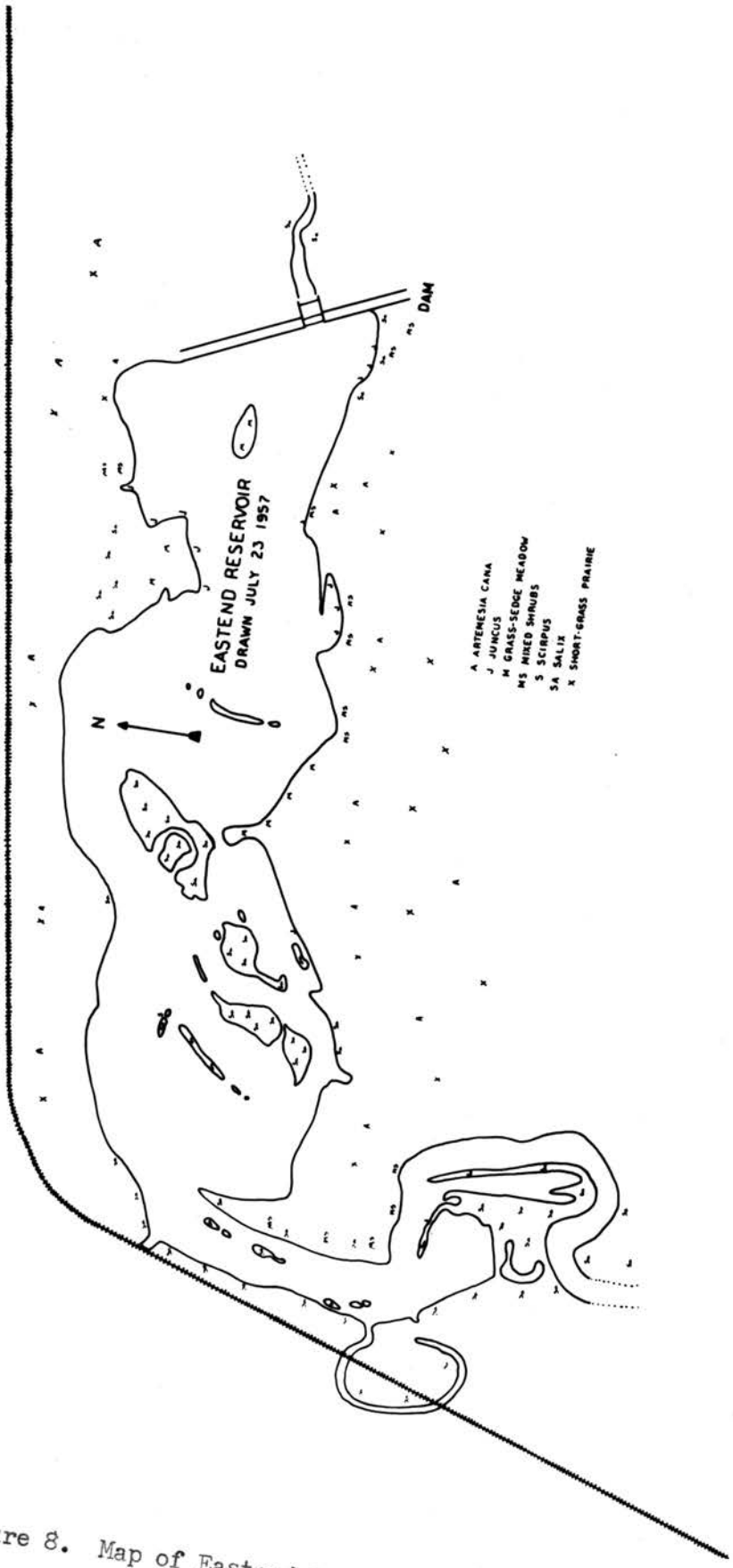


Figure 8. Map of Eastend Reservoir. (2 by 1/3 miles)

while work on canals and the development of suitable lands continued until 1939.

Soper's 1942 report contained three successive observations on the development of the reservoir.

> At the time of inspections [July 3-4, 1937], a considerable body of water had accumulated above the Eastend dam. Immediately above it the depth was several feet. This gradually diminished westward to the head of the basin in the river channel. Considering the fact that the dam had been built only the previous summer and that the spring runoff was comparatively light, followed by the hottest and driest season known the amount of water present was not only gratifying but a very surprising development.

Soper found that on June 14, 1939,

> The Eastend Reservoir holds a much superior volume of water than when reported on in 1937. I understand it was filled to capacity during the last spring's flood in Frenchman river.

When Soper again studied the area on June 19, 1941, he found it to be in "much the same condition as when last reported upon."

Description of the Surrounding Area

The Frenchman Valley at this point skirts the southern margin of Cypress Hills. This is the greatest valley in southern Saskatchewan. It locally reaches a depth of 400 to 600 feet, with the greatest heights on the north slope of the trench. In relation to Great Plains scenery, it is a magnificent spectacle with its towering walls, its buttes and palisades, and an over-all width of a mile or more from rim to rim.

The southwestern limits of the reservoir are flanked immediately by higher land which rises abruptly 25 to 50 feet to a rolling bench. Such benches, in turn, give way more or less acutely to the main walls of the valley. These occur at varying distances of a few hundred yards, or one-half mile or more, from reservoir to river. Many parts of these ramparts are markedly spectacular as they rise with sharp or nearly vertical inclines to a height of 400 to 500 feet above the floor of the valley. The average height of the high plains to the south ranges around 3,600 feet above sea level, while the adjacent Cypress Hills plateau to the north and northwest rises to a maximum elevation of 4,240 feet. In most sections the margins of the Frenchman River valley are trenched deeply at intervals by the action of rains, spring run-off, and general atmospheric erosion. The clays and sedimentary Cretaceous deposits are sculptured likewise into fantastic shapes, flat-topped and conical buttes predominating. Some of the strata exhibited as white bands on the slopes are often predominantly displayed (see Figure 9b).

Reservoir Description

Eastend Reservoir has a water area of 600 acres and a storage capacity of 2,000 acre-feet. The reservoir serves to irrigate 3,000 acres of bottomland in the vicinity of Eastend. This project, like the two at Val Marie, is

a

Islands in the west end of the reservoir as photographed by Cameron on July 25, 1946.

b

c

Bottom left: The same view as above, July 22, 1957.

Bottom right: Eastend Reservoir in the background with large clay deposits on the southern slope of the valley in the foreground, June 12, 1957.

Figure 9. Photographs of Eastend Reservoir.

dependent upon the Cypress Lake Reservoir at the head of the Frenchman River.

With waters in the basin at suitable operating depth, the surface is in the neighborhood of 3,011 feet, while the height of the dam is 3,015 feet above sea level. The drainage basin tributary to the point of diversion at the dam is approximately 648 square miles.

Parts of the reservoir have relatively low banks where the margins lie in the bottomlands through which the Frenchman River flows. This is particularly true of the north and west portions. At the western extremity the flood area gradually narrows until water is finally confined to the river course itself. At maximum, the basin will extend to a distance of about one and one-half to two miles above the dam; this naturally follows the valley contour which is very irregular. A sharp right-angled turn to the south is to be found a mile west of the dam. In a small area above the dam, the water is quite deep, but most of the reservoir is three or four feet deep, or even less. Water is fresh, of a brownish tint, and generally opaque, the latter becoming much more pronounced during periods of high winds and rough water. Several small islands are to be found in the western part of the lake.

No pH readings were taken here, but in all likelihood it is mildly alkaline.

The water level was relatively the same between the first and the second visits, but when visited on September 2, the level had dropped three to four feet. Water remained only in the old river channel and in a few scattered low-lying areas on sides of it. The drop in water left behind broad mud-flats with sparse aquatic growth.

The Vegetation of the Area

a. Aquatic Communities. Aquatics were represented by nine rather sparsely distributed plants. The only places these were found in any abundance were in sheltered bays, around the islands, and in the mouth of the river channel. This is to be expected due to the great fluctuations in water level which occur in the lake (see Figure 10c) due to the release of water for the two reservoirs downstream and to spring flood control.

1. Wholly submersed: Chara sp. was found only in a restricted area next to an island in the south-central part of the lake.

   Potamogeton foliosus, P. pectinatus, and P. richardsonii occurred in sparsely scattered beds in favorable sheltered regions.

2. Partially submersed with floating leaves: Polygonum coccineum was never common but occurred fairly regularly at many places close to the water's edge.

a

Extreme west end of the reservoir as photographed by Soper on June 17, 1942.

b

c

Bottom left: The same view as above, July 22, 1957.

Bottom right: East end of the reservoir following a large drop in water level, September 2, 1957.

Figure 10. Photographs of Eastend Reservoir.

Alopecurus aequalis occurred in a fairly thick bed of around 500 plants in the sheltered bay found in the southeast corner next to the dam.

3. Partially submersed with aerial leafy stems: *Alisma gramineum*, *Sagittaria cuneata*, and *Beckmannia syzigachne* were encountered regularly around the river mouth but were very scarce elsewhere.

b. *Marginal Communities*. One grass, *Glyceria grandis*; three sedges, *Carex athrostachya*, *C. douglasii*, and *C. lanuginosa*; one spike rush, *Eleocharis palustris*; and one rush, *Juncus balticus* var. *montanus*, were found irregularly in scattered groups. Other herbs encountered were *Equisetum arvense*, *Triglochin maritima*, *Ranunculus cymbalaria*, *R. flammula* var. *ovalis*, *Potentilla anserina*, *Mentha arvensis*, *Scutellaria galericulata* var. *pubescens*, and *Plantago major*.

Three willows, *Salix bebbiana*, *S. interior*, and *S. lutea*, were very well represented upstream on the western islands and in scattered low places around the reservoir (see Figures 9a, 9b, 10a, 10b). The map of the area shows the distribution in detail.

c. Dry-land Communities. The accompanying map shows that the land immediately to the south and north is chiefly shortgrass prairie. In some low areas Artemesia cana was relatively common but never abundant enough to designate as a sagebrush flat.

In scattered spots close to the reservoir, ravine communities of trees and shrubs occurred. These were found to consist of chokecherry (Prunus melanocarpa), pincherry (Prunus pennsylvanica), skunkbrush (Rhus trilobata), hawthorn (Crataegus chrysocarpa), saskatoon (Amelanchier alnifolia), roses (Rosa sp.), wolf-willow (Elaeagnus commutata), and snowberry (Symphoricarpos occidentalis).

Plant Succession

Work on the dam was started in 1936 and completed in 1937. Soper (1942) visited the area on July 3-4, 1937, and reported:

Despite the infancy of the water area created here, there was, much to my surprise, a very considerable aquatic growth. The rapidity with which this has appeared is unquestionably attributable to the presence of Frenchman River with its already established water plants.

In 1942, Soper (1942) found that

Submerged aquatic growth has gone into more rapid production and now exists in considerable abundance. It is represented in part by various pondweeds such as Potamogetons, and other species including Chara, Sagittaria, Eleocharis, Myriophyllum, and some forms of algae. The only emergent aquatic growth observed was roundstemmed bulrush (Scirpus), but this obtains in only small scattered quantities.

Cameron (1946) photographed some of the islands in the western end of the reservoir. These were rephotographed (1957) and show very strikingly the development of a thick twelve foot stand of willows.

Waterfowl Potentialities

Table IV gives the past and waterfowl presence and abundance at the Eastend Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

Duck food was rather scarce at this reservoir except along some areas close to the river mouth. Nesting cover for land nesting birds was plentiful, but no nesting cover was present for marsh nesting species. The proximity of the town of Eastend, with the resulting use of the lake for recreational purposes, tends to lessen its value as waterfowl habitat.

Waterfowl conditions were rather poor at this area, and with no foreseeable future changes, it is expected that the waterfowl population will show little in the way of change in the future.

TABLE IV

EASTEND, WATERFOWL PRESENCE AND ABUNDANCE

Species	Soper 1937	Soper June 10 1942	Cameron July 22-27 1946	Bird All Visits 1957
Mallard	1	2	1	1
Gadwall	-	-	2	-
Pintail	-	3	-	-
Blue-winged Teal	2	4	5	3
Baldpate	3	1	3	2
Shoveller	-	-	6	-
Canvas-back	4	-	-	-
Lesser Scaup	-	5	4	-
Ruddy Duck	-	-	7	-
American Merganser	-	-	8	-
Totals	300-400	200-300	130	100

Cypress Lake Reservoir

Location

Cypress Lake (see Figure 11) is located in Township 6, Ranges 26 and 27 west of the third Meridian, the greater part of the basin being in Range 26. The town of Maple Creek is 28 miles to the north; Eastend is 26 miles east; and the International boundary is 32 miles south. The

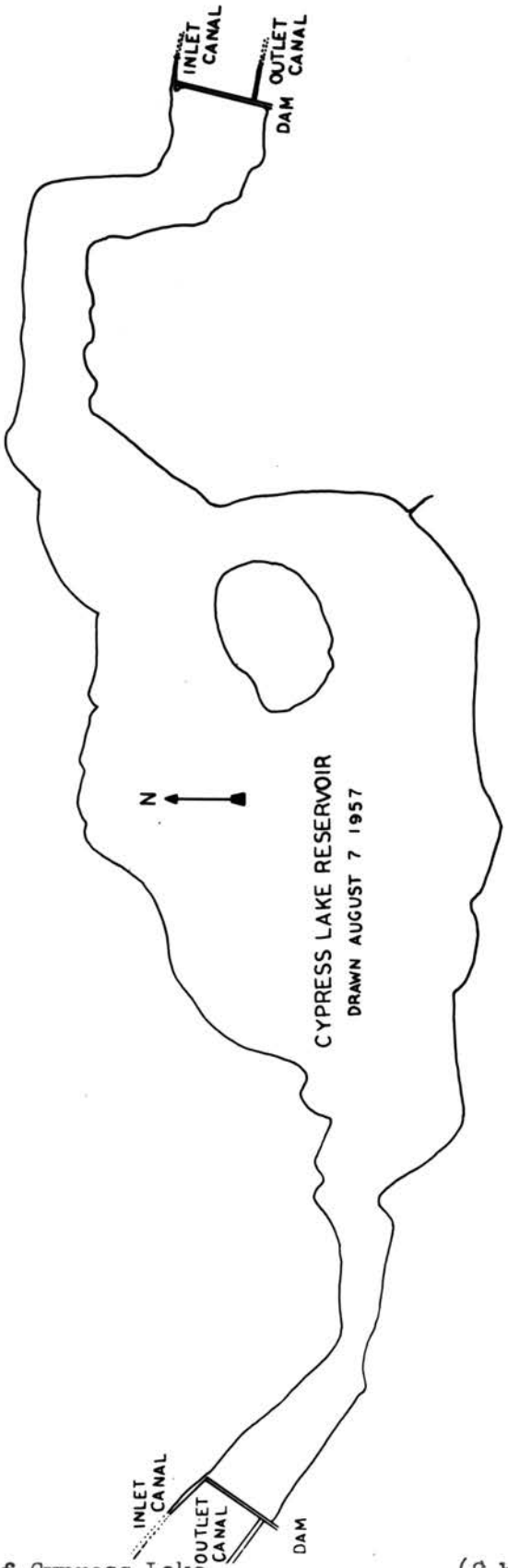


Figure 11. Map of Cypress Lake. (8 by $2\frac{1}{2}$ miles)

reservoir is on the south side of the Cypress Hills and is fed by streams which originate in the hills to the north.

