45

UNITED STATES
DEPARTMENT OF THE INTERIOR
Julius A. Krug, Secretary

FISH AND WILDLIFE SERVICE
Albert M. Day, Director

Special Scientific Report No. 45

WATERFOWL BREEDING CONDITIONS - SUMMER 1947

By

Cecil S. Williams et al.

Issued February 1948

Washington, D. C.

Explanatory Note

The series, special scientific reports, embodies results of investigations, usually of unrestricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. It is issued in limited quantities for the official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

UNITED STATES DEPARTMENT OF THE INTERIOR
JULIUS A. KRUG, Secretary
FISH AND WILDLIFE SERVICE
Albert M. Day, Director

Special Scientific Report No. 45

WATERFOWL BREEDING CONDITIONS - SUMMER 1947

By

A. G. Smith — R. H. Smith — H. L. Mendall
J. J. Lynch — B. S. Wright — M. C. Hammond
A. S. Hawkins — J. Stoudt — E. Wellein
R. E. Griffith — D. L. Spencer

TABLE OF CONTENTS

WATERFOWL BREEDING GROUND CONDITIONS, SUMMER 1947

INTRODUCTION

Cecil S. Williams

The kind of duck hunting regulations sportsmen get each year depends a lot on how many ducks and geese appear evident on the wintering grounds the preceding January. At that time the birds are more concentrated than they are at other periods and a widespread inventory serves as a means of obtaining trends in the populations. But the winter waterfowl population is not the only factor which has an important influence on hunting regulations. The number and distribution of hunters in the flyways and the distribution of the birds themselves are two other factors of concern. Also of prime importance is the kind of breeding season the birds have preceding hunting, common sense saying that the current hunting regulations should be modified in accordance with what takes place on the breeding grounds. If, when the birds migrate north to nest they find conditions favorable to nesting and production, the regulations in the fall should be different than if the same breeding population migrated north and found nesting locations few and far between and, for one reason or another, generally unattractive. The annual production of waterfowl is the backbone of our sport of waterfowling and we must know about the conditions which prevail each season on different sections of the breeding grounds in ample time to draft appropriate shooting regulations. The better the appraisal that can be obtained of breeding conditions the more efficient will be the regulations governing the harvest.

This problem of getting a sound appraisal of what is taking place on the breeding grounds is far more difficult than is generally thought, it being one of the toughest jobs in the wildlife management field. In the first place and contrary to the popular idea, breeding ground appraisals cannot deal with total breeding populations or total production of young birds. The breeding range of waterfowl covers too vast a chunk of the North American continent, much of it inaccessible, and no one yet has found a way of covering or sampling it all in a way that would permit coming out with satisfactory figures on the total number of breeding birds or total production in the range. Any such figures can be taken to be the result of wishful thinking, guesswork, or both. The impossibility of covering all breeding locations, isolated and scattered as they are, makes it necessary for reliance to be put in sampling methods which will satisfactorily record trends in conditions and populations in those sections of the breeding range which have been found through past experience to be most important, and which are accessible with present day equipment.

Getting of trend appraisals is made difficult not only by the size and isolation of much of the breeding range, but also by the secretive habits of the nesting birds, by the differences in birds' movements and by the limited personnel, funds, and equipment with which it has been possible to tackle this important job. Added to these considerations is the fact that, the field biologists are expected to have a fair concept of current breeding ground conditions in the hands of the Committee on Regulations by June 15th, a date on which the breeding season is hardly more than half finished. While the preliminary draft of regulations may be adjusted as breeding ground information is compiled, this does not obviate the necessity of having an appraisal as complete as possible accomplished by mid-June. This fact has an important bearing on the type of sampling method which can be used. It should also be borne in mind that the technique used in 1947 would in all probability not be the one used if additional personnel and equipment could be alloted to the task.

Up until the 1947 season, the Fish and Wildlife Service obtained its appraisals of breeding ground conditions in Canada by having its observers make

broad surveys of breeding territory every year about the same time. While estimates of populations and brood counts were made, there was no standard method of evaluation. As a result, the appraisals were more or less impressions of how the overall populations and habitat compared with previous years. This method is not without value, especially if the surveys are made by the same observers every year, but what has been needed is a sampling method of appraisal which could be applied broadly and which would give quantitative data on breeding conditions -- similar quantitative data regardless of changes in observers. It should appear evident that only through this type of information shall we be able to do away with such general terms as poor breeding conditions or, more breeding birds than expected. It is also only through a uniform method and quantitative information that the relative value of the different types of habitats to production in the breeding range finally can be determined.

It was with these thoughts in mind that waterfowl biologists of the Fish and Wildlife Service undertook last season to set up a somewhat uniform method of appraising the breeding grounds of the three prairie provinces of Canada. Results of these appraisals were to serve as standards for comparative purposes in subsequent years and to be used to point to better techniques in the getting of necessary management information. The men who conducted these appraisals were asked to summarize the findings in their own words; and these summaries, along with the results of a number of other breeding ground studies carried on by the Wildlife Management Institute personnel in Canada, form this report.

Before submitting the various breeding ground reports, it would seem that a word is in order about what the wintering ducks are up against when they go north to find places to nest and to rear their young. Anyone who will look at a map showing the area north of the United States cannot but be impressed with the number of lakes which abound in the vast potential breeding territory stretching to the Arctic ocean and from Alaska to Labrador. On the map this country looks ideal for waterfowl; in actuality, however, appreciable production of our game ducks seems to stem from only a small segment of this vast territory. Great expanses of this land likely have never seen more than a few ducks a season.

This northland country may be considered divided into about five major regions: (1) tundra, (2) heavy forest, (3) aspen parklands, (4) long grass prairies, and (5) short grass prairies. The latter two usually are grouped together to form the grassland plains. Each of these regions, because of its climate and soils, has a potential to produce certain types of plant and animal life, including different kinds of waterfowl.

The tundra region extends from the line of trees to the Arctic Ocean. Here there is always an abundance of water but there is little or no soil and duck food and cover plants are very limited. Tundra conditions means short growing seasons and low air temperatures, two factors which cannot be tolerated by very many waterfowl species. While the tundra is very extensive, those who have studied it agree that appreciable production of game ducks there is, for the most, restricted to river deltas. Elsewhere breeding birds are widely scattered.

The second region, that of the heavy forest, is also characterized by an abundance of water areas and a scarcity of breeding ducks. Here too, soil is relatively shallow, the lakes, large and small, being for the most on a rocky substratum. Except for limited sections the soils and waters are not conducive to producing attractive conditions for waterfowl. Predation may also be an important factor in explaining the scarcity of ducks which have been observed in this region. The climate, although generally more severe than in the prairies to the south, is probably within the range of tolerance of many of our game ducks. Whatever the factors involved, they add up to the conclusion that this extensive potential breeding region has a scant duck breeding population. At least no areas producing a large number of birds has come to light.

These brief comments about the tundra and heavy forested regions should not be taken to indicate that an appreciable number of ducks, in the aggregate, could not be produced therein. But to infer a high aggregate production to an area just because of its size and availability of water areas does not seem to be

advisable. There is still a vast area in the United States with an abundance of water areas but few consider this section as contributing a large proportion of ducks to the continental population. Water in itself is not the solution to the production of waterfowl.

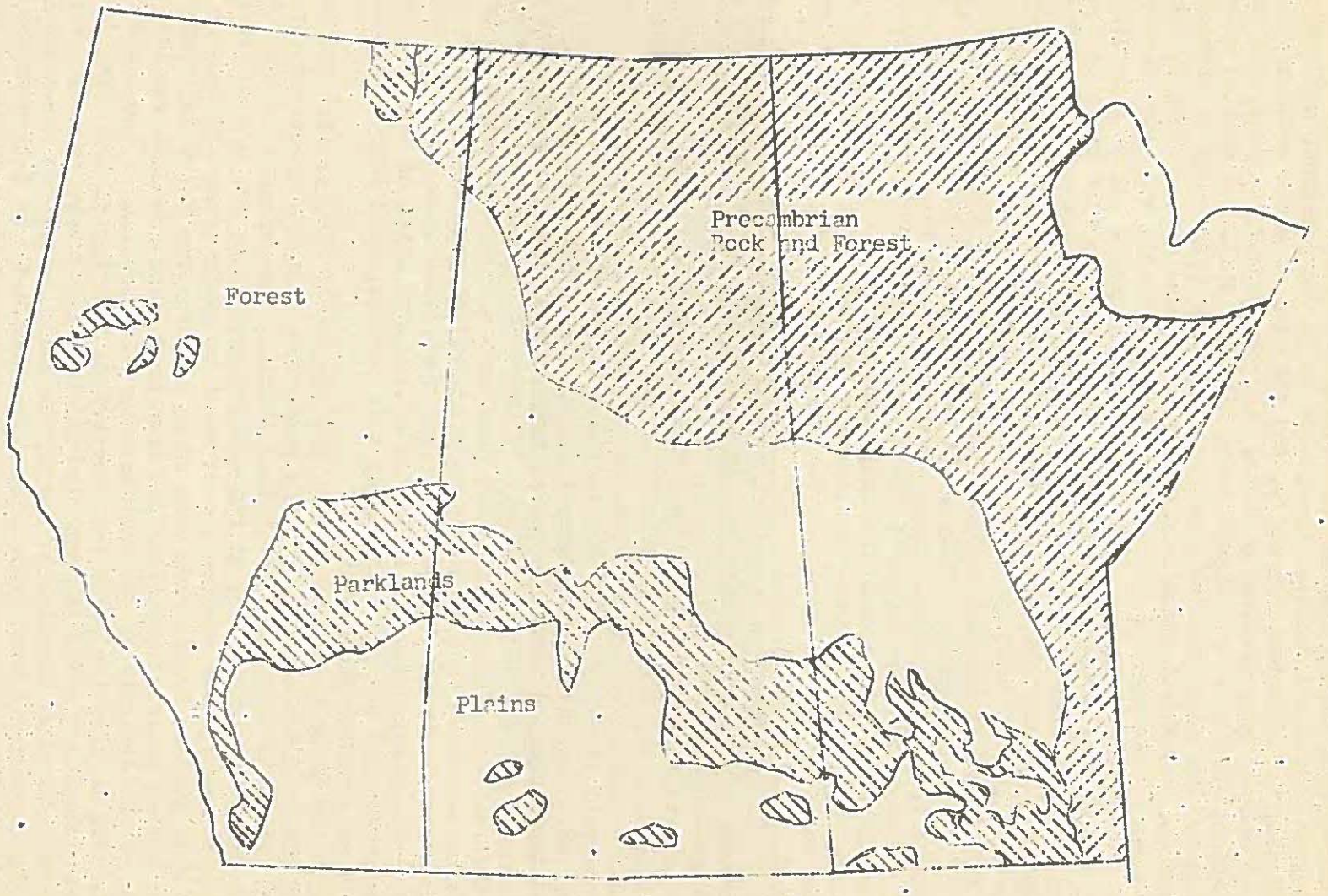
In comparison, take a look at the prairie and bordering parkland regions in the United States and Canada. Here, more so in the prairies, and less so in the parklands, the climates, the soils, and the kind of water areas are normally such as to attract game species of ducks. Lengthy growing seasons, not too much precipitation, favorable air temperatures, alkaline soil, and shallow water, combine to foster the production of duck food and cover plants and to attract nesting waterfowl. In short, these regions appear to have more of what it takes to produce ducks of the species we hunt than does the tundra and heavy forested sections which form so large a part of the north country. It is generally agreed among those who have made surveys in the various regions that it is in the comparatively limited area of the plains and parklands of northern United States and Canada that most of the game ducks east of the Rocky Mountains originated in the past, and will continue to breed as best they can in the future. To the west in the United States and British Columbia, north to Alaska, similar environments of the inter-mountain valleys and river deltas supply waterfowl to the western states. In some cases, birds produced in these areas may move into the midwest and east, but for the most, the eastern hunters appear to be dependent on the eastern breeding grounds for their targets.