History

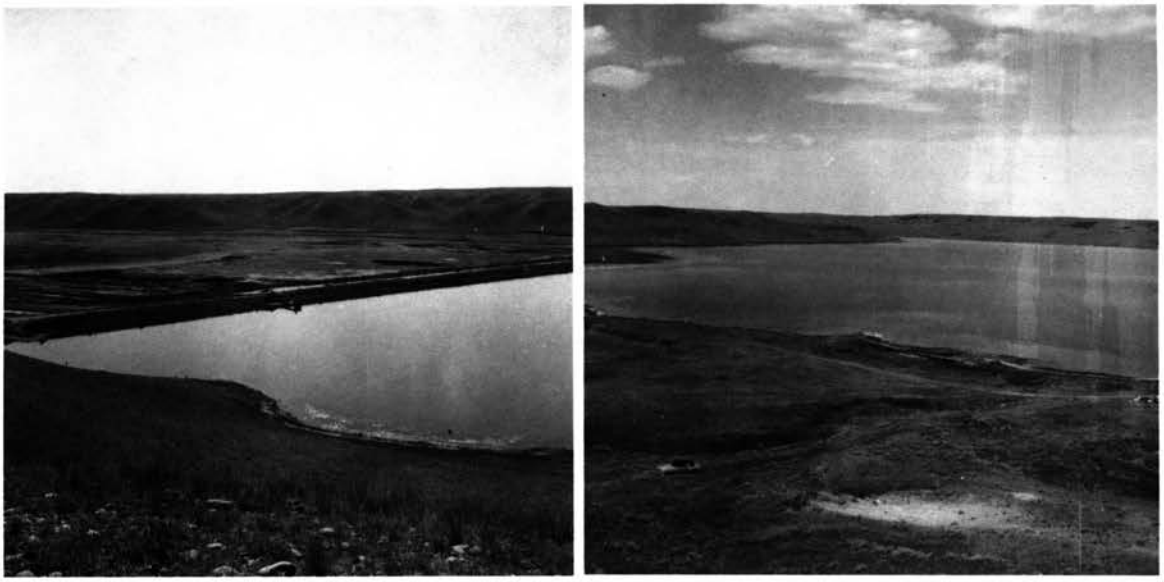
Prior to dam construction this reservoir consisted of a lake at the headwaters of Frenchman River. Due to run-off the lake would contain a large amount of water in early spring and often would connect directly with Frenchman River. Water evaporation rapidly reduced the water level so that in late summer and fall the lake would be only a vestige of its former size or might even dry up entirely.

In order to conserve the water supply for irrigation and stock-watering purposes, the Department of Agriculture, under authority of the Prairie Farm Rehabilitation Act, constructed dams and spillways at both ends of the lake, thus raising the level about 14 feet. The dam at the west end of the lake contains an outlet irrigation canal and an inlet canal which is able to divert water from Oxarart and Battle creeks to the lake. The dam at the east end (see Figures 12a, 12b) of the lake also consists of an outlet canal and an inlet canal. The inlet canal here is able to divert water from Sucker, Belanger, and Davis creeks to the lake.

Various major phases of the Cypress Lake storage development were completed from 1938 to 1939 with minor improvements being made in ensuing years.

a

Dam at the east end of the reservoir as photographed by Soper on June 4, 1939.



b c

Bottom left: The same view as above, July 30, 1957.

Bottom right: Cypress Lake looking north-west along the east arm, July 30, 1957.

Figure 12. Photographs of Cypress Lake.

Soper (1942) reported that on his visit to the area in June, 1939, the "lake bed is now covered with several feet of water in the central portions." In 1942 he reported that an "excellent water level now prevails."

Description of the Surrounding Area

The surrounding terrain is rugged and rolling with an average height of 300 feet above the lake. In some sections it is notably precipitous, with steep banks rising more or less sharply from the water's edge to the high plains above. In other places it slopes gently from the lake to intervening benchlands at various elevations above the water. On the whole, the adjacent country is hilly, and the main drainage acclivities are deeply trenched by tributary washes and major coulees. Some of the latter terminate in the higher plains at distances of several miles from the lake; this is particularly true along the north shore. The terrain in that direction rises successively through abrupt slopes, benchlands, and ridges of increasing height to the Cypress Hills plateau where elevations of over 4,000 feet above sea level occur.

The lake's main tributary stream is Oxarart Creek, which enters at the west end. Most of the natural drainage to the lake is by way of freshet streams only. These dry up during the summer.

Closely related to the lake is an extensive marsh immediately below the dam at the east end. Most of this covers portions of Sections 13, 14, 23, and 24 in Range 26.

Much of the country is reserved for grazing, especially in the rugged country flanking the lake and on the southern watershed of the Cypress Hills. The upper plains (average altitude about 3,400 feet) are largely devoted to dry farming.

Reservoir Description

The lake basin area is 5,900 acres, and the storage basin capacity is 109,000 acre-feet.

This is one of the most important projects on the works program of P.F.R.A. in southern Saskatchewan, as it has a direct bearing on the success of several other improved areas at lower levels to the south and southeast. Projects dependent upon or benefited by the Cypress Lake development include Val Marie, West Val Marie, Eastend, Eastend extension, and the Vidora areas.

When at average capacity, the waters of the reservoir lie at an elevation of about 3,264 feet above sea level.

Total length of the lake is approximately eight miles. It is very irregular in outline, with the principal axis trending almost east and west. East (see Figure 12c) and west (see Figure 13c) extremities take the form of long, narrow extensions from the main, bulbous central portion, which is about four miles long and two and a half miles in

a

Center of Cypress Lake showing the east end of the island. Photographed by Soper on June 4, 1939.

b

c

Bottom left: The same view as above, July 30, 1957.

Bottom right: Heavy growth of Hordeum and Grindelia along the lake edge in the west end of the reservoir, August 5, 1957.

Figure 13. Photographs of Cypress Lake.

width. A fairly large island (see Figures 13a, 13b) is situated in the eastern portion of this area, about three-quarters of a mile from the south shore.

The shoreline is characterized by numerous indentations forming many shallow coves and a few larger bays; the major ones are represented by the attenuated eastern and western extremities. Under normal conditions, the lake is fairly deep in most places, and the water is moderately fresh. During periods of low levels in the past, the water became distinctly alkaline. The immediate shoreline is usually narrow and gravelly, often studded with boulders. In a few places it is soft and marshy, or it has vertical, clay cut-banks several feet high which erode with relative rapidity from wave action.

The reservoir may be classed as mildly alkaline with a pH reading of 8.4-8.5.

The water level was relatively the same between the first and the second visits, but when visited on September 1 it had dropped one to two feet.

Vegetation of the Area

a. Aquatic Communities.

1. Wholly submersed: The lake level was close to maximum capacity with the result that in most places the water next to the shoreline deepened quickly so that depths of three feet or more were found within ten yards of the

water's edge. Potamogeton pectinatus, P. richardsonii, P. vaginatus, and Elodea canadensis were encountered along the muddier bottom in depths of two to four feet of water.

2. Partially submersed with floating leaves: Polygonum coccineum was rather scarce but found occasionally in places where the bottom was relatively muddy.

3. Partially submersed with aerial leafy stems: Encountered in sheltered situations were the following emergents: Rumex maritimus var. fueginus, Hippuris vulgaris, and Cicuta maculata.

b. Marginal Communities. A sand gravel beach was found around much of the lake with the result that marginal aquatics were not common. Those that were found were Eleocharis acicularis, E. palustris, Juncus balticus var. montanus, Rumex mexicanus, Ranunculus cymbalaria, R. sceleratus, Rorippa islandica, Potentilla anserina, and Mentha arvensis.

Salix interior was represented by only a few plants located on the dam.

c. Dry-land Communities. Mixed grass prairie was represented along the north facing slopes of the

southern escarpment, while the remainder of the area was occupied by shortgrass prairie.

Of especial interest was the collection of Crepis atribarba var. atribarba on June 20 from the north side of the south escarpment at the west end of the lake. The plant was apparently new to Saskatchewan.

Plant Succession

The construction of dams at Cypress Lake was completed in 1938 and 1939.

Soper (1942) visited the area in that year and found that "in some sections there appears to be a very heavy subaquatic flora." On the basis of his very general description it would appear that the lake had come very close to reaching the degree of stabilization evidenced during the present study.

An examination of Cameron's (1946) study also reveals that stabilization had been reached. The only possible exceptions to this are that he records Myriophyllum present, at intervals, in "dense beds" while very little was observed by the author and that he records "isolated stands" of Potamogeton perfoliatus--also not observed by the author. It is possible that the latter should have been P. richardsonii, a plant of common occurrence in 1957.

The speed with which vegetational stabilization appears to have occurred is believed to be due solely to the fact

that a well established lake existed before the dams were constructed and that the rate at which the water rose after damming was slow enough to allow the plants to move up with it.

Waterfowl Potentialities

Table V gives the past and present waterfowl presence and abundance at the Cypress Lake Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

The large size of the reservoir with accompanying heavy growths of aquatic plants for food make this area an ideal one for waterfowl. An estimated population of 10,000 birds makes this the largest number encountered at any of the water bodies under study and probably the largest population at any water body in extreme southwestern Saskatchewan.

Conditions are not good for marsh nesting birds due to the almost complete absence of emergent plants for nesting sites.

On July 29, ninety-six Canada Geese were observed near the island in the center of the lake. Residents indicated that these birds nested on the island.

Informants indicated that large populations of ducks and geese use the lake as a congregation point in the fall.

The vegetation in the lake is regarded as being relatively stable, and little change in resident waterfowl populations is expected in coming years.

TABLE V

CYPRESS LAKE, WATERFOWL PRESENCE AND ABUNDANCE

Species	Soper July 10 1936	Soper June 4 1939	Soper June 23-25 1942	Cameron July 27 1946	Bird All Visits 1957
Canada Goose	-	-	9	7	6
Mallard	1	1	2	3	1
Gadwall	-	-	11	6	4
Pintail	2	2	4	1	9
Green-winged Teal	-	-	12	-	-
Blue-winged Teal	7	5	5	5	3
Baldpate	4	3	1	9	2
Shoveller	5	4	3	10	8
Redhead	8	-	10	-	-
Canvas-back	6	-	8	2	7
Lesser Scaup	3	6	6	8	5
American Golden-eye	-	-	-	11	-
Bufflehead	-	-	13	-	-
White-winged Scoter	-	-	-	-	10
Ruddy Duck	-	-	7	4	-
American Merganser	-	-	-	12	-
Totals	1000-2000	1000-2000	3000-4000	10,000+	10,000

Middle Creek Reservoir

Location

Middle Creek Reservoir (see Figure 14) may be reached by traveling 14.7 miles north of Govenlock to Battle Creek, going 2.7 miles southwest to Middle Creek, and then going about five miles west-southwest along a prairie trail.

The dam in connection with this reservoir is located in the northeast quarter of Section 21, Township 5, Range 30 west of the third Meridian. It lies about one mile east of the boundary between Saskatchewan and Alberta, 27.5 miles north of the International boundary, and approximately six miles south of the southern fringe of Cypress Hills. Govenlock is 14.5 miles to the southeast, and Fort Walsh is 13 miles northeast. In the township and range in Saskatchewan, already given, it occupies fractional portions of Sections 9, 16, 17, 20, 21, 28, and 29 and in Alberta, parts of Sections 13, 24, 25, 26, 34, and 35, Township 5, Range 1 west of the fourth Meridian. The portion in Alberta is small, as the main body of water lies east of the fourth Meridian.

History

This reservoir was created by impounding the waters of Middle Creek which constitutes a part of the Missouri drainage system. The work was completed by P.F.R.A. in 1937.

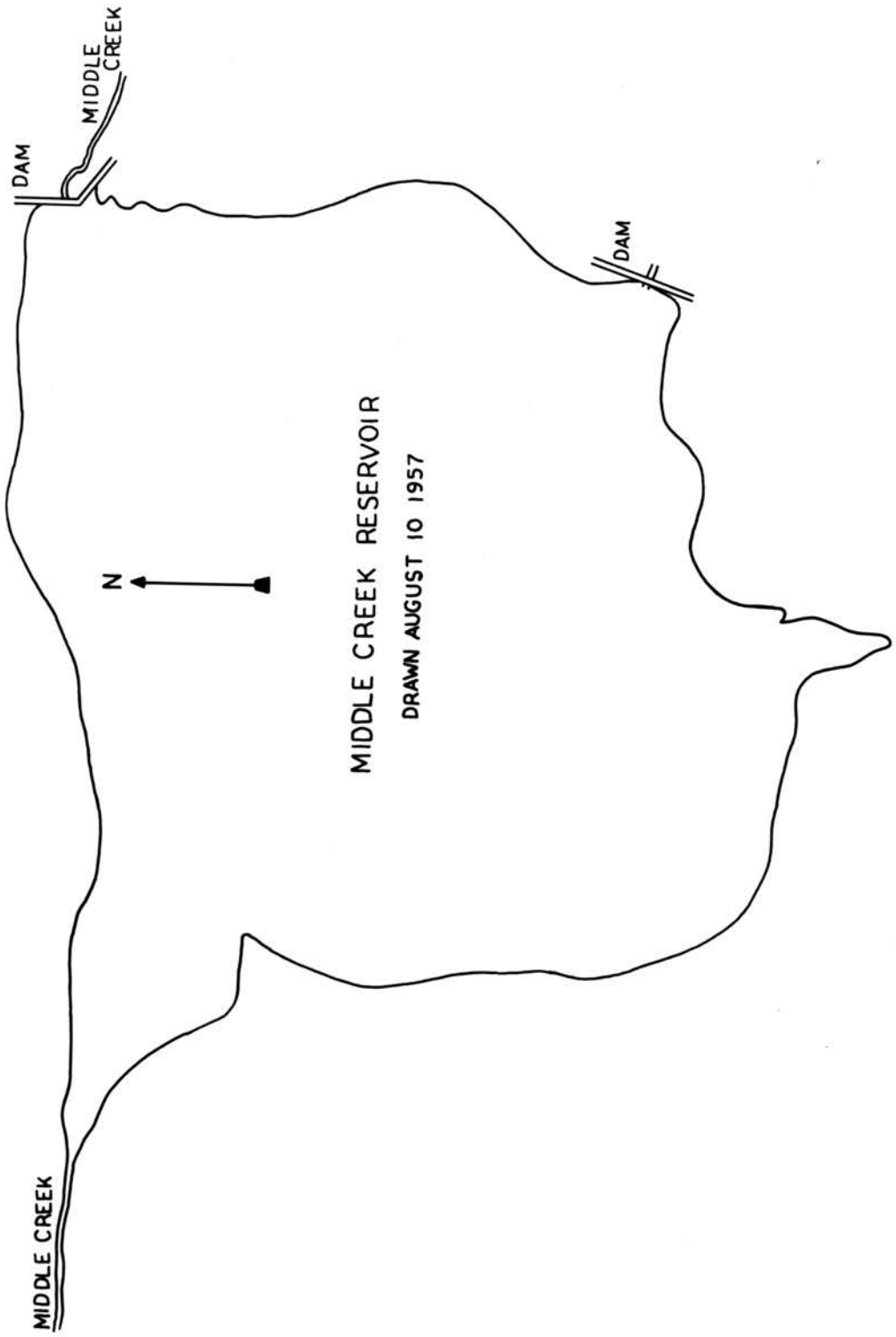


Figure 14. Map of Middle Creek Reservoir. (2 by 2 miles)

Soper's 1942 report contained some of the early history of this reservoir.

> At the time of the July inspection [July 5, 1937] a very considerable body of water lay in the basin above the dam. It is difficult to state the area covered, but it was apparently about six tenths of the area projected, or about 900 acres. Several feet of water obtained over a substantial area immediately above the dam. Over a wide tract elsewhere it was still shallow but extended in the irregular natural basin almost to the Alberta border.

On June 4, 1939, Soper reported that "The water is up to a few feet of maximum level."

Figure 15 shows changes in the shoreline over an eleven year period.

Description of the Surrounding Area

The terrain to the north and west of the reservoir is comparatively bold and rolling with an average altitude of about 3,600 feet above sea level. In some parts of this sector, it ascends sharply from 100 feet or more to undulating benchlands. These give rise, in turn, to successively higher ridges approaching Cypress Hills, where elevations of over 4,000 feet occur. A narrow tongue of the lake basin extends up a valley for a mile or two on the west side of the lake, the distance depending upon the height of the water in the reservoir. Rather extensive flats are found on the floor of this valley and one, with slight inclination to the north, also occurs along the north shore where it is hemmed in by hills. Contours of the land are rounded gently with wide, open draws leading to the lake.

a

North-east corner of the reservoir as photographed by Cameron on August 12, 1946.

b

c

Bottom left: The same view as above following erosion and a rise in the water level, August 10, 1957.

Bottom right: Scanty vegetation around the northern edge of the reservoir, June 24, 1957.

Figure 15. Photographs of Middle Creek Reservoir.

Directly east of the dam, in the valley of Middle Creek, are broad, level bottomlands, part of which are now under irrigation.

The broad plains to the south and east of the reservoir are generally lower and more gently undulating than to the north and west. Slopes rising from the lake are low and extended with smoothly flowing lines. Drainage depressions are usually shallow and grassy with little evidence of erosion. While most of this territory is only moderately rolling, a few ridges traverse the country imparting somewhat bolder lines to the landscape. Few of these exceed 50 to 75 feet in height. Here the average elevation above sea level is about 3,300 feet.

South and southeast of the reservoir these rolling plains are characterized in wet years by numerous sloughs in the broad depressions. These are highly attractive to waterfowl and support heavy breeding populations. Ducks Unlimited has improved many of these water bodies and calls them the "Orleans Lakes." They are normally alkaline and are fairly shallow with muddy shorelines.