We arrive then at the idea that despite the vast potential area for nesting waterfowl north of the United States the greatest concentrations of breeding birds, (exclusive of Alaska and British Columbia) stem from a relatively small segment of the area which on a map looks so favorable. This small segment, about 200,000 square miles makes up less than a third of the entire area of the three prairie provinces.

It is said that in the early days before agriculture began its encroachment on the duck habitat, the plains area of prairie provinces was practically covered with shallow alkaline lakes, marshes, and potholes of the types ducks favor so much. However, it is unlikely even in those days that duck production was uniform over this more productive segment of Canada. There were undoubtedly nearly as many blank spots as there are today, but now the extensiveness of the blank areas is more apparent and startling. If there is one point which the sportsmen of the United States should ponder over more than on any other, it is that there is no extensive area of high production on the prairies of Canada any more than there is in the United States and that, what does exist, is just as subject to the disappearing act. The 200,000 square miles of fair-to-good breeding region has so many blank areas that perhaps, much less than half of it can be regarded as good habitat.

There can be no question but that the advance of civilization has reduced by leaps and bounds the acreage of the attractive breeding locations for the ducks in Canada as well as in the United States. The evidence is there to see on every side. Important too, is the effect agriculture has had in lowering water tables through the greater use of water by grain crops and through the loss of soil humus. Grains have been shown to transpire about 35% more water than the native prairie vegetation and crop production has also resulted in the lowering of the capacity of the soil to hold water because of the lower humus content. All in all, the trend has been toward lowering of the water table. This means that many ponds and potholes which formerly were full of water, now are dry or hold water temporarily during the early spring and after the snows melt. The permanent water areas which ducks need badly to thrive on are now not plentiful in the agricultural areas of Canada. This would become apparent to anyone who would take a care trip through the three provinces in July or August. The ducks have one strike against them by having to seek nests in areas, which, with few exceptions, are now so dependent upon the vagaries of the weather. Another thought which might be well to mention here is, that only after several consecutive years of good winter run off and good spring precipitation, are permanent types of breeding —

Figure 1. Major Land Areas of the Prairie Provinces



marshes likely to develop. These permanent ponds and potholes are the ones on which ducks are really produced in appreciable numbers and the extent to which they are available conditions the size of the duck population which flies south after a breeding season. Without permanent areas of the right character the birds are forced into third or fourth rate habitat, from which only a low production should be expected, due to climate, food and cover conditions, predators, haying, grazing, burning, plowing of stubble, and perhaps, many other factors.

These are some of the reasons why the Service has emphasized study of the prairie provinces in its breeding ground surveys. What is found there in the way of breeding conditions and nesting birds should be a good index to the number of ducks sportsmen may expect to see in the United States east of the Rocky Mountains.

In all, the Fish and Wildlife Service had 12 trained workers on the breeding ground assignment in Canada during the summer. However, only 7 of these entered into the spring appraisals. The other 5 joined in the study in mid-summer to aid in the banding of ducks on the breeding grounds. Not all of these workers are permanent employees of the Fish and Wildlife Service. The Illinois Natural Survey contributed the services of Frank Bellrose; the Winous Point Gun Club of Port Clinton, Ohio, sent their biologist John Anderson; Lee Bush came from Illinois, Ray Murdy from Massachusetts; and Paul Springer from Wisconsin. In addition, the Fish and Wildlife Service had biologists Winston Elkins, H. Anderson, R. W. Sharp and Edmund Doling of its River Basin Staff conducting a detailed survey of the entire Lake Manitoba - Winnipegosis basin, Cedar Lake, and the lower part of the Saskatchewan Delta in cooperation with the Provincial Government. The information these men obtained was invaluable in helping to appraise conditions in Manitoba.

The Dominion Department of Mines and Resources and the Game Branches of the Provincial Governments also contributed greatly to the breeding ground survey, assisting in every practical way to make the appraisal a satisfactory one. The Wildlife Management Institutes' Research Station at Delta, Manitoba extended its facilities to the Manitoba crews and, wherever practicable, its personnel entered into the appraisal program. Thanks are due as well to many individuals in Canada who went out of their way to be of assistance, particularly Harrison Lewis, E. S. Huestis, S. W. Malaher, D. Forslund, Fred Bard, Frank Farley, William Campbell, Rex Harper, Roy Beny, Jack Williams, J. Dewey Soper, Albert Hochbaum, Lyle Sowls, Peter Ward, William Garrick, and William Elder.

In order to learn what the score was on the breeding grounds of the three prairie provinces the work was divided into 2 principal phases:

(1) a reconnaissance phase which pointed toward:
   (a) getting before June 15, information to aid in the preliminary draft of regulations.
   (b) obtaining, after June 15, data which would serve to judge whether or not the preliminary draft of regulations should be modified;

(2) a banding phase beginning in July and extending to September 1 in which breeding waterfowl and their young were banded for the purpose of outlining more clearly the species flyways and determining mortality rates and population turnovers. This report deals principally with the reconnaissance phase.

In appraising conditions and breeding populations, both airplane and ground crews were brought into play. Essentially, the technique used in ground appraisal was as follows: Permanent transects 1/8 or 1/4 mile wide (depending largely on the terrain) were established along each side of accessible roadways through the various regions of each province. These were examined by means of car, on foot, and by boat, during the pre-nesting and nesting seasons, a time when the breeding activity is displayed by paired birds and single drakes. For each area within a transect, the following information was noted on special forms (See Figure 2): location of the area by speedometer reading; size in acres; type of cover and its density; water level; land use (grazed, burned, hayed, mowed, stubble, etc.); degree of use; and the number of breeding birds by species as

Figure 2

U.S.D.I. - F. [illegible] SERVICE

Form A

DAILY [illegible] BROOD INVENTORY

State or Province Sask. Locality Moose Jaw (south) Date 5/7/47

Starting mileage at Mitchellton(19505) Ending mileage at Total

Route Mitchellton → Readlyn (Cardross)

WEATHER

*Acreage:A(0-1/2);B(1/2-1);C(1-5); D(5-10);E(10-25);F(25-100);G(100-200);H(200+)
"Cover: Use code, ie. Sedge (s) Summerfellow (F); Stubble (st) Density*
#Water:)(dry); 1(low);2(full);3(flooded)=Brood age: I downy; II-1/2grown;III Gr.

LOCATION No.	Mile	Hour	Size*	Cover"	H2O#	Use+	Species	Prs.	L♂	L♀	Tot.	Br.I=	Br.II	Br.III	Eggs	Rem.
167	50.5	15.30	C-2	GW-2	2	A-II	O									
168	51.1		C-1	F-0	1	AIII	O									
169	51.2		C-1	F-0	1	AIII	P		1		1					
170	51.3		D-8	F-0	2	AIII	P		3		3					
							S	1			2					
							Can		1		1					
							G	1			2					
							W	1			2	♀	Pintail flushed			
171	51.5		C-1	F-0	2	AIII	P		1		1		from nest - 2 eggs			
172	51.5		C-1	F-0	2	AIII	O									
173	51.9		B	St.-1	2	AIII	O									
174	52.1		A	F-1	1	AIII	O									
175	52.3		C-2	GW-2	2	A I	O									
176	52.5		C-2	F-1	2	AIII	P		1		1					
							G	1			2					

442

*Density: 1(nearly bare), 2(light), 3(heavy), 4(choked). Used in cover column.

+Land Use: G or U (grazed or ungrazed), B - (burned), M(mowed) etc. Degrees I-III (light to heavy).

U. S. D. I – F. & W. SERVICE Form D

AERIAL RECONNAISSANCE SHEET
(Breeding Ground)

State or Province Sask. Flight No. 1 Transect No. or Area 6

Time In Transect, 9 min.; Speed, 110 mph; Distance, 16.5 Miles

Date, 5/22; Location Moose Mountains – West Side of Mountains – East to Bear Lake

Type of Country – Rolling Hills – grassland

No. of Potholes	47	Mallard	9	Canvasback	
Potholes occupied	33	Pintail		Redhead	
Pot. / sq. mile	23	Gadwell	2	Scaup	10
% occupied	70	Shoveller	2	Scoter	
No. of waterfowl	132	Baldpate	2	Ruddy	
Waterfowl / sq. mile	71	B.W. Teal	10	Other	107
Comments:		C. Teal		Canada Goose	
Size of Samples		G.W. Teal		Other Geese	
2 square miles					

540

Observers R. H. Smith and D. Spencer

evidenced by pairs and single drakes.

Ground appraisals, however, could be expected to tell only part of the story for there are many large lakes, marshes, and other expanses which are not readily accessible. Airplanes are needed to cover these areas and to determine the limits of the various land types for use in putting ground data on a square mile basis. The Service had two planes in use on the study last season, one a Stinson L-5, the other a Grumman Widgeon amphibian. The sampling technique used by these planes was somewhat similar to that of the ground crew. Transects 1/8 mile wide on either side of the plane were established usually between towns or other major landmarks. An important difference, however, lies in the fact that ground crews could count pairs and single drakes whereas plane crews could not do so satisfactorily. Therefore, plane counts were made on the basis of water areas and numbers of ducks observed.

Plane data obtained in the parkland and grassland belts were primarily used to substantiate the data of the ground crews and to determine differences in, and extent of land types. While at the present stage of our techniques, air observers must deal with numbers of birds and not breeding pairs, so doing in itself may be determined eventually to be the most practical means of getting trend data over such a vast territory. If plane figures are to be translated into terms of breeding pairs, it is necessary first for ground crews to determine the composition of the waterfowl population as seen from the air. Studies on this were undertaken as time permitted this last season and are discussed in later sections.

The information obtained from ground coverage (which amounted to 28,000 miles in 1947) was correlated as much as possible with aerial assistance (totaling 32,000 miles), and because land along roadways or in a swath from the air over appreciable distances stand as a fair sample of adjacent lands, it is possible to obtain a satisfactory appraisal of surface water conditions and duck populations over a much wider territory than actually covered. Thus, for any given type or stretch of land, every four miles covered in a transect means a square mile of that kind of land sampled.

In compilation and analysis of the sampling figures, some physiographic, botanical, climatic or other division of the land area proves desirable and assists in arriving at the more satisfactory appraisals.

The end product brings out usable figures on: (1) the number of potholes, slough and other water areas per square mile of transect or land type; (2) the number and percent of the available water areas occupied by breeding ducks; (3) the average number of breeding pairs per area, per transect, or per square mile of land type or area sampled.