The surrounding country is devoted almost entirely to ranching. In favorable lowlands, however, ranchers raise limited quantities of oats, alfalfa, hay, and vegetables. Farther east and south dry farming is common.

Reservoir Description

Water area above the dam is approximately 1,350 acres, and the storage capacity is 20,000 acre-feet. The reservoir serves to irrigate 1,000 acres of land on which legume crops are grown as a supplementary food for range stock.

At average capacity the waters of the reservoir will lie at an elevation of about 3,350 feet above sea level. The drainage area tributary to the point of diversion at the dam is about 155 square miles.

Middle Creek has its origin in Cypress Hills to the north-northwest. It flows in a general southerly direction for a distance of about 60 miles to join Lodge Creek, 10 miles south of Govenlock; this stream, in turn, flows to the Missouri River in Montana. Middle Creek is a small stream averaging only a few feet in width.

The reservoir is a fair-sized body of water with dimensions of roughly two miles by two miles. Of this large area, however, only the northern portion, where the old river channel is found, is covered by deep water; the rest of the lake is three or four feet deep, and many places are much shallower. P.F.R.A. soundings record the greatest depth at 45 feet. The outline is fairly irregular with occasional embayments being found. The water is fresh, of a brownish tint, and generally opaque, especially after periods of rough water.

The reservoir may be classed as mildly alkaline with a pH reading of 8.4 plus.

The water level apparently fluctuated less than one foot during the two visits made to the area.

The Vegetation of the Area

a. Aquatic Communities.

1. Wholly submersed: The western arm of the reservoir, which runs into Alberta, was fairly shallow and contained rich beds of submersed aquatics. The plants also occurred in moderate numbers along the southern edges of the lake and sparsely elsewhere. Species encountered were: Potamogeton foliosus, P. pectinatus, P. richardsonii, P. vaginatus, Zanichellia palustris, Ranunculus subrigidus, and Myriophyllum exalbescens.

2. Partially submersed with floating leaves: Occasional stands of Alopecurus aequalis were found in both the western arm and in the southeast corner of the lake.

3. Partially submersed with aerial leafy stems: Plants of this category occurred with scarce to regular abundance and were represented by: Alisma gramineum, Beckmannia syzigachne, Rumex maritimus var. fueginus, Hippuris vulgaris, and Limosella aquatica.

b. Marginal Communities. One grass, Distichlis stricta; two sedges, Carex douglasii and C.

lanuginosa; and one spike rush, Eleocharis palustris, were of scarce to common abundance. Additional herbs were Equisetum hyemale var. intermedium, Polygonum lapathifolium, P. scabrum, Rumex mexicanus, Ranunculus cymbalaria, Rorippa islandica, Potentilla anserina, P. paradoxa, Collomia linearis, Plagiobotrys scopulorum, Aster brachyactis, and Senecio congestus var. palustris.

Two willows, Salix amygdaloides and S. interior, were represented by young plants occurring in widely scattered areas. It is probable that under favorable conditions they will increase greatly in numbers.

c. Dry-land Communities. Just back of the marginal aquatic zone an area of weedy annuals usually was encountered. The chief grass in this zone was Hippuris vulgaris.

With the exception of the river bottom, the entire surrounding area was covered with shortgrass prairie.

Plant Succession

The construction at Middle Creek Reservoir was completed in 1937.

The only valuable previous record relating to the vegetation of the area is that of Cameron (1946). The majority of his observations agreed completely with what was observed

during this study. The exception was his remark: "The only sub-aquatic noted on the reservoir was the Sago Pondweed [Potamogeton pectinatus] and then only in a few isolated stands." As previously noted, the writer collected Potamogeton foliosus, P. richardsonii, P. vaginatus, Zanichellia palustris, Ranunculus subrigidus, and Myriophyllum exalbescens in addition to Potamogeton pectinatus. This would infer that the above have all moved in since 1946 or, more likely, that at least some were present then but escaped Cameron's scrutiny.

Waterfowl Potentialities

Table VI gives the past and present waterfowl presence and abundance at the Middle Creek Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

Marsh nesting birds were represented poorly due to the absence of emergent vegetation. Land nesting birds, however, were well represented but were restricted to certain specific areas. The largest populations were found in the vicinity of the mouth of Middle Creek where extensive shallows prevailed and where heavy growths of submerged aquatics were present.

It is apparent that the vegetation has reached a fairly high degree of stability and, hence, the waterfowl population probably will fluctuate, in the future, only in relation to the regional waterfowl numbers.

TABLE VI

MIDDLE CREEK, WATERFOWL PRESENCE AND ABUNDANCE

Species	Soper July 5 1937	Soper June 19-23 1941	Soper June 22 1942	Cameron Aug. 9-15 1946	Bird All Visits 1957
Canada Goose	-	-	10	7	-
Mallard	1	1	3	2	1
Gadwall	-	-	-	5	3
Pintail	2	4	2	1	6
Blue-winged Teal	4	5	4	4	4
Baldpate	-	2	1	3	2
Shoveller	3	3	5	-	7
Redhead	-	8	6	-	8
Canvas-back	-	12	8	-	-
Lesser Scaup	-	6	-	-	5
American Golden-eye	-	7	-	6	9
Bufflehead	-	11	7	-	-
White-winged Scoter	-	10	-	-	-
Ruddy Duck	-	9	-	8	-
American Merganser	-	-	9	-	-
Totals	350	?	?	500	800

Lee's Lake Reservoir

Location

The reservoir (see Figure 16) is located in Section 14, Township 14, Range 26 west of the third Meridian. It is approximately 10 miles east-southeast of Golden Prairie and is 13.8 miles north on Highway 21 from the junction of this highway and the Trans Canada Highway. Distance north of the International boundary is 81 miles.

History

Lee's Lake is a part of the Tenaille Lake Irrigation System which was completed in 1939 by the Department of Agriculture under authority of the Prairie Farm Rehabilitation Act. The construction of the dam apparently altered the lake only slightly, but it is serving to prevent rapid fluctuations in the water level. Hence, it is an aid in the growth of aquatic plants.

Description of the Surrounding Area

The terrain surrounding Lee's Lake is level or gently rolling and lacks the precipitous coulees and escarpments characteristic along the Frenchman River.

In its pristine condition the dominant vegetation is shortgrass prairie, but this is seldom in evidence, as most of the area is utilized for grain and mixed farming.

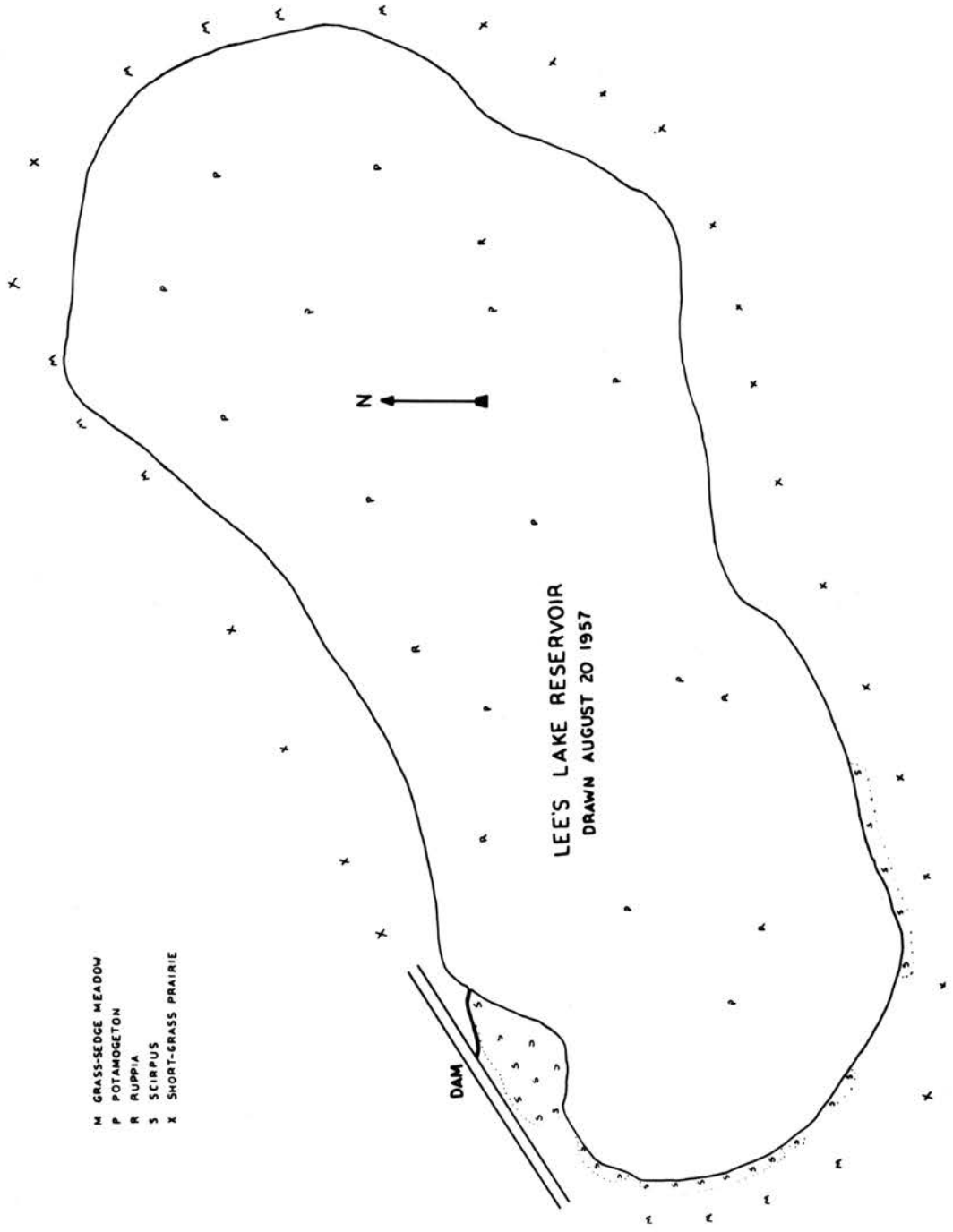


Figure 16. Map of Lee's Lake Reservoir. (2/3 by 1/5 miles)

Reservoir Description

The lake is not used actively now for irrigation purposes, but it serves the function of a reserve supply of water, should such be needed, and as a stock-watering pond.

Lee's Lake is the smallest of the water bodies under study. It is approximately two-thirds of a mile long along an axis running from the east-northeast to the west-southwest. The width is fairly uniform and is about 300-400 yards. The depression in which the lake is found is a part of a creek bottom leading into Maple Creek.

The lake is shallow and probably is not over five feet in depth at a maximum. The color of the bottom is yellow, and the bottom deposits are sand and silt. There is more sand along the southern shoreline than along the northern. A six to ten foot strip all around the reservoir is a film of water with plant debris, green algae, and occasionally growths of Scirpus and Eleocharis overlying the sand and silt deposits (see Figure 17a).

On the bottom of the lake are frequent patches of green algae (Spirogyra ?) and scattered beds of Eleocharis. Toward the center are beds of Potamogeton.

Except for the west-southwest and the east ends, there is a sharp three to five foot bank all around the lake. On the lakeward side of this bank is a sparse ring of Populus and Salix in the central and east parts.

a b

Top left and right: Two different views of the marginal vegetation at Lee's Lake. The fringe plants along the water's edge to the right are Rumex maritimus var. fueginus. July 19, 1957.

c d

Bottom left: Heavy stand of Scirpus in the north-western corner of the reservoir, August 22, 1957.

Bottom right: Scirpus and Juncus along the south-western edge of the reservoir, August 22, 1957.

Figure 17. Photographs of Lee's Lake Reservoir.

The reservoir may be classed as mildly alkaline with a pH reading of 8.4 plus.

At the second visit (August 19) the lake level had dropped only a few inches. The fact that the lake was springfed may account for the small drop.

The Vegetation of the Area

a. Aquatic Communities.

1. Wholly submersed: Due to the small size of the water body and the muddy nature of the bottom, excellent conditions for wholly submersed plants prevail. The water was found to accomodate heavy growths of Potamogeton pectinatus, Ruppia occidentalis, and commonly small clumps of Eleocharis acicularis.

2. Partially submersed with aerial leafy stems: The most common emergent encountered was Rumex maritimus var. fueginus (see Figure 17b). In places this plant formed a solid ring along the water's edge. Found in much smaller numbers was Cicuta maculata.

b. Marginal Communities. The ground in the northwest corner of the lake apparently was markedly saline, and salt crystals could be found coating the soil. Marginal aquatics found in this specialized area were Triglochin maritima, T. palustris, Distichlis

stricta, Scirpus americanus, and Salicornia rubra (see Figures 17c and 17d).

Marginal aquatics found in the remainder of the area included Equisetum hyemale var. intermedium, Puccinellia nuttalliana, Carex lanuginosa, Eleocharis palustris, Scirpus americanus, S. paludosus, Juncus balticus var. montanus, Chenopodium rubrum, Ranunculus cymbalaria, Epilobium glandulosum, Lycopus asper, Lactuca scariola, and Senecio congestus var. palustris.

In the northeast corner and along the south side, at a distance of around 10 yards from the water's edge, a sparse ring of Populus Sargentii, Salix amygdaloides, S. brachycarpa, and S. interior occurred.

To the east of the lake another water body with characteristic aquatics and marginal aquatics was found.

c. Dry-land Communities. On the high ground back of the north and south sides of the lake, shortgrass prairie occurred. This was partially diluted by mixed grass prairie with the inclusion of fair numbers of grasses such as Stipa comata.

Plant Succession

Lee's Lake was constructed in 1939 by a dam that apparently altered only slightly a lake already present. It is

to be expected, because of this, that the vegetation became stabilized very quickly merely by the slight extension of range of plants already present.

Regardless of the above, Cameron (1946) made two comments that indicated some change has occurred lately. He said that the "west shore of the lake is occupied by an excellent stand of (Typha latifolia)." The writer was unable to discover the presence of this plant during his study. Instead, large stands of Scirpus were found occupying the area along the western shore of the lake.

Cameron also remarked that the "Sago Pondweed (Potamogeton pectinatus) is the only truly aquatic plant growing on the lake bottom." The writer found that this plant was indeed very common but that large growths of Ruppia occidentalis and Eleocharis acicularis were also present.

Waterfowl Potentialities

Table VII gives the past and present waterfowl presence and abundance at the Lee's Lake Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

Lee's Lake was found to have the same population of waterfowl during the writer's study as when observed by Cameron. As the vegetation was believed to have reached a high degree of stabilization at both visits, this was to be expected.

TABLE VII

LEE'S LAKE, WATERFOWL PRESENCE AND ABUNDANCE

Species	Cameron August 19-21 1947	Bird All Visits 1957
Canada Goose	-	7
Mallard	1	1
Gadwall	7	-
Pintail	3	4
Green-winged Teal	5	-
Blue-winged Teal	2	3
Baldpate	6	2
Shoveller	4	-
Redhead	-	5
Canvas-back	-	6
Lesser Scaup	8	-
American Golden-eye	-	8
Totals	250	250

The presence of Canvas-back and Canada Geese is felt to be due to the proximity of Big Stick Lake where informants state nesting birds were found.

It is hard to conceive a pond with a better supply of aquatic duck food than this one. Nesting cover for land-nesters was plentiful in the form of tall grasses, weeds, and willow.

Piapot Reservoir

Location

The reservoir (see Figure 18) is found in Section 8, Township 14, Range 23 west of the third Meridian. It is one-quarter mile south of Piapot and 17 miles east-northeast of Maple Creek. The International boundary is 68 miles to the south, and the Alberta-Saskatchewan boundary is 39 miles to the west. The Cypress Hills, in which Bear Creek has its start, lie some 14 miles to the south.

History

In 1902, the Canadian Pacific Railway Company, seeking a supply of water for the station at the town of Piapot (see Figure 19b), created a reservoir just south of the town. This was done by empounding the waters of Bear Creek, a stream which flows north out of the Cypress Hills. The dam which was built served to raise the water level some four or five feet and prevented rapid fluctuations.

Description of the Surrounding Area

The terrain is fairly level with frequent low, rolling hills. To the northwest a few miles, rather extensive sand dunes and sand deposits are to be found.

The land is devoted to mixed farming, and those areas not under cultivation are dominated by shortgrass prairie.