It should be borne in mind that the population figures arrived at by this technique are not to be regarded as total breeding populations. As yet an unknown number of breeding pairs may move into the sampled areas after the appraisals have been made. While this turn over appears to be small in some instances, we are still not justified in using the figures to represent total populations. Until the rate of turnover can be determined, the figures recorded in the following reports for Alberta, Saskatchewan, and Manitoba should be treated as minimum populations or production figures which will serve as indices to trends in breeding conditions from year to year. That is the purpose for which they were obtained.

WATERFOWL BREEDING CONDITIONS IN ALBERTA, 1947

Allen G. Smith

With continental waterfowl populations already in a critical condition, the primary purpose of this survey was to ascertain the condition of Alberta waterfowl breeding grounds during the summer of 1947; to attempt through field observations to estimate breeding populations; to note nesting, hatching, and rearing success, sex-ratios, water conditions and climatic and other factors as they affect the waterfowl populations in the Province.

With these as objectives, this survey was begun on May 1, 1947 by Allen G. Smith, Biologist, and William C. Garnick, U. S. Game Management Agent as field assistant.

Physiographic Features and General Climatic Conditions

One of the greatest waterfowl breeding areas in North America is located within the confines of the three prairie provinces of Canada - Alberta, Saskatchewan and Manitoba.

Of these three great provinces, Alberta is probably the most interesting physiographically. In size somewhat smaller than Texas, it is some 760 miles from its southern to its northern border and 400 miles in width at its broadest point. It is a vast plateau whose altitude ranges from 1000 feet above sea level in the north to 4000 feet above sea level in the south. On its western edge rise the high peaks of the Rockies, thirty-one of which tower over 11,000 feet in height. The major portion of Alberta, however, is comprised of the plateau mentioned above which slopes downward toward the north and upward toward the south and west. Just north of the city of Edmonton, a height of land turns the drainage coming from the mountains in the west toward the north and the Arctic Ocean. South of this height of land, the flow is eastward into Saskatchewan.

The northern half of Alberta is drained by the tributaries of the Mackenzie River, the Peace, the Athabaska and Hay Rivers. Southern Alberta is drained by the North and the South Saskatchewan Rivers and their many tributaries.

Thousands of lakes are scattered throughout this province, among which Athabaska, Lesser Slave, Claire and Lac la Biche are the largest.

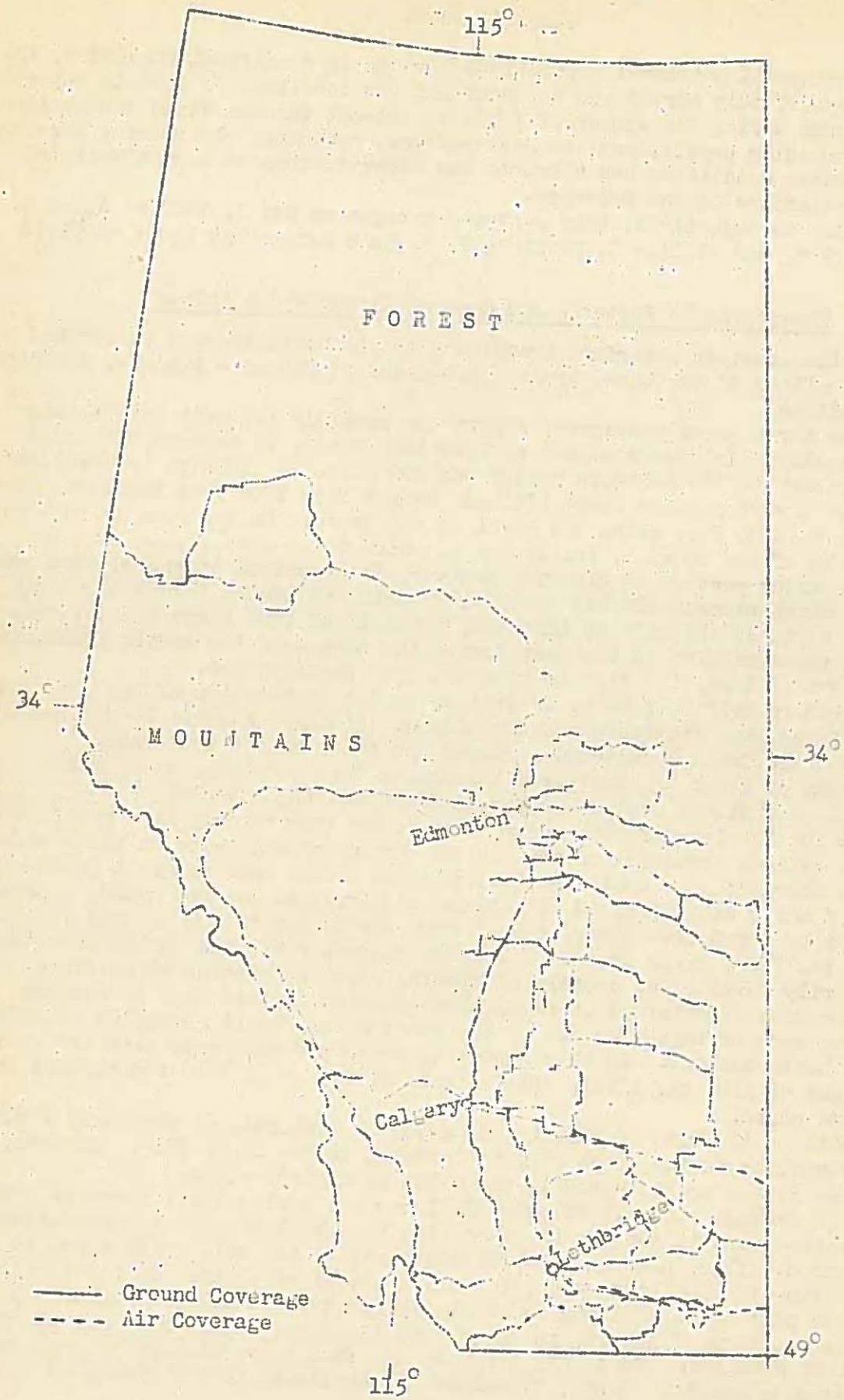
Except for the Pre-Cambrian rocks which enter Alberta only in a restricted area in the extreme northeast corner and the fringe of mountains on the western border, the province as a whole is overlain with arable soil of great depth. This soil, a marly clay overlaid with black or chocolate colored mould, a product of ages of vegetative decay, ranges from six inches to two hundred feet in depth, (in the Peace River area). The loamy character of these soils make them extraordinarily fertile and capable of storing great quantities of moisture.

This quality of moisture storage, plus climatic factors and the natural terrain have made of this area one of the greatest potential waterfowl breeding grounds in North America. As this survey is concerned primarily with the Prairies and Parklands of Alberta, little will be said of the great forested regions in the west and north.

In spite of the size of Alberta, mean summer temperatures vary only 2 degrees from Ft. Vermilion in the north (59) to Cardston in the south (61). Winters, though often severe are tempered in the south by chinook winds.

With an average rainfall of only 23.71 inches, agricultural pursuits would be very limited were it not for the fact that the greatest fall occurs during the growing season. This, plus the absorbing quality of the soil which tends to hold the winter run-off of melting snow, makes for excellent crops. As the terrain is for the most part gently rolling and marked by frequent shallow depressions, the southeastern portion of Alberta in the spring is characterized by hundreds of small, shallow potholes. These may vary in size from a fraction of an acre to several acres in extent. Depth, freshness or alkalinity of the water, as well

Study Transects - Alberta



as natural vegetation depend upon such factors as agricultural pursuits (grazing, plowing, etc.), soil types, and the annual vagaries of the weather. When winter run-off is moderate to heavy and summer rains are normal, these small pot-holes provide potential breeding areas for those waterfowl which come north.

Into this picture, however, come several limiting factors which from time to time may prove disastrous to both crops and waterfowl. Among these are drought, floods, hail, disease and predation. Because of the unpredictable nature of these occurrences and the important effect which they may have on waterfowl populations and breeding success, an annual 'on-the-spot' study of Canadian waterfowl breeding habitats is extremely important.

Areas Surveyed

This survey was confined, generally speaking to that portion of southern, central and eastern Alberta from the U. S.-Alberta-Saskatchewan border northward to the North Saskatchewan River, westward to St. Paul and Edmonton, south to the U. S.-Alberta-British Columbia border and east to Saskatchewan. This represents the area of most inclusive coverage. To this may be added a narrow strip of territory north of Edmonton to Athabaska, north and west to High Prairie, Grande Prairie, Dawson Creek, B. C., and Peace River. West of Edmonton, one transect was run to Jasper National Park, another south through Jasper and Banff National Parks, and a third into southeastern British Columbia to Cranbrook, Fernie and Crow's Nest. The scarcity of waterfowl seen on the western portion of the survey allows for only passing mention of this area at present. The main emphasis will be made on the central and southern portions of the province. The Peace River country will be treated, however, because of the important place which it formerly held in the waterfowl picture.

Survey Methods

Considering the great size of Alberta (248,800 sq. mi.), any ground survey, the purpose of which is an estimation of waterfowl conditions and population trends, must of necessity become a sampling process because of the limited time available. With this in mind, it was thought to be advisable to proceed with the sampling study from the south, working northward with the season. This would coincide with the advance of the birds and of the season.

Within the limits of a six-week period (May 1 - June 15), it was necessary to visit as many and as much of the representative waterfowl areas as possible in order to get data for use in preparing the preliminary draft of hunting regulations. With a truck and a canoe as the means of transportation, roads and the effects of weather on these roads represented the most serious handicap. Practically all roads were passable during dry weather but during rainy periods, gravelled highways were the only practical and safe lanes of travel, for earth grades become more slippery than ice and deeply rutted. Roads made impassable by rains became a serious factor in June, preventing access to much of the lake country north and east of Edmonton. In early May, the effects of the heavy winter run-off left many minor roads and trails closed to travel. Nevertheless, it is felt that by June 15 much data valuable in drawing up regulations were obtained and that before the summer was over the inspection of a large number of representative breeding habitats permitted formulation of a fair picture of conditions as they effect waterfowl in Alberta during the season of 1947.

During the course of the survey, over 8,500 miles were driven by car. In conducting the ground survey, transects were run throughout the breeding areas, on which observations were made for 1/4 mile each side of the transect line, a width made possible by the lay of the land in the parts of Alberta covered. This represents a strip of land and/or water 1/2 mile in width on which notes were taken as to time of day, size of area, cover types, water levels, land use, species of waterfowl seen, numbers of pairs, lone males, lone females, sex-ratios, brood sizes and classes, nests and clutch sizes, and any other information pertinent to the waterfowl problem.

On the basis of this field information, it is possible to make a fair appraisal of breeding ground conditions and of waterfowl breeding populations.

Weather and Water Conditions

The winter of 1946-1947 was a particularly severe one in Alberta. Temperatures were very low and snowfall was heavy. Spring run-off threatened to bring flood conditions to many portions of the province, but a prolonged cool spring held back the melting process, releasing the water gradually, a fact which was a boon to farmers because of the great reserves of moisture which were thus added to the soil. By April 1, moisture content of Alberta soils was at a high level, and the continued cool, cloudy weather prevented surface evaporation. This, of course, delayed agricultural activities and prevented plowing and seeding for periods up to two weeks or more beyond normal. Only in the Peace River country did a warm spring allow for agricultural activities to proceed at its normal pace.