The land immediately surrounding the reservoir is shortgrass prairie except in the occasional low-lying area

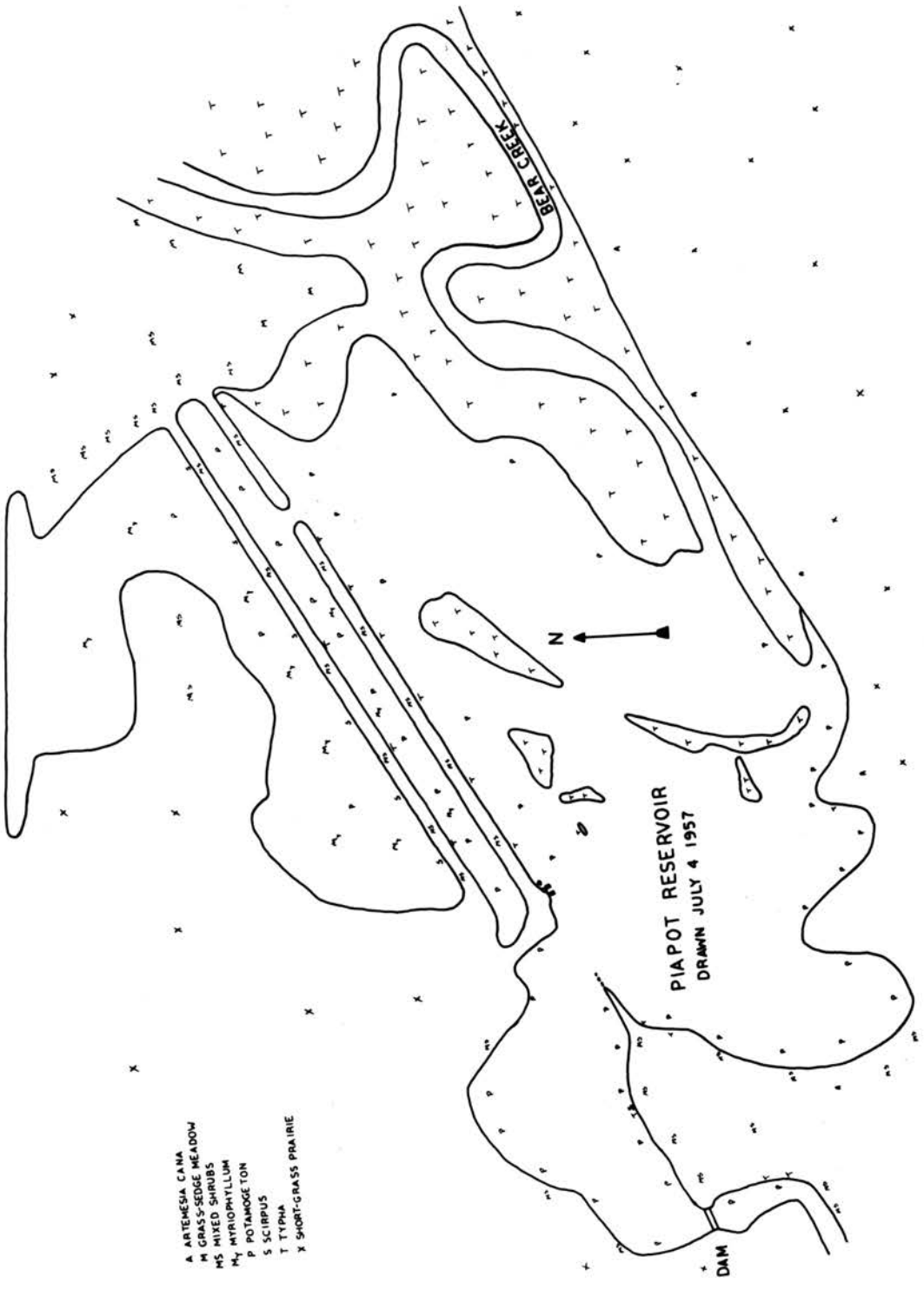


Figure 18. Map of Piapot Reservoir. ($\frac{1}{2}$ by 1/3 miles)

and along the creek margins where tall grasses and marginal aquatic plants are to be found.

Reservoir Description

This body of water serves the purpose of supplying water for trains and stock-watering but is not used for irrigation.

The elevation of the town of Piapot is 2,501 feet above sea level, and the elevation of the reservoir is close to 2,495 feet.

The Piapot Reservoir is rather small and only slightly larger than Lee's Lake. The main axis is from east to west with a length of one-half mile and a width of one-third of a mile in the widest part.

Two earth ridges (apparently the walls of a water-storage dugout) run almost the length of the water body, and being situated near the center, they serve to prevent excessive wave action and, hence, improve conditions for the growth of aquatic plants. The shoreline is irregular with many embayments. The lake is shallow (probably not over five feet), and the bottom sediments are sand and silt.

The reservoir may be classed as mildly alkaline with a pH reading of 8.4 plus.

At the second visit (August 22) the water level had dropped about one foot. Water no longer flowed over the dam, and dry sand-mud beaches were beginning to rim the

areas whereas before the water went to the edge of a sharp bank.

The Vegetation of the Area

a. Aquatic Communities. Due to the small size and irregular outline of the water body, aquatic plants were represented by substantial growths.

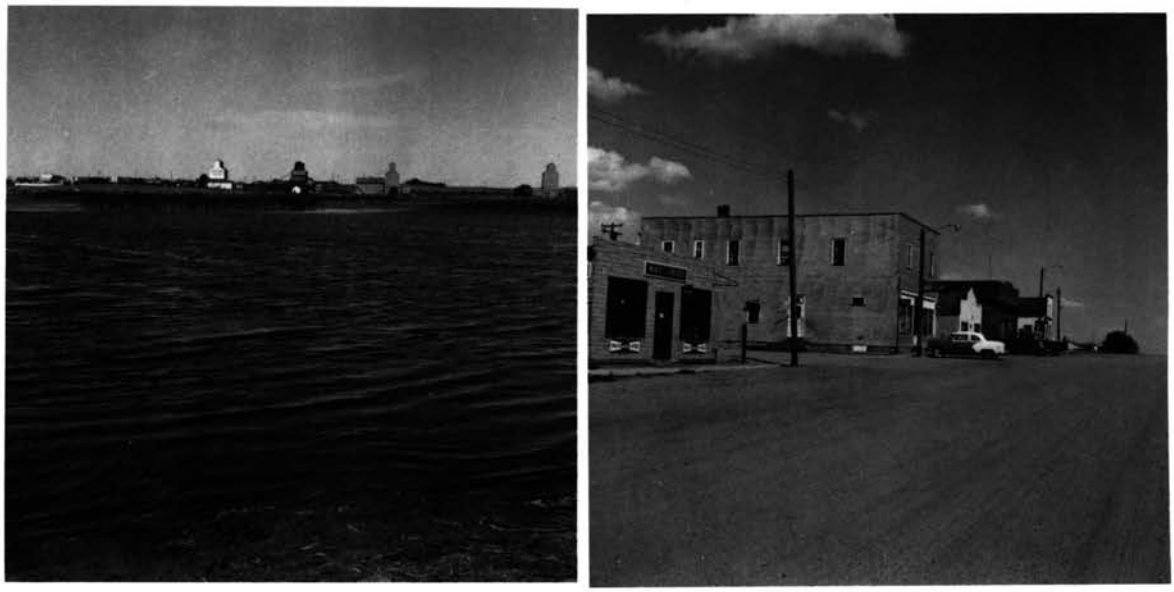
1. Wholly submersed: Substantial numbers of the following were found throughout the lake: Potamogeton pectinatus, P. richardsonii, Ranunculus subrigidus, and Myriophyllum exalbescens.

2. Floating: The only floating aquatic encountered was Lemna minor. This was generally scarce but locally common in occasional shallow protected areas associated with Typha latifolia.

3. Partially submersed with aerial leafy stems: As indicated by the map, very large stands of Typha latifolia were present (see Figure 19a, 19d). This is to be expected in reservoirs of this size that have had time enough to become fully stabilized.

Also indicated on the map are moderate stands of Scirpus validus var. creber.

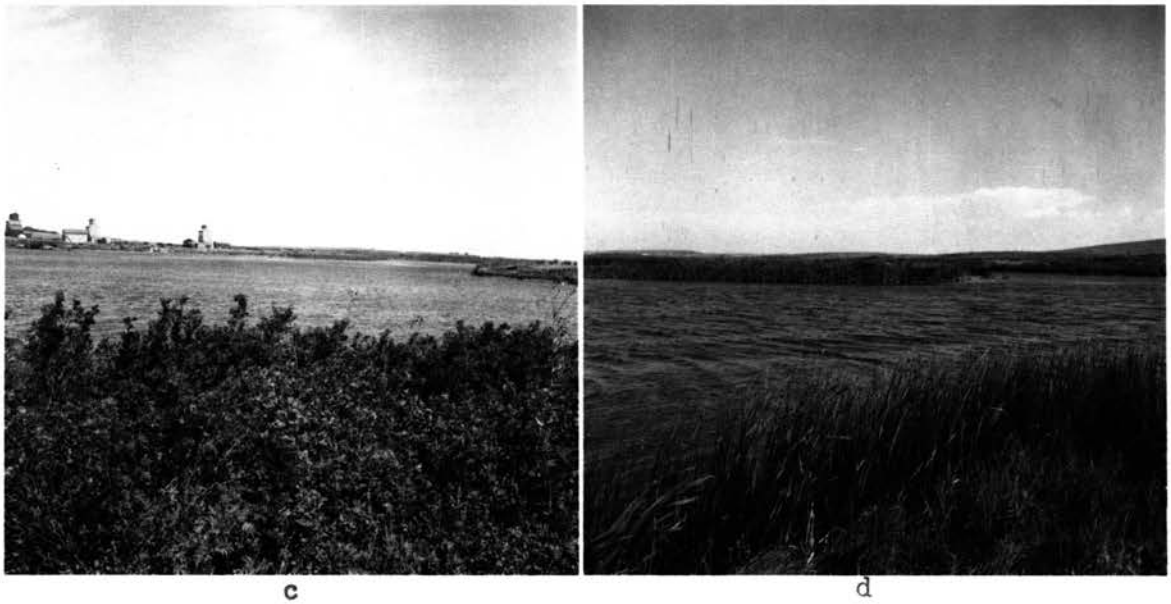
Rumex maritumus var. fueginus was commonly encountered along the water's edge.



a b

Top left: Piapot Reservoir in the foreground, the town of Piapot in the background, August 24, 1957.

Top right: Main street of a typical prairie town, Piapot, August 24, 1957.



c d

Bottom left: Dense tangle of roses in the foreground, Piapot Reservoir in the background, August 24, 1957.

Bottom right: Stands of Scirpus and Typha on the south side of the reservoir, August 24, 1957.

Figure 19. Photographs of Piapot Reservoir.

b. Marginal Communities. Three grasses, Calamagrostis inexpansa, Deschampsia caespitosa, and Puccinellia nuttalliana; two sedges, Carex aquatilis and C. lanuginosa; one bulrush, Scirpus americanus; and one rush, Juncus balticus var. montanus were commonly represented along the water's edge. Other characteristic herbs were: Equisetum arvense, E. hyemale var. intermedium, Stellaria calyacantha, Ranunculus cymbalaria, Potentilla anserina, Lycopus asper, Scutellaria galericulata var. pubescens, Bidens cernua, and Iva xanthifolia.

More alkaline areas in the northeast part contailed several additional species in Triglochin maritima, Distichlis stricta, and Spartina gracilis.

c. Dry-land Communities. A close examination of the accompanying map shows substantial numbers of shrubs. Perhaps the most common of these were roses (Rosa sp.) which formed very thick tangles close to the water's edge, especially in the southwestern end (see Figure 19c). Often associated with the roses were snowberry (Symphoricarpos occidentalis) and wolf-willow (Elaeagnus commutata). Small numbers of Artemesia cana were found extending into the surrounding shortgrass prairie in many places.

Plant Succession

The Piapot Reservoir was constructed in 1902. With 55 years between the establishment of the lake and the writer's study and 44 between that of Cameron, it is strongly felt that, in both cases, stabilization had been reached.

The only difference which the writer was able to find between Cameron's comments and the 1957 appearance of the water body was that Cameron recorded Potamogeton perfoliatus. This plant was not found by the writer; instead he collected P. richardsonii, a plant which Cameron may have mistaken for P. perfoliatus.

Due to the unique characteristics of the water body (age, small size, irregular outline, shallow, running water to deposit silt), it is in an ideal situation for the hypothetical hydrosere from water communities to dry-land communities. It is because of these characters that the writer feels it evidences the advanced flora that is present.

Waterfowl Potentialities

Table VIII gives the past and present waterfowl presence and abundance at the Piapot Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population. The letter "P" indicates that the species was present and that no order of abundance was made.

TABLE VIII

PIAPOT, WATERFOWL PRESENCE AND ABUNDANCE

Species	Cameron August 23 1946	Bird All Visits 1957
Canada Goose	P	4
Mallard	P	3
Gadwall	P	7
Pintail	P	6
Blue-winged Teal	P	2
Baldpate	P	1
Redhead	-	5
Canvas-back	P	-
Ruddy Duck	P	-
Coot	P	-
Totals	?	300

The Piapot Reservoir may be called an ideal habitat for waterfowl. It has reached stabilization and, due to the features already mentioned, supports an excellent variety and number of wildfowl food and cover plants.

On July 1, broods of Mallard and Blue-winged Teal were observed. Thirty-four Canada Geese also were observed. This group was composed of 8-10 adults and 24-26 fair-sized goslings. The birds were very secretive and quiet which indicated that the summer moult was underway.

Only slight variations in the waterfowl population may be expected to occur in this ideal water body.

Cameron (1946) claimed that this may "be regarded as a picture of future events in the lives of the P.F.R.A. reservoirs of today." The author feels that this may be stretching the point a bit as the other reservoirs studied by both Cameron and himself are generally much larger, have regular margins, deeper water, and much greater fluctuations in water level, thus indicating the need of a much longer period of time before the above situation will be reached, if at all.

Maple Creek Reservoir

Location

Maple Creek Reservoir (see Figure 20), also called Junction Reservoir or Dixon Dam, is found three miles north of the town of Maple Creek. It is 65 miles north of the International boundary and 22 miles east of the Alberta boundary. The lake is found in Sections 22, 27, 28, 29, 32, and 33 of Township 11 and Sections 4 and 5 of Township 12, Range 26 west of the third Meridian.

History

The reservoir was formed by throwing up an earth and rock-fill dam across a narrow part of the valley of Maple

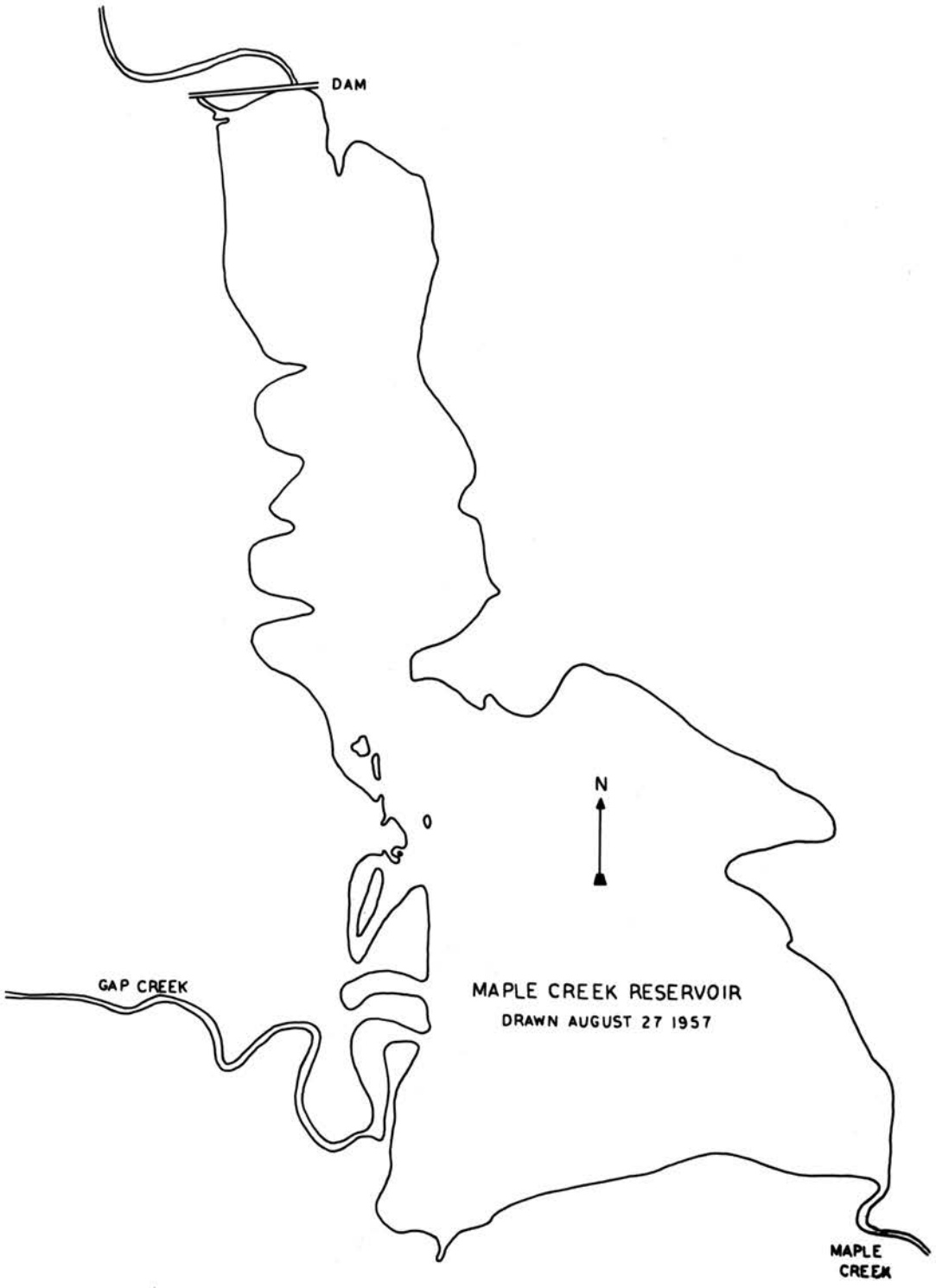


Figure 20. Map of Maple Creek Reservoir. (4 by 2 miles)

Creek. Work was carried out under the jurisdiction of the Prairie Farm Rehabilitation Act and completed in 1938.