On April 30, the first Searle Precipitation Report showed Alberta's moisture condition as of that date, 107% of normal. This included fall rains of 1946, winter snows and spring run-off and rainfall between April 1 and April 30. At that time, with normal summer rains, prospects were excellent for crops as well as breeding waterfowl.

Throughout the month of May, very little rain fell, temperatures continued low, and skies were generally cloudy. Evaporation remained low, yet the moisture content of the soils declined from 107% on April 30 to 96% on June 2. During this period the rainfall was only 57% of normal and some fears were being expressed of possible drought conditions by July.

By mid-June only two areas were observed to contain water conditions dangerous to waterfowl; the pot-hole country east of Hanna and Coronation, and spotty areas in the Peace River region. East of Hanna, most of the pot-holes contained only small quantities of water and mud, yet were heavily populated with ducks in proportion to the size of the individual areas. Nesting had begun and occasional broods were observed on these drying pot-holes.

In the Peace River district, particularly around Grande Prairie, individual lakes were very low, others very high, some were reported by residents as higher than for several years but lower than former high levels. In that area, even the lowest lake, (Brainard or St. Claire Lake) appeared to have sufficient water to carry over the ducks until fall, barring excessive evaporation or prolonged drought.

Elsewhere throughout the province water levels were normal to high. Even the southeastern semi-arid portion of Alberta was dotted with small bodies of water. Beginning on May 29 with a rain in Grande Prairie (their first since the previous fall), successive showers began to fall throughout the province which brought renewed moisture to the top-soil of all Alberta crop districts south to the United States border. Cloudy and cool weather between showers continued to keep evaporation levels low and water levels high. By June 30th the total moisture condition of Alberta soils stood at 99% of normal. June rains brought early summer rainfall to 85% of normal, thus placing the province in a seemingly excellent condition as far as waterfowl were concerned as of July 1.

July is a critical month for Alberta. Drought or hail at this time can cause irreparable damage. The summer of 1947 has been a good example of this. Beginning with the advent of July, hot, dry winds blew across central Alberta day after day without relief. Sub-soil moisture was still high but top-soil moisture decreased rapidly. Shallow lakes, ponds and pot-holes were subjected to heavy evaporation and became visibly smaller day by day. For the first time in history, Camrose, an area hitherto untouched by drought, began to show the unmistakeable signs of dry weather. By late July, pot-holes, ponds and small lakes were dry, much of the grain crop was lost, and the drought area which stretched from a point just east of Edmonton south to Camrose, was extending itself eastward in an ever-widening wedge into Saskatchewan. Losses in the east

were even greater than in the west for total soil-moisture content is normally lower there. In the entire countryside, once dotted with small water areas, it became difficult to find water except in the larger lakes. Even here water levels were dropping dangerously. Bittern Lake, one of Alberta's larger lakes was completely dry except for a narrow and shallow film of water of very small proportions by late July.

In the north, in the Peace River districts, July brought much needed rains, raising moisture conditions to a point well over 100% of normal.

In the southern and southeastern parts of Alberta, normally more subject to drought than other areas, moisture conditions remained better than usual. True, surface water in small ponds and lakes disappeared and the surface soil became quite dry, but the severe drought of central Alberta did not extend into this area.

By July 21, the Searle Precipitation Report placed the condition of all Alberta as far as moisture content of the soil is concerned at 78% of normal. At first glance, this would appear to be unworthy of much concern. However, the most severely drought-stricken crop districts recorded conditions 61%, 64% and 65% of normal. As these percentages represent the overall picture, reserves of sub-soil moisture as well as surface soil moisture, the situation becomes more serious. Waterfowl are dependent upon rainfall and low evaporation to keep water in the shallow ponds and lakes of this area. Sub-soil reserves have little effect upon intermittent bodies of water once the hot, dry winds begin to blow. As a result one body of water after another, which harbored moulting ducks, broods and late nesters disappeared. By August 7, a good proportion of the small central and southern Alberta waterfowl areas had dried up.

To this disastrous condition must be added another factor, much in evidence this summer, - hail. Beginning earlier than usual (mid-June), hail has been reported officially as more severe, more devastating and more widespread in its destruction than at any time in the past ten years. As those areas most severely hit were the Edmonton-Camrose area east to Saskatchewan and the southern portion of the province from Stavely south to the United States border and east to Saskatchewan, it will mean added destruction to waterfowl, as these also represent the two best breeding areas noted this year.

Therefore, it would seem that what gave early promise of being one of Alberta's best years for waterfowl production, rapidly deteriorated after July 1 to a point where the heaviest populated breeding areas were either raked by hail of disastrous proportions or subjected to drought conditions equally serious.

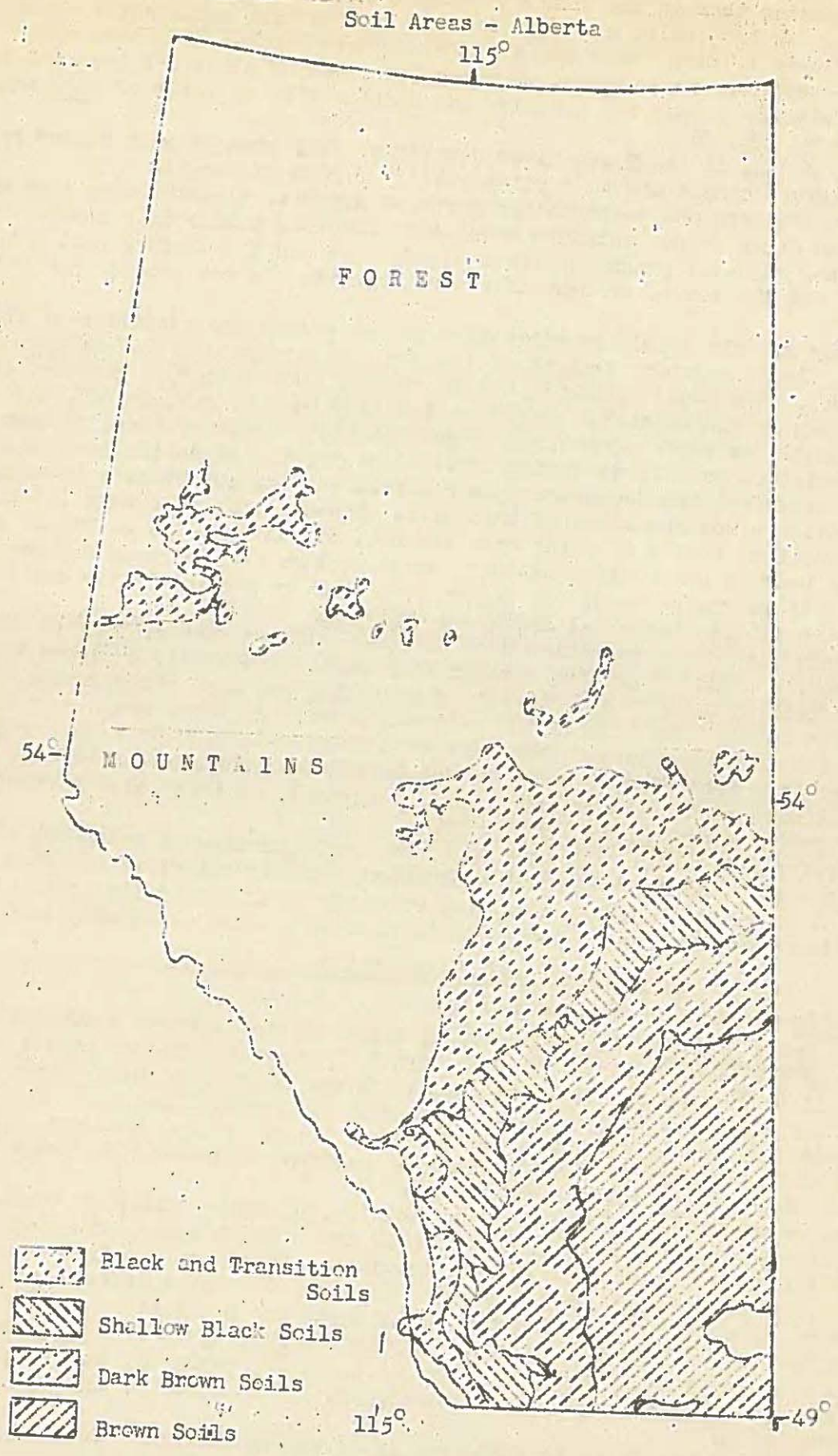
Waterfowl Breeding Populations in Alberta

Brown soils (pot-hole area, semi-arid)

The brown soils of Alberta occupy a region in the extreme southeastern portion of the province. The climate here is semi-arid, with an annual rainfall of from 11 to 13 inches. It is subject to frequent drought, high evaporation, and hot dry winds. A great deal of this area is rangeland but some 20% of it is under cultivation. In average to better than average years, the more western portion of this region is characterized by hundreds of pot-holes. Only two large lakes are found here, Pakowki and Newell.

The brown soils of Alberta occupy some 19,531 square miles or about 8% of the province. In the ground survey of this area, 343.6 square mile were sampled through the use of transects 1/2 mile in width. This sample represents 1.7% of the area of brown soils. As the sample was taken in representative sections of the entire area, an attempt was made to estimate the population of this soil type through the use of this 1.7% sample. In other words, 5,373 nesting pairs of ducks were seen on the sampled area, or about 15.6 nesting pairs per square mile. This would give us approximately 312,496 nesting pairs of ducks for the entire area of the brown soils.

The fate of the ducks in this area is always questionable because of fre-


Soil Areas - Alberta
115°
FOREST
MOUNTAINS
54°
54°
49°
115°
Black and Transition Soils
Shallow Black Soils
Dark Brown Soils
Brown Soils

quent droughts. This year was an exception, though severe drought conditions did not occur except in the northern portion of this zone. Elsewhere sub-soil reserves have not been endangered. Waterfowl production was seriously hampered in this region by the combination of drying pot-holes and severe hail storms.

Dark Brown Soils

(Pot-holes-irrigation area)

The dark brown soils extend in an arc from the U. S. border, north and east on the western edge of the brown soils to the Saskatchewan border. With an annual rainfall of from 13 to 15 inches, it is less subject to drought, but evaporation is still fairly high and hot dry winds are common. Both brown and dark brown soils are chiefly short grass prairie with a more dense cover in the case of the dark brown soils. Pot-holes are very frequent and some of the greatest irrigation projects in Alberta are found in this region.

The dark brown soils of Alberta cover an area of 13,671 square miles, of which 328.7 square miles or 2.4% were sampled in this survey. 7035 nesting pairs of ducks were observed on this sample or the equivalent of 21.4 nesting pairs on 1%. This per square mile would represent some 292,559 nesting pairs for the entire area.

This region with its irrigation projects and Ducks Unlimited developments rates the best chance of showing a high level of waterfowl productivity this summer, even though some portions of the southern part of the dark brown soils were heavily raked by hail.

Shallow Black Soils

West of the dark brown soils, where rainfall averages from 14 to 17 inches annually, are found the so-called shallow black soils. Droughts occur here only occasionally. With increased moisture, trees become more evident with aspens and willows appearing where moisture conditions are favorable.