Cameron (1946) commented on part of the past history of the lake:

> The [Irrigation] demands which are placed upon it are normally so great that by mid-summer both it and Downie are almost, if not completely dried-out. The writer visited the Maple Creek Reservoir on August 29, 1946, and it was absolutely dried-out at that time. The former bottom of the reservoir was a wide lush meadow clothed in a luxuriant verdure where horses and cattle were grazing.

Information obtained from local residents indicates that the reservoir has not been completely dried out for many years--perhaps as far back as 1946.

Description of the Surrounding Area

Land immediately surrounding the lake is gently rolling and devoted to pasture use. It is composed of shortgrass prairie on which some extensive stands of *Artemesia cana* and *A. frigida* are found (see Figure 21c, 21d). Irrigated land and canals are found to the south and southwest of the lake, while dry-land farming occupies the other areas.

Reservoir Description

This project has a total irrigable acreage of approximately 5,000 acres, including the Maple Creek flats adjoining the town of Maple Creek, and the "V" irrigation flats 20 miles north of town. In addition, an extra 3,500 acres of private flood schemes take water along the stream course through P.F.R.A. works. (P.F.R.A. Ann. Rept. 1955-56).

Although the storage capacity of the reservoir is 23,260 acre feet, the demands placed upon it are normally

great, and the water level drops quickly so that by fall some of the southern areas will become very shallow.

It is fed by Maple Creek and Gap Creek and may be replenished by allowing water to come downstream from the two reservoirs up Gap Creek.

The reservoir is three to four miles in length, approximately two miles in width at the southern end, and occupies 1,145 acres. The water in much of this large area is shallow, and in the southern end scattered clumps of emergent aquatic plants are prominent in the fall (see Figure 21a). The deepest parts in the south end are around the channels of Maple Creek and Gap Creek. In the central part these two creeks join, and from there to the dam at the north end, the water is much deeper with depths of 24 to 33 feet being common.

The color of the water is a light fawn and is opaque, especially after periods of churning of the bottom sediments by wave action.

The shoreline of the lake is fairly irregular, and low islands are to be found in the southwest corner.

According to information obtained from P. H. Edwards, Saskatchewan Fishery Officer, the lake had pH readings of 8.2 on the surface and 7.8 at a depth of 31 feet.

The water level showed a steady drop throughout the summer with a fall aspect of wide sand-mud beaches (see Figure 21b).

a b

Top left: Emergent groups of Polygonum in the shallow, southern end of the reservoir, August 28, 1957.

Top right: Rapid erosion along the vertical cut-banks around the southern edge of the reservoir, August 28, 1957.

c d

Bottom left: South-west end of the reservoir with short-grass prairie in the foreground and the town of Maple Creek in the background, July 4, 1957.

Bottom right: Opuntia in bloom on the short-grass prairie, July 4, 1957.

Figure 21. Photographs of Maple Creek Reservoir.

The Vegetation of the Area

a. Aquatic Communities

1. Wholly submersed: Although most of the shoreline was examined, no signs of wholly submersed aquatics could be found. It is possible that some beds of *Potamogeton* or other plant may be present, but if so it would seem hard to believe that they could be extensive.

2. Partially submersed with floating leaves: *Polygonum coccineum* appeared in good numbers in the southern end as the water level dropped and extensive shallows developed.

3. Partially submersed with aerial leafy stems: The most common plant in this category was *Rumex maritimus* var. *fueginus* which was found scattered all around the lake.

Small groups of *Beckmannia syzigachne* were encountered in several protected areas.

b. Marginal Communities. Two grasses, *Agrostis scabra* and *Deschampsia caespitosa*; two spike rushes, *Eleocharis acicularis* and *E. compressa*; one bulrush, *Scirpus americanus*; and one rush, *Juncus tenuis*, were scattered around the water's edge. Other herbs were *Polygonum lapathifolium*, *P. scabrum*, *Chenopodium glaucum* var. *salinum*, *C.*

rubrum, Ranunculus cymbalaria, Rorippa islandica, Epilobium glandulosum, Lycopus asper, Aster brachyactis, Bidens cernua, and Senecio congestus var. palustris.

Along the shoreline close to the dam a few young Populus sargentii, Salix amygdaloides, S. interior, and S. pseudomonticola were found. Salix interior also was observed on two of the small islands near the mouth of Gap Creek. In the future it is expected that the willows will greatly extend their present range.

c. Dry-land Communities. The surrounding land is composed of shortgrass prairie on which some extensive stands of Artemesia cana and A. frigida are found.

In the valley below the lake, good stands of Prunus virginiana, Amelanchier alnifolia, Crataegus sp., Symphoricarpos occidentalis, Rosa sp., and a few Acer negundo are to be found.

Plant Succession

Construction work on the Maple Creek Reservoir was completed in 1938.

Cameron (1946) visited the area on August 29, 1946, and found the lake dried-out and with a "meadow" type of vegetation. He also reported that it was almost completely devoid of aquatic vegetation.

With more favorable water conditions in recent years, better chances prevail for aquatic plants; but up to the present no submersed plants are recorded, and only three emergents are recorded.

More stability in water levels will have to be reached before the flora can be expected to develop.

Waterfowl Potentialities

Table IX gives the past and present waterfowl presence and abundance at the Maple Creek Reservoir. The numbers indicate the estimated total population.

TABLE IX

MAPLE CREEK, WATERFOWL PRESENCE AND ABUNDANCE

Species	Bird July 4 1957	Bird August 27-29 1957
Canada Goose	7	7
Mallard	1	1
Pintail	2	2
Blue-winged Teal	4	4
Baldpate	3	3
Redhead	6	6
Lesser Scaup	5	5
Totals	1000	10,000+

Cameron had no records on the 1946 duck population due to the fact that at that time the lake was dry.

The differences in the author's figures resulted from a large influx of Mallard and Pintail from surrounding water bodies. Those birds were observed in a very large concentration in the southwest corner of the lake from which they were feeding in nearby grain fields.

Due to the absence of submersed aquatics in this large lake, conditions are not good for waterfowl. Emergents suitable for nesting cover for marsh nesting species were totally absent.

Downie Reservoir

Location

The Downie Reservoir (see Figure 22) is to be found some 12 miles southwest of the town of Maple Creek. The lake is found in Sections 35 and 36 of Township 9 and Sections 1, 2, 11, and 12 of Township 10, Range 28 west of the third Meridian.

History

This reservoir is a part of the P.F.R.A. Maple Creek irrigation district. In 1936 work was commenced to empound the waters of a small creek flowing into Gap Creek by the construction of a dam across a narrow part of the valley of

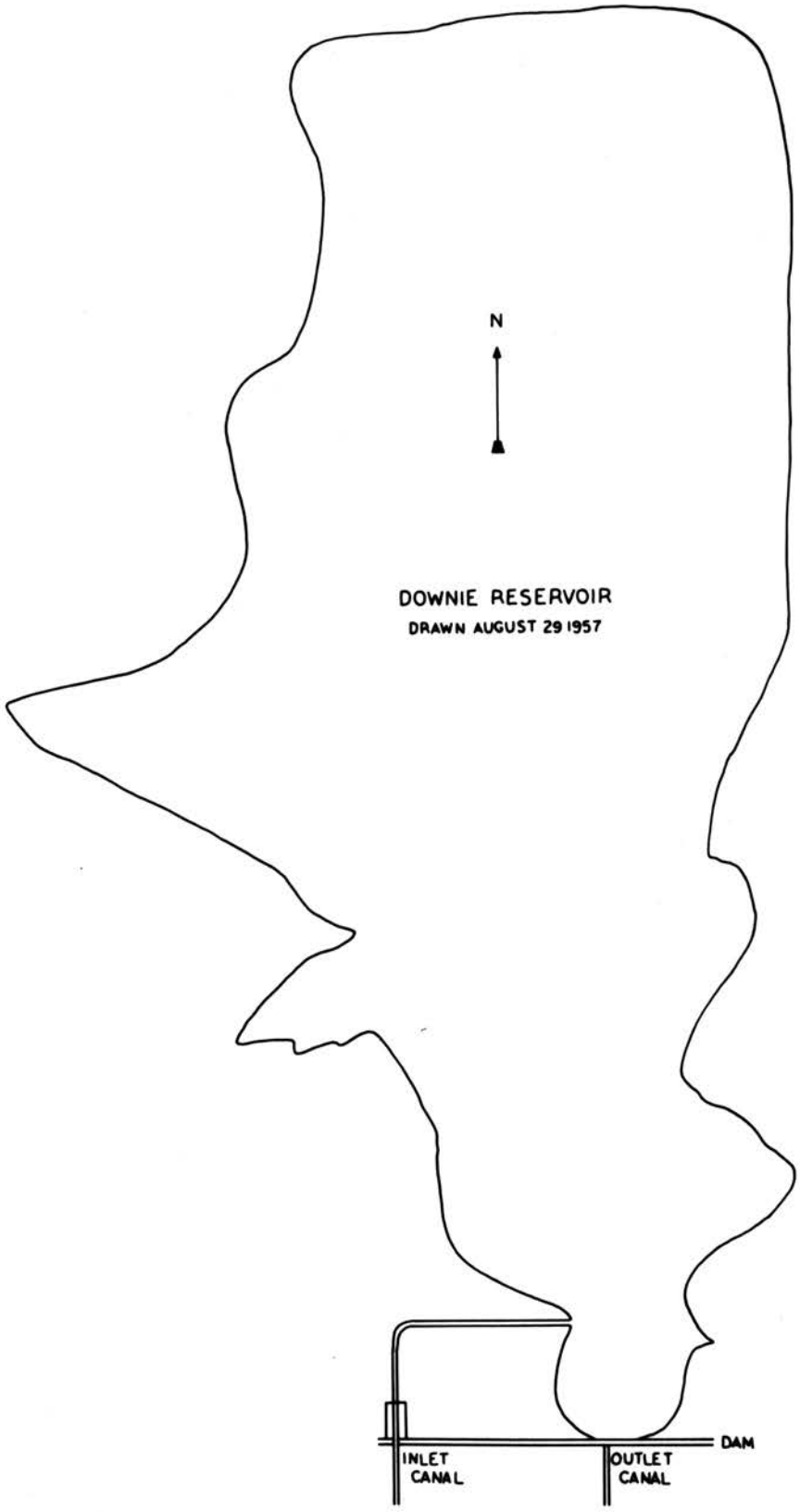


Figure 22. Map of Downie Reservoir. ($2\frac{1}{2}$ by $1\frac{1}{4}$ miles)

this creek. The dam and an inlet (see Figure 23c) and outlet canal were completed in 1937.

When Cameron visited the area on August 30, 1946, he found that "only a small remnant of the former quantity of water remained." Judging by one of Cameron's photographs of the area, the water level was indeed low--perhaps one to two feet below what the author observed on August 29, 1957.

Description of the Surrounding Area

The terrain around this reservoir is rolling and hilly and is a part of the foot-hills of the Cypress Hills which are less than 10 miles to the south.

The predominant land cover is shortgrass prairie, and ranching is the main industry. Only occasional dry-land farms are found.

Reservoir Description

The reservoir is designed to hold 10,000 acre-feet of water. The water is not used in the immediately surrounding district but is held in reserve until water is needed in the two reservoirs downstream--Harris and Junction.

A dam at the south end of the lake serves to hold the water which enters the depression through run-off from the north and through a canal which flows into the lake at the southwest end from Gap Creek. Water may be released from the lake by another canal, sending it into Gap Creek again. Gap Creek is about two miles southeast of the reservoir and

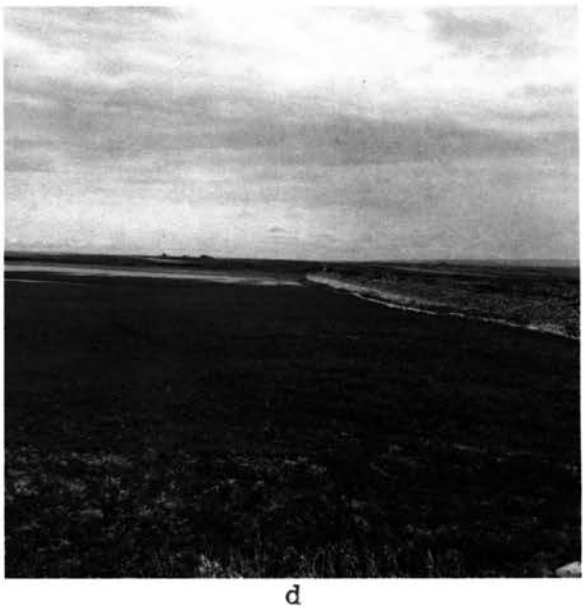
a

b

Top left: Mud flats to the north of the dam, August 31, 1957.

Top right: Eroded bank and the very wide beach in the south-east corner of the reservoir, August 31, 1957.

c



d

Bottom left: Mouth of the inlet canal, August 31, 1957.

Bottom right: Exposed flats which have become quickly vegetated with annual plants; south-west corner of the reservoir, August 31, 1957.

Figure 23. Photographs of Downie Reservoir.

flows north-northwest into the Maple Creek Reservoir some 14 miles away.

During the spring of the year, this reservoir must have been filled to near capacity, but when examined on July 5 the level had dropped some three or four feet, and many areas in the lake were of a shallow nature. When visited on August 29, the lake was found to have gone down another two to three feet, and extensive mud-flats dominated the south end while the entire shoreline was a wide sand-mud beach (see Figure 23).

Around the canal inlet in the southwest end of the reservoir, land dried very quickly and graphically illustrated the almost complete absence of aquatic plants except a few emergent plants of Polygonum natans. Almost everywhere the lake margin is composed of a sandy beach with very scanty marginal aquatics (the major plant being Potentilla anserina L.). Aquatic growth is composed chiefly of a green alga (probably Spirogyra sp.).

The water is opaque and of a muddy-fawn color. The color is mostly due to soil particles held in suspension and to a certain amount of phytoplankton and zooplankton growth. Due to the shallow nature of the lake, wave action results in much churning of the bottom sediments.

The reservoir may be classed as mildly alkaline with a surface pH reading of 8.2.

At the first visit to the area (July 5) it was determined that the water level had dropped some three to four feet since spring. By the second visit (August 29) the level had dropped another two to three feet, and extensive mud-flats were evidenced along the south side while the entire shoreline was a sand-mud beach.

The Vegetation of the Area

a. Aquatic Communities

1. Wholly submersed: Although extensive searches were made, no plants of this category were found. It is possible that small groups may have eluded the observer.
2. Partially submersed with floating leaves: A few Alopecurus aequalis were found stranded on the mud bank in the southwest corner on the last visit.
3. Partially submersed with aerial leafy stems: Stranded plants of this grouping included small numbers of Beckmannia syzigachne and large numbers of Rumex maritimus var. fueginus and Polygonum natans.

b. Marginal Communities. In an area such as this which undergoes great drops in water level, it is expected that the marginal communities will be made up of large numbers of weedy annuals which will germinate quickly and will grow as mud-flats are

drained. The following listing includes these as well as a few perennial plants which are of relatively large ecological amptitude: Alisma triviale, Echinochloa crusgalli, Carex douglasii, Eleocharis acicularis, Rumex mexicanus, Chenopodium glaucum var. salinum, Rorippa islandica, Potentilla anserina, Lycopus asper, Mentha arvensis, and Stachys palustris.

c. Dry-land Communities. The surrounding land is covered with shortgrass prairie. A few low roses (Rosa sp.) and sagebrush (Artemesia cana) are found on the prairie next to the lake.