These soils comprise about 11,068 square miles of the province of Alberta. 223.2 square miles or 2% of the area was sampled. On this sample were observed 2757 nesting pairs of ducks. This would represent approximately 136,136 nesting pairs for this region or 12.3 nesting pairs per square mile.

The northern portion of this soil type has suffered severe losses from hail and drought and with so much of the southern portion intensively cultivated, the annual increment here will hardly be spectacular.

West of this area are found the black soils and the transition soils which extend northward in a more or less interrupted manner into the Peace River district. Annual precipitation averages between 17 and 19 inches and droughts are rare. Evaporation is lower and hot winds less frequent than in the other areas. This is the so-called 'parkland' of Alberta, grasslands interspersed or invaded by small areas of aspen woodlands. As progress is made toward the outer fringes of this black soil into the transition soils, coniferous trees appear in greater numbers.

Many lakes are found in this soil type and though the soil here is the best in the province and thus is under extensive cultivation, nevertheless the improved moisture factor has provided great numbers of ponds and lakes which are attractive to waterfowl.

With a total area of 15,625 square miles, the black soil region of Alberta represents the best agricultural lands in the province. 669.2 square miles or a 4.2% sample was made of this region, 9465 nesting pairs of ducks were seen or 14.1 nesting pairs to the square mile, representing approximately 220,312 nesting pairs on the whole area.

In spite of the low figures noted above, in spite of hail and drought which cut a wide swath across the widest portion of the black soils of Alberta, the Province has as many opportunities for a fair success in waterfowl production as have the more stabilized irrigated districts to the south. Greater numbers of larger lakes with more or less stable water levels are found throughout this

soil type than in all the other types combined. Though larger bodies of water are not utilized to the extent of smaller ones, and goodly proportions of their surfaces are barren of all types of waterfowl, nevertheless, those birds that have used these areas this year will have been more or less free from the severe climatic conditions that beset many of the regions to the south.

For reasons of comparison with population figures in the past, the following estimates are given of waterfowl seen on a few of the more important lakes in Alberta this past summer:

Lake	Ducks	% of area noted
Antelope Lake	50	25%
Kirkpatrick Lake	25	10%
Keho Lake	225	20%
Big Hay Lake	200	100%
Cooking Lake	450	2%
St. Claire Lake	1300	100%
Flying Shot Lake	100	100%
Saskatoon Lake	300	100%
Cut Bank Lake	125	100%
Deep Lake	100	100%
Bear Lake	300	5%
Dry Stick Lake	100	100%
Swan Lake	216	100%
Lac Magloire	135	90%
Kimiwan Lake	775	40%
Sturgeon Lake	3500	10%
Lesser Slave Lake	200	20 mile of shore

These figures may appear low to those who have seen far greater numbers of waterfowl on these lakes in the past. For that matter they may also seem to be low to those who had heard reports of thousands of ducks spotting the lakes of the Peace River country. Upon closer observation, however, it was discovered that particularly on the lakes of the Grande Prairie area, thousands of 'ducks' became grebes and coots upon closer examination. This was very apparent at Big Hay Lake where the restricted water area was reported to be literally 'alive' with ducks. Close examination showed this lake to be one of the greatest grebe and coot lakes in Alberta!

Estimated Total For the Four Major Soil Types

304,683 nesting pairs on brown soils
292,559 " " " dark brown soils
136,136 " " " shallow black soils
220,312 " " " black and transition soils.

943,690 nesting pairs on four major soil types.

Based on figures of representative areas in western Alberta and the lake country to the north and east of Edmonton, a very liberal estimate of 50,000 nesting pairs might be added to the grand total to account for those ducks breeding on some of the mountain lakes, woodland ponds and lakes of the inaccessible portions of central Alberta and the thousands of lakes in the St. Paul region. However, certainly only the 943,690 nesting pairs or the 24,630 nesting pairs for the 1564.7 square miles sampled an average of 15.7 pairs / square mile should be used as index figures.

Nesting

Once again, a combination of factors which at first appeared to favor waterfowl worked to their detriment, this time in nesting success. The delayed spring plowing resulting from an excessively wet top-soil made early plowing of stubble an impossibility. As nearly every depression contained standing water this

spring, and as cool, cloudy weather maintained these water areas while farmers were kept from the fields, many ducks began nesting in the stubble before plowing began. Normally this stubble would have been plowed under by the time the ducks began to choose their nesting sites. This past spring, however, the lateness of the agricultural season caused the destruction of numerous nests in late May and early June. Many farmers reported unavoidable destruction of these nests. Considering the thousands of acres of stubble in Alberta which was plowed up from one to two and one-half weeks later than usual this year, the problem of estimating nest destruction becomes one of pure conjecture.

It is true, however, that at the time when the sex ratios of early nesting ducks should have shown fewer and fewer females, there came a sudden reverse which was apparent in the field even before the actual figures had been compiled. This period from May 27 to June 9 seems to have been the critical one. Its correspondence to the time when Alberta farmers carried out the late but speedy plowing and seeding of their soils does not seem to be coincidence. Mallard sex ratios rose from 1.7 males to 1 female in early May to 4.1 to 1 during the week of May 27 to June 2. During the following weeks this ratio dropped from 3 to 1 to 2 to 1, to be followed by a second rise after the third week (4.2 to 1). The sex ratio of pintails rose gradually from 2.3 to 3.6 to 1 until May 26 but from May 27 to June 9, the trend was downward to a low of 2 to 1 female. Recovery came after June 16 when the ratios rose to 3.3 to 1, to be followed the next week by 3.6 to 1.

Shovellers showed the greatest variations. From a low of 1.8 males to 1 female as of May 6 to a high of 5.7 to 1 June 2, an abrupt change was noted the following period by a drop to 2 to 1. Recovery came after June 16.

As sampling during this period covered all soil types in about equal amounts, these figures are thought to be indicative of considerable early nesting losses, with a sharp up-swing of renesting after June 15. Had these changes in sex ratios been for periods in July and August, they might have been accounted for by exodus of males from the breeding areas, but the dates themselves point to nesting losses as the most important factor.

It is likely that when renesting occurs, the average clutch at second laying is smaller than the first. Though the tremendous acreages of unplowed stubble in May and early June made the discovery of many nests disappointing, those which were found showed better than average clutch sizes. Nests discovered after mid-June (mallards, pintails and shovellers) on the other hand were very small, often containing only two or three eggs.

-Weekly sex ratios-*
May 6 - June 26, 1947

	M	Pt.	Bp	Gd	Sh	BWT	Gwt	Rdy	Rh	Can	Scp	Buf	Gld
May 6-12	1.7	2.3	1.2	1.1	1.8	1.2	1.2	1.1	1.3	1.4	1.5	1.1	1.2
May 13-19	2.2	2.5	1.4	1.1	1.6	1.1	1.2	1.3	1.9	2.0	1.4	2.1	1.0
May 20-26	3.0	3.6	1.5	1.1	2.5	1.6	1.7	1.0	1.3	2.3	1.2	1.0	1.3
May 27-June 2	4.1	2.2	1.6	1.0	5.7	2.1	2.5	2.2	1.3	1.1	1.4	1.5	1.2
June 3-9	3.0	2.1	2.3	1.4	2.0	2.1	3.3	1.0	2.2	3.4	1.4	2.1	2.5
June 10-15	(No field work in area of sufficient waterfowl concentration)												
June 16-22	4.2	3.3	5.8	2.5	4.5	4.0	5.2	1.8	2.2	9.8	2.4	2.0	1.0
June 23-26	3.7	3.6	3.9	2.2	8.7	4.6	-	3.0	1.7	2.7	2.7	-	-

*Numbers above represent proportion of males to one female. For example, during the week of May 6-12, mallard males were observed in a 1.7 to 1 ratio to females, pintail males 2.3 to 1, etc.

The sex ratios given above are not presented with the idea that they represent the actual sex ratios of those particular species in Alberta, but rather the ratios as we observed them on the survey routes taken.

Because of the fact that White-winged Scoters are usually observed well offshore on the larger lakes, it is often impossible to identify them as to sexes. No attempts were made to indicate sex ratios of this species in the sex ratio chart above. Sexed individuals were recorded in the Forms A, however.

Broods and Breeding Success

Despite the lateness of the spring, waterfowl seem to have begun their nesting as early if not earlier than usual in Alberta. The first broods of the following thirteen species were observed on the dates given below:

Mallard - May 8
Pintail - May 9
Shoveller - May 9
Baldpate - May 27
Canvasback - June 5
Barrow's Goldeneye - June 14
Blue-winged Teal - June 14
American Goldeneye - June 23
Gadwall - June 26
Ruddy - July 22
Green-winged Teal - July 30
Bufflehead - July 24
White-winged Scoter - Aug. 1

The average brood size at hatching (Class I), when all species are considered together, was 7.5 ducklings per brood. The average brood size at maturity (Class III) was 6.9 ducklings per brood. This represents an average mortality for successfully reared broods of 8.0% from all causes. In other words, these figures would indicate that 8 ducklings out of every 100 hatched disappear before reaching the flying stage.

Several individual species deserve particular attention because of a greater or lesser mortality figure than the average.

Species	Brood Class I	Brood Class III	Mortality
Gadwall	6.5	6.5	0%
Mallard	6.8	6.6	3%
Blue-winged Teal	7.2	6.8	5%
Pintail	7.2	5.9	18%
Ruddy	10.5	8.5	19%

Because of the fact that so few downy young of canvasbacks, baldpates and shovellers were observed in proportion to the number of broods seen of these same three species in Classes II and III, actual figures would indicate a gain in brood size. In these cases, where the number of Class I broods was so insignificant, they were not considered in the mortality figures with Class II and Class III broods.

No data is available on the brood success of the white-winged scoters as the first downy young were not observed until August 1. American and Barrow's Goldeneye broods were seen too seldom to form any justifiable opinion on their success.

In the drought area, losses in potholes approached 100% in numerous instances, for large permanent bodies of water were usually too far removed from the drying potholes for the females to walk their broods to safety. In the semi-arid south where hail damage was intensive, broods suffered severely, possibly upwards to 85%.

Actual figures on hail mortality were not obtained, for on nearly every occasion the most severe storms occurred at times and in areas other than where the survey party happened to be located. However, in several cases it was possible to revisit hail-damaged areas no more than a week later; and, no living ducks, either adults or young could be found. As these areas had been visited only a few days previous to the storm and as normal populations of adults and young in Class I and II size had been observed there at that time, we have only circumstantial evidence to indicate that as broods could not have reached the flying stage in the short space of time intervening between visits, the total disappearance of these waterfowl could only be laid to storm damage. The failure to find carcasses and the presence of both coyote and skunk sign would lend credence to the belief that the dead birds had been eaten or carried away. During banding operations on Sterling Lake in southern Alberta, an adult pintail was seen to fall out of a flock in flight during a moderate hail storm. On the following day, while making a drive through the heavy cover of cattails and bulrushes some ten ducks of all ages and sizes, several coots, grebes, and gulls were found dead, each with the same scalped appearance, characteristic of a hail wound. As these dead were found in heavy cover, those waterfowl on more open and less vegetated potholes would undoubtedly suffer proportionally. As most breeding habitat in the prairie country subject to hail damage is characterized by lack of heavy vegetation, the effects on flightless broods becomes disastrous.

It would seem, therefore, to be a conservative statement to say that at least 75% of all young hatched in those stricken areas probably victims of the weather. Accounting for no losses among the adults, this means that only about two ducklings out of every brood in these areas probably left the Province in the fall. Computed with the production of all areas, good and bad together, the figures would indicate that only 5.2 ducklings out of the 6.9 average brood size joined the fall migration. This would represent around a 20 percent mortality instead of the original 8 per cent computed by use of Class I and Class III to brood size alone.

Disease and Predation

During the period of the survey only one outbreak of botulism was noted in Alberta. This was a minor one on Big Hay Lake. On one mile of the east shoreline five sick and ten dead ducks were found. One hundred and forty-eight Franklin gulls, twelve coots, one Common Tern and three Black Terns were also picked up in the same area. While making a drive on this lake during banding operations, many more dead Franklin gulls were seen in the tules, though no further evidences of sick and dead ducks were found.

As the bird population of Big Hay Lake was primarily made up of gulls, coots, and grebes at that time, even a severe botulism outbreak would have had a slight overall effect on general game duck populations. Though reports were received of past botulism outbreaks on several lakes in this province, no other evidences were found of this disease during the summer of 1947.

The predation problem on Albertan waterfowl appears to be primarily one of nest destruction by crows, magpies and skunks. In spite of the increase of both crows and magpies during the past year, it is not felt that losses caused by these predators were serious enough to give cause for alarm. Coyotes undoubtedly account for some losses, but this past summer it appeared to be fundamentally a case of scavenging the dead which were stricken by hail and drought.

APPENDIX

Relative Sizes of Soil Types and Samples

Soil Type	Total Area	Area of Sample	% Sample	Computed Population Nesting Pairs
Brown	19,551 sq. mile	343.6 sq. mile	1.7%	304,683
Dark Brown	13,671 sq. mile	328.7 sq. mile	2.4%	292,559
Shallow Black	11,068 sq. mile	232.2 sq. mile	2.0%	136,136
Black & transition	15,625 sq. mile	669.2 sq. mile	4.2%	220,312
Total	59,895 sq. mile	1564.7 sq. mile	2.5% (aver)	953,690
Gray wooded	49,478 sq. mile	198.7 sq. mile	0.4%	100,000

Aquatic Habitats Surveyed

Size	Number	% of whole
A (0 - 1/2 A)	315	27.9
B (1/2 - 1 A)	252	22.3
C (1 - 5 A)	277	24.5
D (5 - 10 A)	108	9.5
E (10 - 25 A)	61	5.4
F (25 - 100 A)	48	4.4
G (100-200 A)	27	2.3
H (200 + A)	39	3.4
Total	1127	100 %

Occupancy of Water Areas by Waterfowl

Areas	Total	Occupied	Unoccupied	% Occupancy
A (0 - 1/2 acre)	315	222	93	70.47
B (1/2 - 1 acre)	252	188	64	74.60
C (1 - 5 acres)	277	237	40	85.55
D (5 - 10 acres)	108	103	5	95.37
E (10 - 25 acres)	61	54	7	88.52
F (25 - 100 acres)	48	42	6	87.50
G (100-200 acres)	27	22	5	81.48
H (200 + acres)	39	33	6	84.61
Total	1127	901	226	79.94%

WATERFOWL BREEDING CONDITIONS IN SASKATCHEWAN, 1947

John J. Lynch

This report describes the waterfowl producing regions of southern Saskatchewan, and appraises nesting populations and probable nesting success for the summer of 1947.

Our ground surveys covered the Prairies and "Aspen Parklands" of the Province. These are considered to be the "Duck Factory of Saskatchewan". We travelled 10,000 miles of roads and trails during the summer, and spent 80 air-hours mapping the various waterfowl regions and making brood counts. To this might be added many miles of foot-work, and an unrecorded number of hours in the water.

In determining nesting populations we established 208 permanent transects, representing a 230 square mile sample (see Figure A for locations). 110 check transects add 345 square miles to this figure. Three large plots, totaling 200 square miles, were given 30% coverage in studying nesting success.

The Prairie Nesting Grounds

The Prairie grasslands and the Aspen parklands of southern Saskatchewan are 75,000 square miles in extent, slightly less than one-third the total area of the Province. They include all of the agricultural land of Saskatchewan.

A region of short-grass priarie is found in the extreme southwest. Parts of this prairie, including the Cypress Hills and the Wood Mountains, are deeply-dissected plateau lands. Severe natural drainage, drougthy soils, and semi-mountainous terrain render the plateau lands unsuitable for agriculture, but the entire region is grazed heavily. Waterfowl habitat here is confined to stream-bottoms, beaver ponds, and man-made reservoirs.

North and east of the plateau is a band of moderately-rolling short-grass prairie. Every depression in this prairie becomes a pot-hole in wet years. In some sections such as the Missouri Coteau, we recorded 50 to 80 full pot-holes per square mile this summer. There are many larger and more permanent lakes through-out this "Brown-soil Zone". These attract moulting adult ducks, and serve as emergency rearing sites for young during dry years.

The "Great Sand-Hills", a conspicuous feature of the short-grass belt, failed to come up to expectations as a duck-producing region. In these dune sand formations, the water table lies close enough to the surface to support small groves of trees, but it seldom comes above the surface. Surface water is absent save for large, shallow alkali lakes.

Skirting the short-grass prairie is a band of "Mixed Prairie" that is characterized by heavy "gumbo" soils and more gently rolling topography. Before the advent of man, this prairie was well-grassed, and dotted with many sloughs, some several hundred acres in extent. However, the clays and clay-loams of the mixed prairie proved to be ideal for cereal crops, so nearly all of this region is now farmed intensively. Wheat farming is particularly well-developed on the Regina Plain, the Assiniboia Flats, and the Kindersely Flats. We found large concentrations of nesting ducks in these wheat lands during the past summer, and the part of the hatch that escaped being plowed up in the egg stage fared well, since the heavy soils retain moisture much better than the light loams of the hill country. In dry years, we can look for a different picture. If the snow-water that fills the shallow sloughs in spring is not supplemented periodically by summer rains, the slough-bottoms will produce wheat instead of ducks.

Above the Mixed Prairie is the "Aspen Parkland", a belt of moderately-rolling black-soil land that touches the Alberta border in the vicinity of Lloydminster, and extends east into the Minnedosa Potholes of Manitoba and south into North Dakota. This region is liberally dotted with small potholes, as many as 90 per square mile, but more permanent ponds and lakes are scarce. Potholes along the

FIGURE A Centers of Production and Drought Areas, 1947.

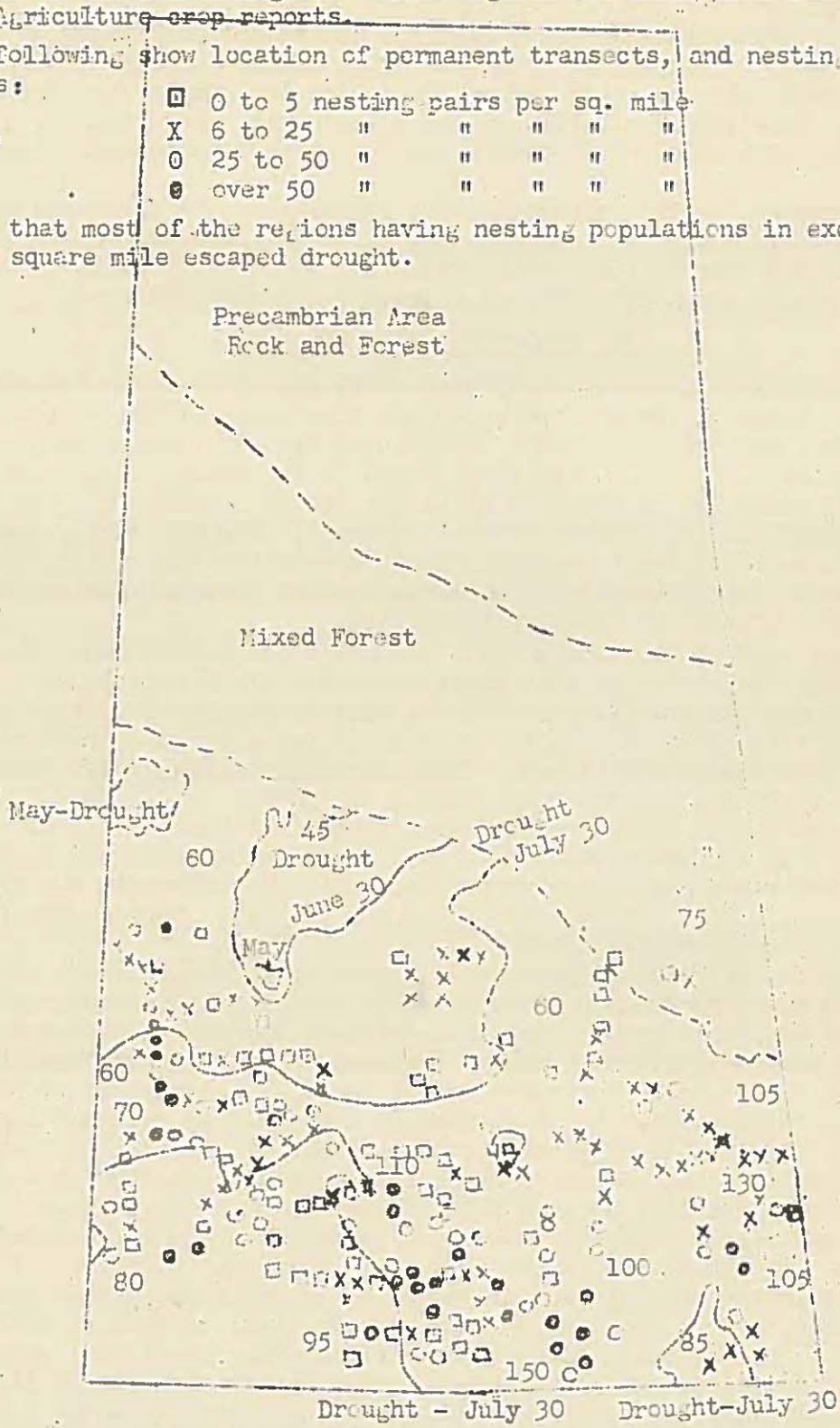
Solid lines show the extent of drought area as of May 30, June 30, and July 30. This information was compiled from Saskatchewan Pool Weekly Crop Reports.

Numbers indicate percent of normal rainfall in various sections of the Province as of the end of August. These figures are taken from Saskatchewan Dept. of Agriculture crop reports.

The following show location of permanent transects, and nesting density, as follows:

□	0 to 5	nesting	pairs	per	sq.	mile
X	6 to 25	"	"	"	"	"
0	25 to 50	"	"	"	"	"
●	over 50	"	"	"	"	"

Note that most of the regions having nesting populations in excess of 25 pairs per square mile escaped drought.



southern extremity of this belt are fringed with willow. Further north, this fringe is replaced by an aspen border. Dense aspen groves occur along the upper limits of the belt, but in many places these woodlands are being cleared for agriculture. The aspens and willows bordering the potholes prevent farming to the water's edge, but at the same time they furnish fine nesting sites for the crows and magpies that infest the Aspen Parkland.