Plant Succession

Dam construction was commenced in 1936 and completed in 1937.

At the time of Cameron's (1946) visit, the lake was "almost completely devoid of aquatic vegetation." Cameron blamed this condition on "extreme fluctuations in water levels."

The writer could find no submersed aquatics and only a few widely scattered emergents at this area. Great amounts of water had been taken from it, as apparently is the practice with a body of this sort which is used to replenish water supplies in lower lying reservoirs used directly for irrigation. The writer agrees with Cameron in attributing the absence of aquatics to unstable water levels.

Waterfowl Potentialities

Table X gives the past and present waterfowl presence and abundance at the Downie Reservoir. The numbers indicate the order of abundance, while the totals indicate the estimated total population.

TABLE X

DOWNIE, WATERFOWL PRESENCE AND ABUNDANCE

Species	Cameron August 20 1946	Bird July 4 1957	Bird August 27-29 1957
Canada Goose		2	1
Mallard		1	2
Totals	12-	15	200

Due to the absence of submersed aquatics and scarcity of emergent aquatics, caused by great fluctuations of water level, this water body is quite unsuitable for waterfowl.

The table indicates very low populations except on the author's last visit to the area. The reason here was the presence of 195 Canada Geese on the mud-banks in the southwest corner. These birds apparently were using the lake as a resting place while feeding in nearby grain fields.

Two Mallard broods were seen on July 5, and informants state that two pairs of Canada Geese and broods were observed on the lake.

SUMMARY AND CONCLUSIONS

History

In this area of Canada, the various features of the climate combine to produce a semi-arid vegetation. The dominant method of land utilization is ranching. Dry-land farming is carried on, but in many cases it is on marginal or submarginal land.

In the early part of the century, empoundment projects were carried out on a small scale. In 1902, the Canadian Pacific Railway constructed the Piapot Reservoir to provide water for its station. A small dam was built at Eastend in 1906 to provide irrigation water for the crops of two ranchers, but this washed out in 1918.

In order to acquire the water needed for more extensive and profitable agriculture, the farmers and ranchers voiced their problems to the Canadian Department of Agriculture. The Prairie Farm Rehabilitation Act was set up, and through its authority many artificial lakes, stock-watering ponds, and dugouts were built. The peak of construction, in this area, corresponds roughly with a few years after the serious and devastating drought of the early 1930's. In 1936, the Val Marie Reservoir was built. This was followed in 1937 by Eastend, Middle Creek, and Downie Reservoirs. Maple Creek

Reservoir was built in 1938; Cypress Lake and Lee's Lake were finished in 1939; and West Val Marie Reservoir was completed in 1941.

General Reservoir Descriptions

All of the reservoirs in this study have been formed by building an earth and rock-fill dam across a narrow place in the valley of some water course. Four of the reservoirs, Cypress Lake, Eastend, West Val Marie, and Val Marie, are on the Frenchman River. One reservoir is on Middle Creek which flows south alongside the Frenchman River to eventually join the Missouri River system.

The other reservoirs are on the north side of the Cypress Hills and, hence, are on streams which flow north. Downie, Maple Creek, and Lee's Lake are on the Maple Creek system which flows into Big Stick Lake, while Piapot is on Bear Creek which flows into Crane Lake.

General Vegetational Features of the Areas

The reservoirs studied are, in general, large, shallow to deep bodies which exhibit a fair range of submersed aquatics. The most common examples were Potamogeton pectinatus, P. richardsonii, and Myriophyllum exalbescens. The most commonly encountered emergent aquatics were Typha

latifolia, Polygonum coccineum, Beckmannia syzigachne, and Scirpus validus var. creber.

Marginal aquatics commonly encountered were Juncus balticus var. montanus, Eleocharis palustris, Distichlis stricta, Puccinellia nuttaliana, Hordeum jubatum, Carex aquatilis, C. lanuginosa, and a number of annual weeds.

The dry-land communities were represented by sagebrush flats, mixed grass prairie, shortgrass prairie, and ravine and stream bottom shrubs and trees.

The sagebrush flats were dominated by Artemesia cana, A. frigida, and Sarcobatus vermiculatus. The mixed grass prairie was composed chiefly of Stipa viridula, S. comata, and several Agropyrons. The shortgrass prairie was characterized by such grasses as Bouteloua gracilis, Koeleria cristata, and several Poas. Shrubs and trees commonly found in the ravines and stream bottoms were Salix spp., Rosa spp., Shepherdia argentea, Symphoricarpos occidentalis, Elaeagnus commutata, Amelanchier alnifolia, and Prunus virginiana.

Plant Succession

1. Time required to reach aquatic plant stabilization: It may be stated with certainty that all of the artificial water bodies examined by the writer had reached a strong degree of vegetational stabilization. It was, therefore, necessary to examine the

reports of Soper and Cameron in order to determine the length of time required for this stabilization to occur. On this basis, the rather indefinite information obtainable was as follows:

TABLE XI

RATES OF STABILIZATION

Area	Date Completed	Dates of Past Vegetational Records	Earliest Record of Vegetational Stability	Elapsed Interval
West Val Marie	1941	1942, 1946	1946	5 years
Val Marie	1936	1937, 1941, 1946	1941?	5 years?
Eastend	1937	1937, 1942, 1946	1942	5 years
Cypress Lake	1939	1942, 1946	1942	3 years
Middle Creek	1937	1942, 1946	1942	5 years
Lee's Lake	1939	1946	1946	7 years
Piapot	1902	1946	1946	44 years
Maple Creek	1938	1946	1946	8 years
Downie	1937	1946	1946	9 years

This table is not exact because of the absence of early records on the vegetation of the areas. If, however, one examines the first five areas apart from the other four, it is apparent that the maximum time required for the vegetation to become stabilized was three to five years. It is

suspected that the average time would have worked out closer to three if more records had been available.

This conclusion closely parallels that of Rawson and Ruttan (1952) who worked on similar areas in Saskatchewan while examining limnological conditions: "New reservoirs appear to reach full biological productivity in three years." Moyle and Hotchkiss (1945) indicated that stabilization occurred in five years or less on the basis of Minnesota records.

2. Factors affecting the development of aquatic vegetation: According to Penfound (1953):

> The conditions for the development of macroscopic plants in lakes may be classified as physical, chemical, and biotic. Physical factors include amplitude of water levels, turbidity, sedimentation, type of bottom, and depth and temperature of the water. Of the chemical factors, oxygen tension, carbon dioxide, nutrients, acidity, and alkalinity are the factors most investigated. Of the biotic agencies, man is paramount, since he builds and manages reservoirs. Plant competition is important in determining succession and dominance. Animal activities such as the feeding of rough fishes, aquatic mammals, and migratory waterfowl undoubtedly contribute considerably to the development and distribution of the higher aquatic plants.

   a. Physical factors: In the reservoirs studied, fluctuations in water level are believed to be the most important factor in controlling aquatic plant development. Of the nine reservoirs, Piapot, Lee's Lake, and to some extent

Cypress Lake and Middle Creek Reservoirs showed little fluctuations and also showed good growths of aquatics. On the other hand, West Val Marie, Val Marie, Eastend, Maple Creek, and Downie Reservoirs showed moderate to great fluctuations and correspondingly poor growths of aquatics.

The reservoirs are not naturally turbid but become so after periods of heavy winds. As winds are common, turbidity is almost always evident. Of course, the larger water bodies are prone to more wave action and hence will be more turbid than smaller bodies.

Penfound (1953) found that:

> The type of bottom is very important in the ecesis of lake plants. The poorest growth occurs on nearly pure sand, gravel, or rock, whereas the best growth is upon organic muds, or upon soft, silty, or clayey inorganic muds.

As mud occupied the majority of the bottoms of all areas, edaphic conditions were generally good.

In the turbid conditions encountered, depth of water is exceedingly important as rate of photosynthesis decreases progressively with depth (Meyer and Heritage, 1941). Aquatics were not observed at depths over four feet; however, the writer was not able to

sample at greater depths and may have missed other records. In the deeper lakes the turbidity-depth relationship considerably restricted the growth of aquatics.

b. Chemical factors: It was determined that the water bodies studied were moderately alkaline with a pH of 8.0 - 8.6, but no further chemical factors were considered. Alkalinity is a potent factor in determining the species present in a lake and, no doubt, influenced the vegetation of those bodies.

c. Biotic factors: Man has been the most important factor affecting these reservoirs, as it was he who built them and later controlled the water levels.

A sizable population of carp was found to occur at Val Marie, West Val Marie, and Eastend Reservoirs. These reservoirs also were found to be turbid and to have low numbers of submersed aquatics. It is felt that the carp may have been an important factor in retarding aquatic growth.

Carp were introduced into America in 1877 (Cole, 1904) and soon spread to occupy almost all natural water bodies in the country (Smith, 1895, 1908; Trippensee, 1953; Wing, 1951). Carp food is mostly animal matter, but

if animal matter is scarce, they will take more plant material (Grafin von Maltzan, 1935; Mitra and Mohapatra, 1956; Moen, 1953a, 1953b). The feeding habits of carp result in the uprooting of many plants and in the restriction of many others by causing turbidity (Brown, 1922; Cahn, 1929), as has been proved by the control experiments of Anderson (1950), Black (1946), Garlick (1956), Ricker and Gottschalk (1940), Threinen and Helm (1954), Tryon (1954), and Weier and Starr (1950). Carp must be taken into account in studies of this sort, and their control should be considered if they prove deleterious enough to disrupt management plans.

Aquatic mammals present in most areas were muskrat and beaver, both of which feed on aquatic vegetation, but apparently they were only very minor factors in plant development.

Waterfowl were abundant on all reservoirs and, no doubt, assumed an important role in the distribution of aquatic plants by fruits and seeds adhering to feathers (Arber, 1920) and by passing out viable seeds in fecal material (Guppy, 1893).

Waterfowl Potentialities

1. Populations: The nine water bodies were found to have an over-all population of 13,265 birds. As all of the water bodies are considered to have stabilized aquatic vegetation, it is felt that the future waterfowl population changes on them will be concerned more with waterfowl populations in the whole prairie region than with vegetational changes on the reservoirs themselves.
2. Waterfowl food: With the exception of Downie and Maple Creek Reservoirs, food for waterfowl is relatively plentiful and consists of the following groups: Potamogeton, Scirpus, Chara, Polygonum, Myriophyllum, Carex, Ruppia, and a few minor foods including Eleocharis, Sagittaria, Alisma, Lemna, Ranunculus, Zanichellia, and Hippuris (Martin and Uhler, 1951). Potamogeton pectinatus, P. richardsonii, Myriophyllum exalbescens, and Polygonum coccineum were considered to be the best food plants.
3. Aquatic nesting and brooding cover: With the exception of a very few stands of Typha latifolia and Scirpus validus var. creber, plants of this category were absent.
4. Dry-land nesting and brooding cover: Though all areas were surrounded by shortgrass prairie, there

were always small areas of mixed grasses, sagebrush flats, and ravine and lake edge communities of trees and/or shrubs to provide cover. Perhaps the best cover was provided by Salix spp., Artemesia cana, A. frigida, Rosa spp., Symphoricarpos occidentalis, Elaeagnus commutata, and Prunus virginiana.

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APPENDICES

APPENDIX 1

THE FLORA

APPENDIX 1

THE FLORA

The following section contains an annotated list of the Bryophyta, Pteridophyta, and Spermatophyta collected by the writer during the summer of 1957. In most cases the specimens were taken either in or in the vicinity of the nine water bodies studied.

The Pteridophyta and Spermatophyta were identified at the Canada Department of Agriculture, Botany and Plant Pathology Laboratory, under the supervision of Dr. Bernard Boivin. The Bryophyta were identified by Dr. G. J. Ikenberry, Department of Botany and Plant Pathology, Oklahoma State University.

The abbreviations for the areas are as follows: WVM - West Val Marie; VM - Val Marie; E - Eastend; CL - Cypress Lake; MC - Middle Creek; LL - Lee's Lake; P - Piapot; JR - Maple Creek; D - Downie; and CH - Cypress Hills.

The scientific naming of the Bryophyta is that of Grout (1928-1940), while that of the Pteridophyta and Spermatophyta is that of Fernald (1950).

THALLOPHYTA

Characeae

Chara sp. E

BRYOPHYTA

Amblystegium serpens (L., Hedw.) Br. & Sch. WVM, E

Barbula unguiculata Hedw. P

Bryum pendulum (Hornsch.) Schimp. WVM

Ceratodon purpureus (Hedw.) Brid. CH

Didymodon recurvirostris (Hedw.) Fenn. P

Funaria hygrometrica (L.) Hedw. WVM, E, P

*Gymnostomum recurvirostrum Hedw. P

Leptobryum pyriforme (L.) Schimp. P

*Orthotrichum pumilum Dicks. E

*Pottia truncata (Hedw.) Furnrohr. WVM

Pylaisia polyantha Bry. Eur. WVM, E

Tortula mucronifolia Schwagr. WVM, E

PTERIDOPHYTA

Equisetaceae

Equisetum arvense L. VM, E, P

Equisetum hyemale L. var. intermedium A. A. Eat.
(E. laevigatum Braun) MC, P

Selaginellaceae

Selaginella densa Rydb. CL, MC

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*Plants new to Saskatchewan

Polypodiaceae

Cystopteris fragilis (L.) Bernh. E

SPERMATOPHYTA

Pinaceae

Juniperus communis L. E

Juniperus horizontalis Moench WVM, E

Typhaceae

Typha latifolia L. WVM, P

Zosteraceae

Potamogeton foliosus Raf. MC

Potamogeton pectinatus L. WVM, VM, E, CL, MC. LL, P

Potamogeton richardsonii (Benn.) Rydb. WVM, E, CL, MC, P

Potamogeton vaginatus Turcz. WVM, CL, MC

Ruppia occidentalis S. Wats. LL

Zannichellia palustris L. VM, MC

Juncaginaceae

Triglochin maritima L. (T. maritimum L.) E, LL, P

Triglochin palustris L. LL

Alismataceae

Alisma gramineum K. C. Gmel. WVM, VM, E, MC

Alismataceae (Continued)

Alisma subcordatum Raf. WVM

Alisma triviale Pursh VM, D

Sagittaria cuneata Sheldon WVM, E, CL

Hydrocharitaceae

Elodea canadensis Michx. (Anacharis canadensis) CL

Gramineae

Agropyron cristatum (L.) Gaertn. WVM, VM, MC, LL, P

Agropyron dasystachyum (Hook.) Scribn. MC, LL

Agropyron smithii Rydb. WVM, VM, MC, P

Agropyron spicatum (Pursh) Scribn. & Sm. var inerme (Scribn. & Sm.) Heller CL

Agropyron trachycaulum (Link) Malte var. majus (Vasey) Fern. WVM

Agropyron trachycaulum (Link) Malte var. novae-angliae (Scribn.) Fern. E, CL, LL, P

Agrostis alba L. P

Agrostis scabra Willd. WVM, JR

Alopecurus aequalis Sobol. WVM, E, MC, D

Avena sativa L. P

Beckmannia syzigachne (Steud.) Fern. WVM, VM, E, CL, MC, JR, D

Bouteloua gracilis (HBK) Lag. VM, LL, P

Bromus inermis Leyss. WVM, VM, P

Gramineae (Continued)

Calamagrostis inexpansa Gray P

Calamagrostis montanensis Scribn. WVM

Calamovilfa longifolia (Hook.) Scribn. LL, P

Deschampsia caespitosa (L.) Beauv. WVM, P, JR

Distichlis stricta (Torr.) Rydb. WVM, VM, MC, LL, P

Echinochloa crusgalli (L.) Beauv. D

Elymus canadensis L. WVM, E, P

Glyceria grandis S. Wats. E

Hordeum jubatum L. WVM, VM, E, CL, LL, P, JR, D

Koeleria cristata (L.) Pers. WVM, VM, E, CL, MC, LL, P

Muhlenbergia asperifolia (Nees & Meyen) Parodi P

Muhlenbergia cuspidata (Nutt.) Rydb. CL

Oryzopsis hymenoides (R. & S.) Ricker E, P

Phleum pratense L. P

Poa canbyi (Scribn.) Piper WVM, VM, CL, MC

Poa compressa L. LL

Poa interior Rydb. WVM, CLM MC

Poa palustris L. LL

Poa pratensis L. WVM, E, MC, P

Poa secunda Presl WVM, E, CL

Puccinellia nuttalliana (Schultes) Hitchc. (P. airoides (Nutt.) Wats. & Coult.) WVM, E, CL, LL, P