Beyond the Parkland is the "Bush". Agriculture is out of the question in the degraded soils of this region, but logging, trapping, and mineral development are extensive. The Bush starts as mixed hardwood and coniferous forest. Further north true spruce forest and muskeg appear, and these are replaced by rock shield and transition Tundra in the extreme North. Ground work is virtually impossible in the Bush, so any appraisal of its waterfowl potentialities must be done by plane.

The Prairie and Parkland regions have a semi-arid climate. Annual rainfall averages 12 to 14 inches. The Short-grass prairie is most susceptible to drought, due to its light soils and a high rate of evaporation. Moisture efficiency is greater in the Parkland soils, thanks to cooler weather and heavier soil texture.

The Nesting Population

Nesting populations were determined by the transect method, record being made of breeding pairs by counting pairs and single drakes. Flocked birds that were obviously transients were not counted in this survey.

Our data show that the 1947 waterfowl nesting population of southern Saskatchewan average 20.7 nesting pairs per square mile. Ponds averaged 14.2 per square mile, and 31.4% of these ponds was occupied by nesting ducks.

The total nesting population of southern Saskatchewan has been computed in several ways. The results are summarized below (see tables at end of report for details):

Method of computing	# pairs / sq. mile	Total area	Nesting Population
Permanent Transects	20.7 pairs	75,000 sq. mi.	1,552,500 pairs
By Regions (Fig. B)	(see Table #1)		1,361,052 "
By Soil Types	(see Table #2)		1,324,238 "
by Occupied Ponds	1.4 pr/pond	1,065,000 ponds (14.2 ponds/sq. mi. x 75,000 sq. mi.	1,491,000 "

*On the basis of these data we can way with reasonable assurance that there were at least 1,500,000 nesting pairs of ducks in southern Saskatchewan in the early summer of 1947. This population is broken down by species below:

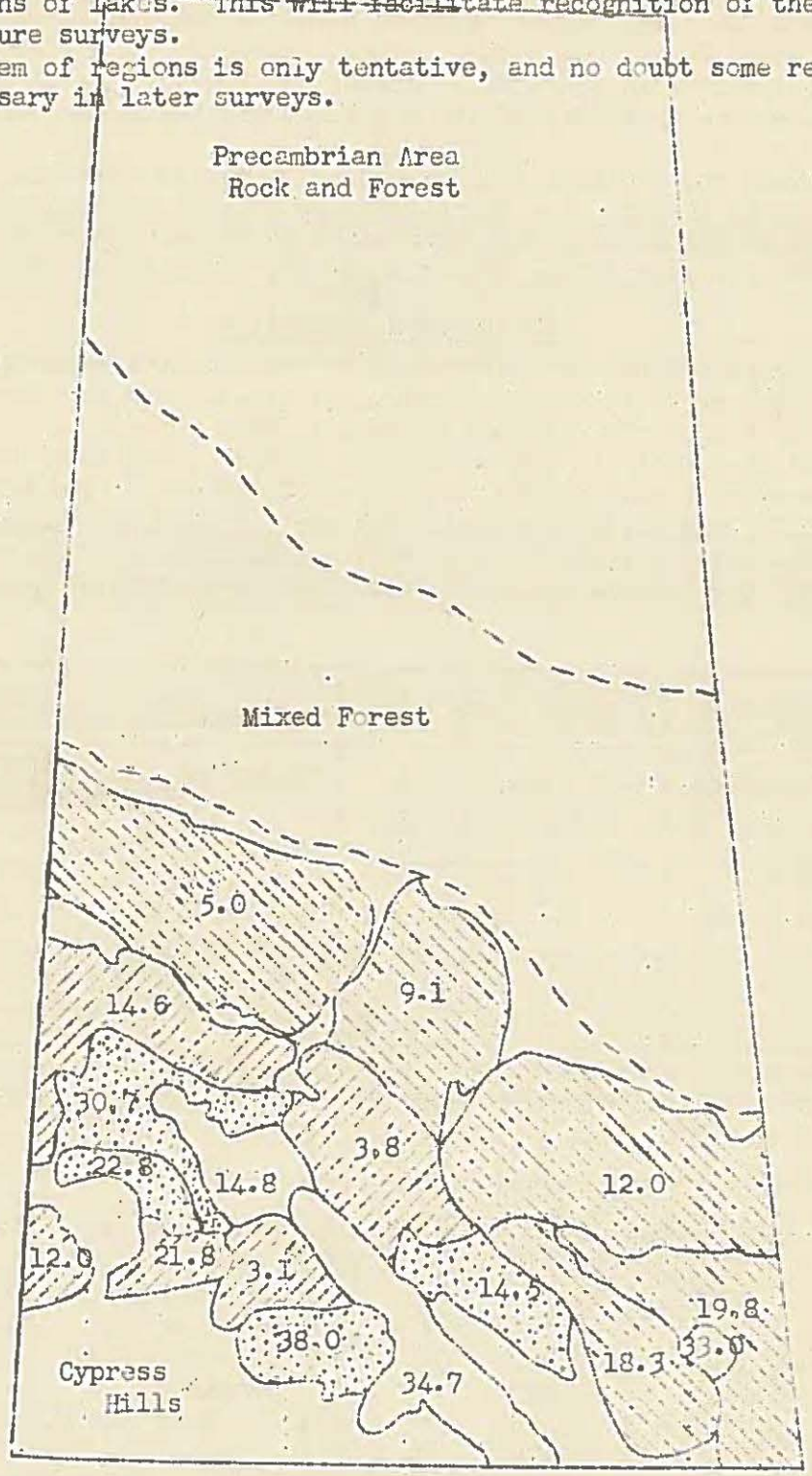
Species	% of Total	Nesting Population	Species	%	Nesting Population
Pintail	37.7 %	565,500 nesting prs.	Ruddy	0.7%	10,500 nesting prs.
Mallard	18.3	274,500 " "	G.W. Teal	0.7	10,500 " "
Shoveler	14.9	223,500 " "	Ringneck	0.1	1,500 " "
Bluewing Teal	10.4	156,000 " "	Goldeneye	0.02	300 " "
Baldpate	7.4	111,000 " "	Cinnamon Teal	0.02	300 " "
Gadwell	3.9	58,500 " "			
Less. Scaup	2.4	36,000 " "			
Canvasback	2.2	33.000 " "			
Redhead	0.9	13.500 " "			

FIGURE B. Waterfowl Producing Regions of South Saskatchewan.

A Provisional break-down of the Prairie and Parkland sections of Saskatchewan, to indicate just where the centers of waterfowl production are located.

These regions have been set up on the basis of dominant soil types, topography, native vegetation, and waterfowl habitat types. Each region was later rounded out so that it was bounded by prominent physiographic features such as rivers or chains of lakes. This will facilitate recognition of the various regions in future surveys.

This system of regions is only tentative, and no doubt some revisions will be found necessary in later surveys.



Populations were relatively low (9 to 19 per square mile) in the Aspen Parkland between Saskatoon and the Manitoba border (Regions 5, 7, 8, & 9 on Map, Figure B). We suspect that these regions may be part of the nesting grounds for Mississippi Flyway Ducks. Much higher populations (34.7 per square mile) prevailed in the well-watered Coteau (Region #3). Heaviest concentrations (38.0 per square mile) were found in the flooded wheat-fields of the Assiniboia Flats, while the Kindersely Flats (Region #15) showed 30.7 pairs per square mile. There is reason to believe that these high populations represent ducks that normally would have nested further north, but were prevented from doing so this year by a very late breakup of the lakes in the Bush.

Nesting Success

Banding work took up most of our time during July and August, so we were unable to study the progress of the hatch in detail. The following observations will give some idea of trends.

Water Conditions

Saskatchewan received 57.4 inches of snowfall during the past winter, the greatest amount in ten years. As a result, most of the prairie sloughs and pot-holes were brim-full by the time the ducks arrived. One outstanding exception was an area in the Northwest bounded by Battleford, Saskatoon and Prince Albert. There was little or no frost in the ground prior to the first winter snows in this region. When the spring thaws came, snow-water was immediately soaked up by the soil.

Snow water must be supplemented by summer rains to insure a successful duck hatch. Not all of the Province received adequate rains this summer. As early as June 30, serious drought developed in the Northwest. Fortunately this section was devoid of nesting ducks, since there was no water in its potholes at the start of the season.

By the end of August, the drought had spread throughout the Northwest and down into the West Central and Southwest. Three-fifths of the Province reported sub-normal rainfall by this time. Fortunately the regions having the heaviest duck populations escaped serious drought. Even in the southwest, where crops were drying up by the end of July, run-off water, augmented by slight summer rains, kept the sloughs wet until all but the very late broods were on the wing. (See Figure A for relation of drought to producing Areas). We are certain that drought did not cause serious loss of broods this year in Saskatchewan, but we are equally certain that it failed to do so only because of sheer luck and an act or two of providence.

Brood Size

What broods were hatched off this summer did exceptionally well. The average for all species, based on 343 brood counts, was 6.43 young per brood. The average for downy (Class I) was 6.7 young per brood, while the average for full-grown (Class III) was 6.4 young per brood. This represents a mortality of only 5.9%. Average brood sizes for the various species are listed in Table #3.

Loss of First Nests

While the size of broods was good this summer, and mortality from hatching to maturity was unusually low, we failed to find the number of broods that high nesting populations should have produced. There might be several reasons for this, but the following is the most likely one.

Nesting cover is at a premium in Saskatchewan in early spring. Prairie grasses do not put out much growth until the month of June. Consequently the stubble-fields, especially those with combine stubble, are very attractive to early nesters such as pintail and mallards.

FIGURE D. Indications of Re-nesting.

Proportion of lone ♂ to pairs in transects thru agricultural lands, compared to same found on grazing lands. Re-appearance of paired mallards and pintails late in season, particularly in agricultural lands, may indicate loss of first nests. Compare with orderly progress of Baldpate.