Gramineae (Continued)

Secale cereale L. P

Spartina gracilis Trin. VM, E, P

Stipa comata Trin & Rupr. WVM, CL, LL, P

Stipa viridula Trin. WVM, E, CL, MC

Cyperaceae

Carex aquatilis Wahlenb. WVM, MC, P

Carex atherodes Spreng. CL

Carex athrostachya Olney E

Carex brevior (Dew.) Mackenz. D

Carex disperma Dew. E

Carex douglasii Boott E, MC, D

Carex filifolia Nutt. CL, P

Carex lanuginosa Michx. WVM, VM, E, MC, LL, P

Carex pensylvanica Lam. var. digyna Boeckl. (C. heliophila Mackenz.) VM

Carex praegracilis W. Boott E, MC

Carex stenophylla Wahlenb. var. enervis (C. A. Mey.) Kukenth. (C. Eleocharis Bailey) CL, LL, P

Eleocharis acicularis (L.) R. & S. WVM, VM, E, CL, LL, JR, D

Eleocharis compressa Sulliv. JR

Eleocharis palustris (L.) R. & S. WVM, VM, E, CL, MC, LL

Scirpus americanus Pers. WVM, VM, E, LL, P. JR

Cyperaceae (Continued)

Scirpus paludosus Nels. VM, CL, LL

Scirpus rubrotinctus Fern. E

Scirpus validus Vahl. var. creber Fern. WVM, VM, CL, P

Lemnaceae

Lemna minor L. VM, P

Juncaceae

Juncus balticus Willd. var. montanus Engler. WVM, E, CL, MC, LL, P

Juncus bufonius L. E

Juncus tenuis Willd. JR

Liliaceae

Allium textile Nels. & Macbr. WVM, VM, CL, MC

Smilacina stellata (L.) Desf. WVM, VM

Zygadenus elegans Pursh VM, CL

Zygadenus gramineus Rydb. MC

Iridaceae

Sisyrinchium angustifolium Mill. WVM, CL

Salicaceae

Populus sargentii Dode LL, JR

Salix amygdaloides Anderss. E, MC, LL, JR

Salix athabascensis Raup LL

Salix bebbiana Sarg. E

Salicaceae (Continued)

Salix brachycarpa Nutt. LL

Salix interior Rowlee WVM, VM, E, CL, MC, LL, JR

Salix lutea Nutt. WVM, E

Salix planifolia Pursh CL

Salix pseudomonticola Ball JR

Corylaceae

Betula occidentalis Hook. E

Urticaceae

Urtica gracilis Ait. WVM, CL

Santalaceae

Comandra pallida A. DC. WVM, VM, E, CL, MC, LL

Polygonaceae

Eriogonum flavum Nutt. VM, E, CL, MC

Eriogonum multiceps Nees WVM

Polygonum achoreum Blake 1301, E

Polygonum aviculare L. MC, P

Polygonum coccineum Muhl. WVM, VM, E, CL, JR

Polygonum convolvulus L. E

Polygonum lapathifolium L. VM, E, MC, JR

Polygonum natans A. Eaton D

Polygonum scabrum Moench MC, JR

Rumex crispus L. P

Polygonaceae (Continued)

Rumex maritimus L. var. fueginus (Phil.) Dusen WVM, VM, CL, MC, LL, P, JR, D

Rumex mexicanus Meissn. (R. triangulivalvis (Danser) Rech. f.) WVM, VM, E, CL, MC, D

Chenopodiaceae

Atriplex nuttallii S. Wats. WVM, VM, CL

Atriplex patula L. P

Axyris amaranthoides L. P

Chenopodium album L. E

Chenopodium berlandieri Moq. var. zochackei Murr. MC

Chenopodium fremontii S. Wats. VM

Chenopodium glaucum L. var. salinum (Standley) B. Boivin JR, D

Chenopodium hybridum L. var. gigantospermum (Aellen) Rouleau E

Chenopodium rubrum L. LL, JR

Endolepis suckleyi Torr. WVM

Eurotia lanata (Pursh) Moq. WVM, CL

Monolepis nuttalliana (R. & S.) Greene WVM

Salicornia rubra Nels. VM, LL

Salsola kali L. var. tenuifolia Tausch. E, MC, LL, P

Sarcobatus vermiculatus (Hook.) Torr. VM, CL

Amaranthaceae

Amaranthus albus L. E

Nyctaginaceae

Mirabilis linearis (Pursh) Heimerl E

Caryophyllaceae

Arenaria lithophila Rydb. VM, CL, MC

Cerastium arvense L. WVM, VM, E

Saponaria vaccaria L. E

Stellaria calycantha (Ledeb.) Bong. P

Ranunculaceae

Anemone canadensis L. VM, E

Ranunculus cymbalaria Pursh WVM, VM, E, CL, MC, LL, P, JR

Ranunculus flammula L. var. ovalis (Big.) Benson E

Ranunculus macounii Britt. WVM, VM, E

Ranunculus pensylvanicus L. f. VM

Ranunculus sceleratus L. CL

Ranunculus subrigidus W. B. Drew VM, CL, MC, P

Thalictrum turneri Boivin E

Capparidaceae

Cleome serrulata Pursh E, LL, P

Cruciferae

Arabis divaricarpa A. Nels. var. hemicylindrica B. Boivin WVM

Arabis retrofracta Graham var. collinsii (Fern.) B. Boivin (A. Holboellii Hornem in part) VM, LL

Brassica juncea (L.) Coss. VM

Descurainia pinnata (Walt.) Britt. var. brachycarpa (Richards.) Fern. LL

Descurainia sophia (L.) Webb VM, E, CL, MC, P

Erysimum cheiranthoides L. WVM

Erysimum inconspicuum (S. Wats.) MacM. WVM, VM, E, CL, MC

Lepidium ramosissimum Nels. WVM, VM, LL, P

Lesquerella arenosa (Richards.) Rydb. CL

Lesquerella spatulata Rydb. WVM, MC

Rorippa islandica (Oeder) Borbas WVM, VM, CL, MC, JR, D

Sisymbrium altissimum L. VM, E, CL, MC, LL

Sisymbrium loeselii L. P

Thlaspi arvense L. VM, E, MC

Saxifragaceae

Heuchera richardsonii R. Br. WVM

Parnassia palustris L. E

Ribes setosum Lindl. WVM, E, CL

Rosaceae

Alemanchier alnifolia Nutt. WVM, VM, E

Rosaceae (Continued)

Chamaerhodos erecta (L.) Bunge var. nuttallii T. & G. CL, MC

Crataegus chrysocarpa Ashe E

Fragaria vesca L. var. americana Porter E

Geum aleppicum Jacq. WVM, VM

Geum triflorum Pursh WVM, E, CL

Potentilla anserina L. WVM, VM, E, CL, MC, P, D

Potentilla fruticosa L. E, MC

Potentilla gracilis Dougl. CL, MC

Potentilla hippiana Lehm. CL

Potentilla norvegica L. MC

Potentilla paradoxa Nutt. MC

Potentilla pennsylvanica L. CL

Potentilla pennsylvanica L. var. arida B. Boivin P

Potentilla plattensis Nutt. MC

Prunus pennsylvanica L. f. E

Prunus virginiana L. E, CL

Rosa acicularis Lindl. var. bourgeauina Crepin (R. bourgeauiana Crepin) E

Rosa arkansana Porter CL, D

Rosa woodsii Lindl. VM

Rubus idaeus L. var. aculeatissimus Regel & Tiling E

Leguminosae

Astragalus agrestis Dougl. WVM, VM, CL, MC

Astragalus bisulcatus (Hook.) A. Gray WVM, VM, CL, MC, P

Astragalus pectinatus Dougl. VM, E, CL

Astragalus striatus Nutt. Cl

Astragalus tenellus Pursh E

Glycyrrhiza lepidota (Nutt.) Pursh WVM, LL, P

Hedysarum boreale Nutt. var. cinerascens (Rydb.) Rollins VM, E

Lupinus argenteus Pursh E

Medicago falcata L. WVM, VM

Medicago sativa L. WVM, VM

Melilotus alba Desr. MC, P

Melilotus officinalis (L.) Lam. VM, E, MC, P

Oxytropis campestris (L.) DC. WVM, VM, E, MC

Petalostemum candidum (Willd.) Michx. (Petalostemon candidus (Willd.) Michx.) WVM, VM

Petalostemum purpureum (Vent.) Rydb. (Petalostemon purpureus (Vent.) Rydb.) WVM, VM, E

Psoralea argophylla Pursh WVM, VM, P, D

Psoralea lanceolata Pursh P

Thermopsis rhombifolia (Nutt.) Richards WVM, VM, E, MC

Vicia americana Muhl. WVM, VM, E, CL, MC

Linaceae

Linum lewisii Pursh WVM, E, CL, MC

Linum rigidum Pursh CL

Callitrichaceae

Callitriche hermaphroditica L. VM

Anacardiaceae

Rhus trilobata Nutt. VM

Aceraceae

Acer negundo L. var. interius (Britt.) Sarg. E

Malvaceae

Sphaeralcea coccinea (Pursh) Rydb. (Malvastrum coccineum (Nutt.) Gray) VM, E, CL, MC, P

Violaceae

Viola adunca Sm. WVM

Viola rugulosa Greene E

Loasaceae

Mentzelia decapetala (Pursh) Urban & Gilg E

Cactaceae

Mamillaria vivipara (Nutt.) Haw. WVM, VM, E, CL, MC, LL, P, JR, D

Opuntia sp. WVM, VM, E, CL, MC, LL, P, JR, D

Elaeagnaceae

Elaeagnus commutata Bernh. WVM, VM, E

Shepherdia argentea Nutt. WVM

Shepherdia canadensis (L.) Nutt. E

Onagraceae

Epilobium angustifolium L. WVM, CL

Epilobium glandulosum Lehm. E, LL, P, JR

Epilobium paniculatum Nutt. WVM, MC

Gaura coccinea Pursh VM, CL, LL, P

Oenothera biennis L. VM

Oenothera caespitosa Nutt. WVM

Oenothera pallida Lindl. P

Haloragaceae

Myriophyllum exalbescens Fern. CL, MC, P

Hippuridaceae

Hippuris vulgaris L. VM, CL, MC

Umbelliferae

Cicuta maculata L. WVM, CL, LL

Lomatium macrocarpum (Nutt.) C. & R. CL, MC

Musineon divaricatum (Pursh) C. & R. VM

Sium suave Walt. WVM, VM

Zizia aptera (Gray) Fern. E

Cornaceae

Cornus stolonifera Mich. WVM, E

Primulaceae

Androsace septentrionalis L. VM, CL

Glaux maritima L. var. angustifolia B. Boivin E

Asclepiadaceae

Asclepias speciosa Torr. E, P

Asclepias viridiflora Raf. VM

Convolvulaceae

Convolvulus sepium L. WVM, VM

Polemoniaceae

Collomia linearis Nutt. WVM, VM, MC

Navarretia minima Nutt. WVM

Phlox hoodii Richards WVM

Boraginaceae

Cryptantha bradburyana Payson WVM, VM, E, CL, MC

Lappula echinata Gilib. WVM, P

Plagiobotrys scopularum (Greene) I. M. Johnston VM, MC

Verbenaceae

Verbena bracteata Lag. & Rodr. D

Labiatae

Lycopus asper Greene LL, P, JR, D

Mentha arvensis L. WVM, VM, E, CL, D

Labiatae (Continued)

Monarda fistulosa L. E

Salvia reflexa Hornem. E

Scutellaria galericulata L. var. pubescens Bentham E, P

Solonaceae

Solanum triflorum Nutt. WVM

Scropulariaceae

Castilleja sessiliflora Pursh VM

Limosella aquatica L. MC

Penstemon gracilis Nutt. VM, E, CL, MC

Penstemon nitidus Dougl. WVM

Penstemon procerus Dougl. CL

Orobanche fasciculata Nutt. MC

Plantaginaceae

Plantago eriopoda Torr. MC

Plantago major L. WVM, VM, E

Rubiaceae

Galium boreale L. E, CL, MC

Caprifoliaceae

Symphoricarpos occidentalis Hook. WVM, VM, E

Campanulaceae

Campanula rotundifolia L. WVM, CL, P

Compositae

Achillea lanulosa Nutt. (A. millefolium L. var. lanulosa (Nutt.) B. Boivin) WVM, VM, E, CL, MC, LL, P

Agoseris glauca (Pursh) Raf. MC

Agoseris scorzoneraefolia (Schrad.) Greene WVM

Antennaria aprica Greene WVM, VM, E, CL

Antennaria parvifolia Nutt. MC, LL

Arnica fulgens Pursh MC

Artemesia cana Pursh WVM, E, CL

Artemesia biennis Willd. MC

Artemesia frigida Willd. CL, MC, LL, P

Artemesia ludoviciana Nutt. var. gnaphalodes (Nutt.) T. & G. (A. gnaphalodes Nutt.) WVM

Artemesia longifolia Nutt. VM

Aster adscendens Lindl. VM

Aster brachyactis Blake MC, JR

Aster canescens Pursh WVM, CL, JR

Aster coerulescens DC. VM, CL, D

Aster erocoides L. CL, LL, P

Aster junciformis Rydb. E

Aster laevis L. E

Bidens cernua L. P, JR

Chrysopsis villosa (Pursh) Nutt. WVM, VM, E, CL, MC, LL, P

Chrysothamnus frigidus Greene CL

Cirsium arvense (L.) Scop. E, CL, LL

Compositae (Continued)

Cirsium flodmani (Rydb.) Arthur VM, LL, P

Cirsium undulatum (Nutt.) Spreng. WVM

Coreopsis tinctoria Nutt. VM, P, D

*Crepis atribarba Heller var. atribarba CL

Erigeron lonchophyllus Hook. E

Erigeron pumilus Nutt. WVM, VM, CL, MC

Gaillardia aristata Pursh WVM, VM, E, CL, MC, P

Grindelia squarrosa (Pursh) Dunal var. quasiperennis Lunell (G. perennis A. Nels.) CL, MC, LL, P

Grindelia squarrosa (Pursh) Dunal E

Gutierrezia sarothrae (Pursh) Britt. & Rusby WVM, VM, E, MC, LL

Haplopappus lanceolatus (Hook.) T. & G. CL

Helenium autumnale L. E, P

Helianthus annuus L. (H. lenticularis Dougl.) WVM, E, CL

Helianthus subtuberosus Bourgeau E, P

Hymonoxys richardsonii (Hook.) Cock. WVM, VM, E, CL, MC

Iva axillaris Pursh WVM, VM

Iva xanthifolia Nutt. P

Lactuca pulchella (Pursh) DC. WVM, VM, E, LL

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*New to Saskatchewan.

Compositae (Continued)

Lactuca scariola L. CL, LL

Liatris punctata Hook. VM, E, CL, MC, P

Lygodesmia juncea (Pursh) D. Don. VM, E

Ratibida columnifera (Nutt.) Wooton & Standl. WVM, VM, E, LL, D

Ratibida columnifera (Nutt.) Wooton & Standl. var. pulcherrima (DC.) Fern. VM

Senecio canus Hook. VM, CL, MC

Senecio congestus (R. Br.) DC. var. palustris (L.) Fern. MC, LL, JR

Senecio pauperculus Michx. var. flavovirens (Rydb.) B. Boivin E

Solidago gigantea Ait. var. leiophylla Fern. E, CL

Solidago lepida DC. E, LL, P

Solidago missouriensis Nutt. WVM, VM, E, CL, MC, D

Solidago mollis Bartl. P, D

Solidago rigida L. var. canescens (Rydb.) Breitung CL

Sonchus arvensis L. var. glabrescens Guenth., Grab. & Wimm. WVM, VM, CL, LL, P

Taraxacum officinale Weber E, P

Tragopogon dubius Scop. WVM, VM, E, P

Xanthium strumarium L. VM, MC, JR, C

APPENDIX 2

THE GASTROPOD FAUNA

APPENDIX 2

THE GASTROPOD FAUNA

The following list of snails represents collections made by the writer and identifications performed by J. P. E. Morrison, Associate Curator, Division of Mollusks, Smithsonian Institution.

Lymnaeidae

Lymnaea stagnalis jugularis Say. CL

Stagnicola caperata (Say). WVM, VM

Stagnicola exilis (Lea). CL

Stagnicola palustris (Muller). WVM, VM, MC, LL

Planorbidae

Helisoma subcrenatum (Carpenter). CL, P

Gyraulus similaris F. C. Baker. WVM, VM, CL, LL, P

Physidae

Physa sayii Tappan. VM, CL, MC

Physa jennessi Dall. LL

APPENDIX 3

THE FISH FAUNA

APPENDIX 3

THE FISH FAUNA

The list is based upon the author's own personal observations, those of P. H. Edwards, Saskatchewan Fishery Officer, and a few records from Rawson (1947). The taxonomy is that of Rawson (1947).

Salmo gairdneri kamloops Jordan - Kamloops Trout. JR

Catastomus commersonii (Lacapede) - Common sucker. WVM, VM, E, CL, MC, P, JR, D

Cyprinus carpio L. - Carp. WVM, VM, E

Pimephales promelas Rafinesque - Fathead Minnow. VM, CL, JR

Platygobio gracilis (Richardson) - Flathead Chub. E, CL

Eucalia inconstans (Kirtland) - Brook Stickleback. VM, CL, JR

Perca flavescens (Mithchill) - Yellow Perch. WVM, VM, E

Stizostedion vitreum (Mitchill) - Pickerel. VM, E, CL

Poecilichthys ? exilis (Girard) - Iowa Darter. CL

Lota lota maculosa (Le Sueur) - Ling. WVM, CL

APPENDIX 4

THE BIRD FAUNA

APPENDIX 4

THE BIRD FAUNA

The following list is an annotated compilation of the birds recorded from the vicinity of the water bodies studied by the writer, with additional records from Soper (1942, 1948) and Cameron (1946). The nomenclature is based on that of the American Ornithologist's Union "Check-List" (Fifth ed, 1957).

Birds

1. Gavia immer (Brunnich) - Common loon. MC
2. Podiceps grisegena holbollii Reinhardt. - Holboell's grebe. CL, MC, LL
3. Podiceps auritus (Linnaeus) - Horned grebe. E, CL
4. Podiceps caspicus californicus Heermann. - Eared grebe. VM, E, CL, MC, LL
5. Aechmophorus occidentalis (Lawrence) - Western grebe. WVM, VM, CL, MC, P, JR
6. Podilymbus podiceps podiceps (Linnaeus) - Pied-billed grebe. WVM, MC, LL, P, JR
7. Pelecanus erythrorhynchos Gmelin - White pelican. WVM, VM, CL, MC, P, JR

8. Phalacrocorax auritus (Lesson) - Double-crested cormorant. WVM, VM, P
9. Ardea herodias Linnaeus - Great blue heron. WVM, VM, E, CL, LL, JR, D
10. Nycticorax nycticorax hoactli (Gmelin) - Black-crowned night heron. VM, LL, JR
11. Botaurus lentiginosus (Rackett) - American bittern. WVM, VM, E, CL, LL, P
12. Branta canadensis (Linnaeus) - Canada goose. WVM, VM, CL, MC, LL, P, JR, D
13. Anas platyrhynchos platyrhynchos Linnaeus Linnaeus - Mallard. WVM, VM, E, CL, MC, LL, P, JR, D
14. Anas strepera Linnaeus - Gadwall. WVM, VM, E, CL, MC, LL, P, JR, D
15. Anas acuta Linnaeus - Pintail. VM, E, CL, MC, LL, P, JR
16. Anas carolinensis Gmelin - Green-winged teal. WVM, VM, CL, MC, LL
17. Anas discors Linnaeus - Blue-winged teal. WVM, VM, E, CL, MC, LL, P, JR
18. Mareca americana (Gmelin) - American widgeon. WVM, VM, E, CL, MC, LL, P, JR
19. Spatula clypeata (Linnaeus) - Shoveller. WVM, VM, E, CL, MC, LL
20. Aythya americana (Eyton) - Redhead. WVM, CL, MC, LL, P, JR

21. Aythya collaris (Donovan) - Ring-necked duck. WVM
22. Aythya valisineria (Wilson) - Canvas-back. VM, E, CL, LL, P
23. Aythya affinis (Eyton) - Lesser scaup duck. VM, E, CL, MC, LL, P, JR
24. Bucephala clangula americana (Bonaparte) - American golden-eye. CL, MC, LL
25. Bucephala albeola (Linnaeus) - Buffle-head. CL, MC
26. Melanitta deglandi (Bonaparte) - White-winged scoter. CL, MC
27. Oxyura jamaicensis rubida (Wilson) - Ruddy duck. WVM, VM, E, CL, MC, P
28. Mergus merganser americanus Cassin - American merganser. WVM, VM
29. Buteo jamaicensis (Gmelin) - Red-tailed hawk. VM, E
30. Buteo swainsoni Bonaparte - Swainson's hawk. WVM, VM, E, CL, MC, LL, P, JR, D
31. Buteo regalis (Gray) - Ferruginous hawk. WVM, VM, E, CL, MC
32. Aquila chrysaetos canadensis (Linnaeus) - Golden eagle. MC
33. Circus cyaneus hudsonius (Linnaeus) - Marsh hawk. WVM, VM, E, CL, MC, LL, P, JR, D
34. Falco mexicanus Schlegel - Prairie falcon. E, CL, MC
35. Falco sparverius Linnaeus - Sparrow hawk. VM, E, CL, MC, JR

36. Pedioecetes phasianellus (Linnaeus) - Sharp-tailed grouse. WVM, VM, E, MC
37. Centrocercus urophasianus (Bonaparte) - Sage hen. WVM, VM, E, CL, MC
38. Phasianus colchicus Linnaeus - Ring-necked pheasant. VM, E
39. Perdix perdix perdix (Linnaeus) - Hungarian partridge. VM, E, CL, MC, P, JR
40. Porzana carolina (Linnaeus) - Sora rail. WVM, VM, CL, MC
41. Fulica americana Gmelin - Coot. WVM, E, CL, MC, LL, P, JR
42. Charadrius vociferus vociferus Linnaeus - Killdeer. WVM, VM, E, CL, MC, LL, P, JR
43. Capella gallinago delicata (Ord) - Wilson's snipe. CL, LL, JR
44. Numenius americanus Bechstein - Long-billed curlew. WVM, VM, E, CL, MC, LL, JR
45. Bartramia longicauda (Bechstein) - Upland plover. E
46. Actitis macularia (Linnaeus) - Spotted sandpiper. WVM, E, CL, MC, LL, P, JR
47. Tringa solitaria Wilson - Solitary sandpiper. JR
48. Catoptrophorus semipalmatus (Gmelin) - Willet. WVM, VM, E, CL, MC, LL
49. Totanus flavipes (Gmelin) - Lesser yellow-legs. WVM, VM, CL, MC, P

50. Erolia bairdii (Coues) - Baird's sandpiper. MC, D
51. Limnodromus griseus (Gmelin) - Short-billed dowitcher. MC
52. Limosa fedoa (Linnaeus) - Marbled godwit. CL, MC
53. Recurvirostra americana Gmelin - Avocet. E, MC, JR
54. Steganopus tricolor Vieillot - Wilson's phalarope. WVM, E, CL, MC
55. Larus argentatus Pontoppidan - Herring gull. CL, MC
56. Larus californicus Lawrence - California gull. E
57. Larus delawarensis Ord - Ring-billed gull. WVM, VM, E, CL, MC, LL, P, JR, D
58. Larus pipixcan Wagler - Franklin's gull. E, CL, MC, LL, JR, D
59. Sterna hirundo hirundo Linnaeus - Common tern. WVM, VM, E, CL, MC, LL, P, JR, D
60. Chlidonias niger surinamensis (Gmelin) - Black tern. VM, E, CL, MC, LL, JR
61. Zenaidura macroura (Linnaeus) - Mourning dove. WVM, VM, E, CL, MC, LL, P, JR, D
62. Coccyzus erythropthalmus (Wilson) - Black-billed cuckoo. E
63. Speotyto cunicularia (Molina) - Burrowing owl. VM, E
64. Asio flammeus flammeus (Pontoppidan) - Short-eared owl. VM, E, MC
65. Chordeiles minor (Forster) - Nighthawk. WVM, VM, E, CL, MC

66. Archilochus colubris (Linnaeus) - Ruby-throated hummingbird. E

67. Megaceryle alcyon (Linnaeus) - Belted kingfisher. VM, E, MC

68. Colaptes auratus (Linnaeus) - Yellow-shafted flicker. E

69. Tyrannus tyrannus (Linnaeus) - Eastern kingbird. WVM, VM, E, CL, MC, LL, P, JR

70. Tyrannus verticalis Say - Western kingbird. VM, E, CL, MC

71. Sayornis saya saya (Bonaparte) - Say's phoebe. VM, E

72. Empidonax trailii trailii (Audubon) - Alder flycatcher. VM, E

73. Empidonax minimus (Baird and Baird) - Least flycatcher. E

74. Eremophila alpestris (Linnaeus) - Horned lark. WVM, VM, E, CL, MC, JR

75. Riparia riparia riparia (Linnaeus) - Bank swallow. WVM, VM, E, CL

76. Hirundo rustica erythrogaster Boddaert - Barn swallow. VM, E, CL, MC, P, JR

77. Petrochelidon pyrrhonota (Vieillot) - Cliff swallow. VM, E, MC

78. Pica pica hudsonia (Sabine) - American magpie. WVM, VM, E, CL, MC, LL, P, JR, D

79. Corvus brachyrhynchos Brehm - Crow. WVM, VM, E, CL, MC, LL, P, JR, D
80. Troglodytes aedon Vieillot - House wren. E
81. Salpintces obsoletus obsoletus (Say) - Rock wren. VM, E, CL
82. Dumetella carolinensis (Linnaeus) - Catbird. VM, E
83. Toxostoma rufum (Linnaeus) - Brown thrasher. WVM, VM, E
84. Turdus migratorius Linnaeus - Robin. E, CL
85. Sialia currucoides (Bechstein) - Mountain bluebird. E
86. Anthus spragueii (Audubon) - Sprague's pipit. VM, E, CL
87. Lanius ludovicianus Linnaeus - Loggerhead (White-rumped) shrike. WVM, VM, E, CL, MC
88. Vireo olivaceus (Linnaeus) - Red-eyed vireo. E
89. Dendroica petechia (Linnaeus) - Yellow warbler. VM, E, CL, MC
90. Geothlypis trichas (Linnaeus) - Yellowthroat. VM, E, MC
91. Icteria virens auricollis (Deppe) - Yellow-breasted chat. VM, E, CL
92. Dolichonyx oryzivorus (Linnaeus) - Bobolink. CL
93. Sturnella neglecta Audubon - Western meadowlark. WVM, VM, E, CL, MC, LL, P, JR, D
94. Xanthocephalus xanthocephalus (Bonaparte) - Yellow-headed blackbird. WVM, CL, MC

95. Agelaius phoeniceus (Linnaeus) - Red-wing blackbird. WVM, VM, E, CL, MC, P

96. Icterus galbula (Linnaeus) - Baltimore Oriole. E

97. Icterus bullockii bullockii (Swainson) - Bullock's oriole. E

98. Euphagus cyanocephalus (Wagler) - Brewer's blackbird. WVM, VM, E, CL, MC

99. Molothrus ater (Boddaert) - Brown-headed cowbird. VM, E, CL, MC

100. Spiza americana (Gmelin) - Dickcissel. E

101. Spinus tristis tristis (Linnaeus) - American goldfinch. VM, E, CL

102. Pipilo erythrophthalmus (Linnaeus) - American goldfinch. VM, E, CL

103. Calamospiza melanocorys Stejneger - Lark bunting. WVM, VM, E, CL, MC

104. Passerculus sandwichensis (Gmelin) - Savannah sparrow. VM, E, CL, MC

105. Ammodramus bairdii (Audubon) - Baird's sparrow. VM, E, CL, MC

106. Pooecetes gramineus (Gmelin) - Vesper sparrow. WVM, VM, E, CL, MC, LL, P, JR, D

107. Chondestes grammacus (Say) - Lark sparrow. VM, E, CL, MC

108. Spizella passerina (Bechstein) - Chipping sparrow. E

109. Spizella pallida (Swainson) - Clay-colored sparrow. VM, CL, MC

110. Spizella breweri Cassin - Brewer's sparrow. E, MC

111. Melospiza melodia (Wilson) - Song sparrow. VM, E

112. Rhynchophanes mccownii (Lawrence) - McCown's longspur. VM, E, CL, MC

113. Calcarius ornatus (Townsend) - Chestnut-collared longspur. WVM, VM, E, CL, MC

APPENDIX 5

THE MAMMAL FAUNA

APPENDIX 5

THE MAMMAL FAUNA

The mammal fauna of the five water bodies studied by the writer in extreme southwestern Saskatchewan consists of 26 entities. These mammals have been recorded on the basis of the author's own personal observations with much help from the field reports of J. D. Soper. The nomenclature is based on that of Miller and Kellogg (1955).

Sorex obscurus soperi Anderson & Rand - Plains Dusky Shrew. MC

Myotis lucifugus lucifugus (Le Conte) - Little Brown Bat. MC

Mustela rixosa rixosa (Bangs) - Least Weasel. VM, E

Mustela frenata longicauda Bonaparte - Long-tailed Weasel. VM, E, CL, MC

Mephitis mephitis hudsonica (Richardson) - Northern Plains Skunk. WVM, VM, E, CL, MC, LL, P, JR, D

Taxidea taxus taxus (Schreber) - Common Badger. WVM, VM, E, CL, MC, LL, P, JR, D

Canis latrans latrans Say - Great Plains Coyote. WVM, VM, E, CL, MC, LL, P, JR, D

Citellus richardsonii richardsonii (Sabine) - Richardson's Ground Squirrel. VM, E, CL, MC, LL

Cynomys ludovicianus lucovicianus (Ord) - Black-tailed Prairie Dog. VM

Thomomys talpoides bullatus V. Bailey - Sagebrush Pocket Gopher. VM, E

Dipodomys ordii terrosus Hoffmeister - Wyoming Kangaroo Rat. VM

Castor canadensis missouriensis V. Bailey - Missouri River Beaver. WVM, VM, E, MC

Onychomys leucogaster missouriensis (Aud. & Bach.) - Audubon Grasshopper Mouse. VM

Peromyscus maniculatus osgoodi Mearns - Osgood White-footed Mouse. VM, E, CL, MC

Peromyscus leucopus aridulus Osgood - Badlands White-footed Mouse. E

Clethrionomys gapperi loringi (V. Bailey) - Red-backed Mouse. E

Microtus pennsylvanicus insperatus (J. A. Allen) - Badlands Meadow Vole. VM, E, CL, MC

Lagurus curtatus pallidus (Merriam) - Sagebrush Vole. VM, E, CL, MC

Ondatra zibethica cinnamominus (Hollister) - Great Plains Muskrat. WVM, VM, E, CL, MC, P, JR

Zapus princeps minor Preble - Saskatchewan Jumping Mouse. E, CL

Erethizon dorsatum epixanthum Brandt - Yellow-haired Porcupine. E, MC

Lepus americanus americanus Erxleben - American Varying Hare. VM, E, MC

Lepus townsendii campanius Hollister - White-tailed Jack Rabbit. WVM, VM, E, CL, MC, LL, P, JR, D

Sylvilagus nuttallii grangeri (J. A. Allen) - Black Hills Cottontail. VM, E, MC

Odocoileus hemionus hemionus (Rafinesque) - Rocky Mountain Mule Deer. WVM, VM, E, CL, MC

Antilocapra americana americana (Ord) - Pronghorn Antelope. WVM, VM, CL, MC, D

VITA

Charles Durham Bird

Candidate for the Degree of

Master of Science

Thesis: VEGETATIONAL CHANGES AS RELATED TO WATERFOWL HABITAT IN ARTIFICIAL LAKES OF SOUTHWESTERN SASKATCHEWAN, CANADA

Major Field: Botany

Biographical:

Personal data: Born at Norman, Oklahoma, July 7, 1932, the son of Ralph Durham and Lois Gould Bird. Became a Canadian citizen.

Education: Attended grade school in Brandon, Manitoba; graduated from Brandon Collegiate in 1950; received the Bachelor of Science degree from the University of Manitoba in May, 1956; completed requirements for the Master of Science degree in May, 1958.

Professional experience: Three summers with the Canadian Northern Insect Survey studying insect ecology in the far north; two summers with the Canadian Government studying forest insect ecology; two summers with the Canadian Wildlife Service conducting ecological studies relating to waterfowl and vegetational problems. Member of American Ornithologist's Union, Lepidopterist's Society, Wildlife Society, American Society of Mammalogists, Society of Canadian Field-Naturalists, and the Bryological Society. Awarded Oklahoma State University Phi Sigma Award for 1957.

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Figures by the Author