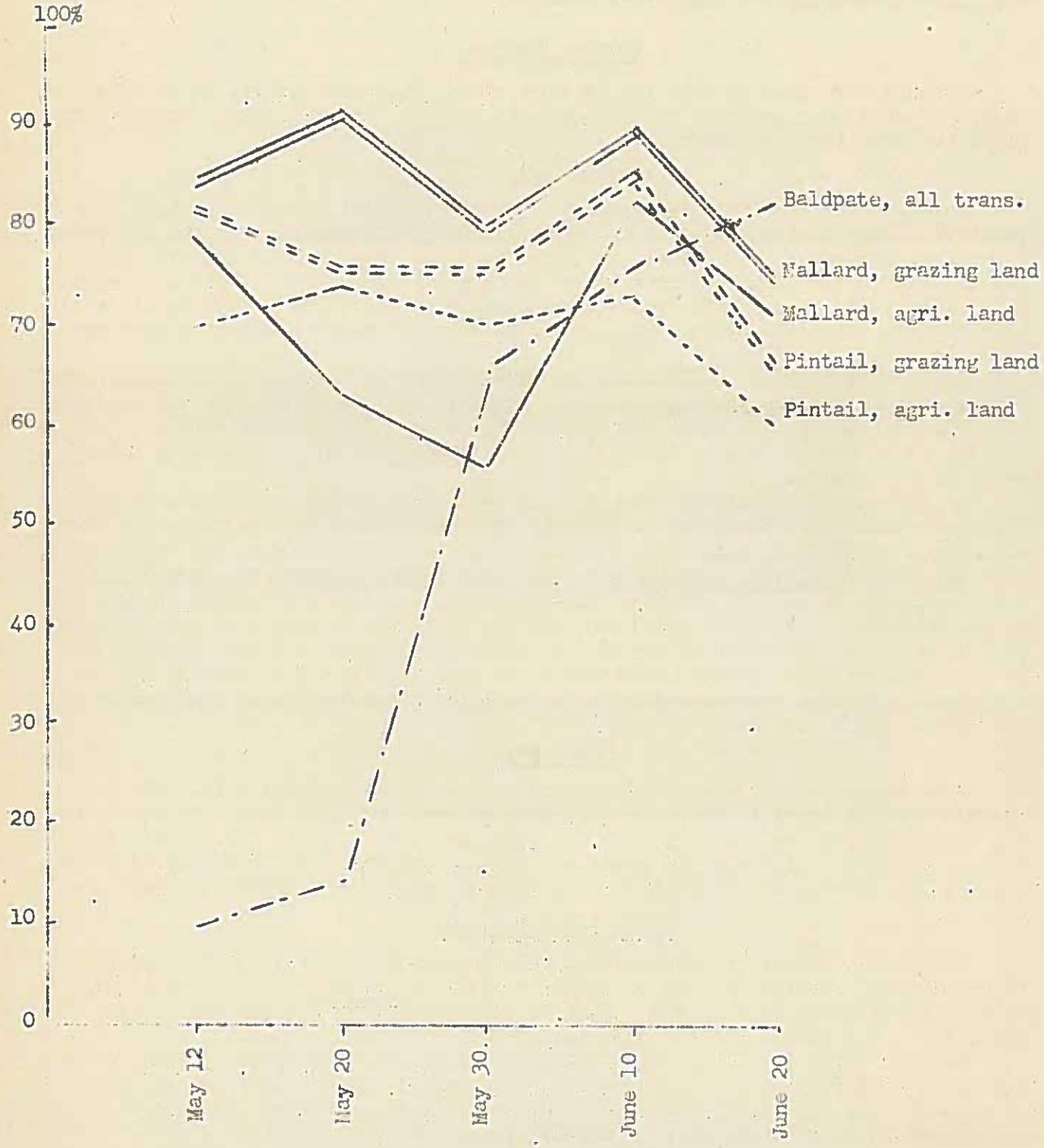
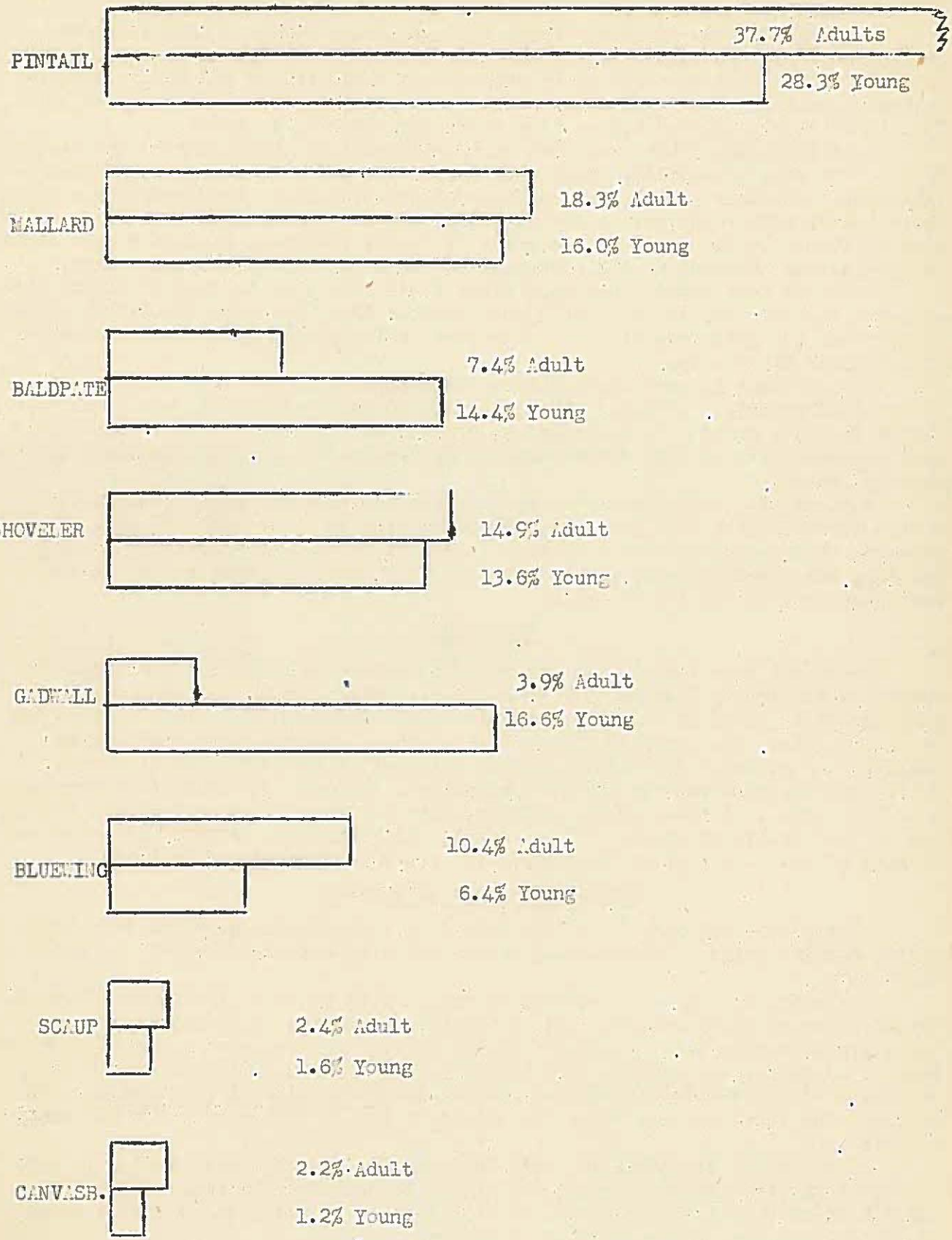


FIGURE E. Indications of Nesting Success.



Ordinarily the prairie wheat farmer rests or "fallows" a portion of his fields every year. Each spring he seeds the land that was fallowed the previous summer, and then plows the stubble of the last season's crop. This "summer fallow" of the current season is then disked several times during the summer to control weeds and conserve soil moisture.

It is the stubble of these fields that are to be fallowed that attracts nesting mallards and pintails. If the planting season should be delayed by bad weather, the stubble nesters may be able to get their broods off before summer-fallowing starts. When very early planting is possible, the farmer may be able to get his stubble plowed before many ducks have started to nest.

It is inevitable that some duck nests will be lost every year in the stubble-fields. In some localities, stubble is burned off prior to the start of summer-fallowing. In other places, the recommended practice is to summer-fallow a field every third, rather than every second year. And the inexorable laws of economics, more particularly the current high price of wheat, make many farmers forget about summer-fallow. Seeding in the past year's stubble is widespread these days.

We do not know exactly how many first nests were lost in stubble-fields this season. Farmer's reports suggest a very serious loss, but give few actual figures. We have one authentic report of 23 duck nests being plowed up in a half-section of land near Kindersely.

We might bear in mind that southern Saskatchewan is far from being a vast undisturbed prairie. Actually 77% of its 75,000 square miles was under cultivation in 1947, and 95% of the cultivated lands was in cereal crops. This means that three-fourths of this "Duck-Factory" are grain-fields. The remainder is heavily grazed.

We might also remember that many mallards and pintails that should have nested further north this year set up housekeeping in the stubble-fields. These ducks might have had to face a number of dangers on the more northerly nesting grounds, but despite these, we suspect they might have had better luck in the Bush than they did on the Prairies.

Renesting

We can get some idea of the extent of renesting by comparing our transects through agricultural regions with those from grazing lands. The proportion of lone drakes to pairs at any given time is a fair indication of how many hens are on their nests. The graph in Figure D (see end of report) shows that paired mallards and pintails were still much in evidence at the end of their normal mating season, particularly in the agricultural regions. We think this represents hens that have lost their first nests and have returned to their drakes. Comparison of the erratic progress of these species with the more orderly disappearance of hens of the late nesters (see baldpate graph) lends credence to this.

Probable Success of Nesting

We made many attempts to get an answer to the pressing question "How many of the nesting pairs of the nesting season actually produced broods? We still don't know.

We counted the number of broods on three plots of 60 to 100 square miles in extent. One of these, known to have a nesting population of 10 pairs per square mile, produced only 0.16 broods per square mile. Another, with a nesting population of 43 pairs, showed only 1.67 broods per square mile. In the latter case, only 3.9% of the nesting population had broods at the time of the survey. And this was the first week in July, the height of the rearing season for the early nesters.

We are not at all satisfied with this survey. In the first place, we have no way of knowing how many broods are missed in dense vegetation. Much more experimentation is in order before we will be in a position to use brood counts as an index to the nesting success in any season.

Lacking definite information at this time, we have employed a sort of "scatter-gun technique" to give us a picture of probable nesting success. On Figure E we have compared for each species its percentage of the original nesting population as against the percentage the young of that species represented in total young observed and trapped throughout the summer. In doing this, we reduced our brood counts to number of individual young seen, and lumped these figures with number of young trapped during the latter part of the summer. A total of 2,207 young ducks was recorded during brood counts, these largely during May and June, the rearing season for early nesters. 2,000 young ducks were classified as to age class in our banding work during July and August. We will be the first to question the wisdom of lumping these two sets of data, but we are going to do it anyway and see what happens.

The graph on Figure E shows that the pintail, which comprised 37.7% of the original nesting population accounted for only 28% of young seen or trapped. The mallard, 18.3% of the nesting population, showed 16% in counts of young. The gadwall, which made up only 3.9% of the nesting population, contributed 16.6% to the total young recorded. All of this might mean that the mallard and pintail had an only fair hatch, while the gadwall and baldpate did exceptionally well. We submit it for whatever it might be worth.

Span of the Nesting Season

In Figure F we have plotted curves showing progress of the rearing season for the most common ducks of the prairie section of Saskatchewan. Here again we have lumped brood count data, representing the early nesters, and banding data, representing the late nesting species. The data have been broken down into periods of approximately two weeks, and we have indicated on the graphs what percentage of young of each species was seen each period throughout the summer. The upper part of the figure represents combined data for all species. From this we gather that the duck-nesting season must get under way the first week in April, since the first brood (day-old pintails) was seen on May 11 this summer. The rearing season for early nesters hits a peak at the end of June, while the late-nesters (gadwall, baldpate, etc.) reach their peak the middle of August. Insomuch as there were many downy young, less than 10 days old, in evidence during the last week of August, and these birds could not possibly be on the wing before the end of September, we figure that the duck-nesting and rearing season in southern Saskatchewan has a span of at least six months. We will not attempt to evaluate the chances of these late broods reaching maturity before freeze-up, other than to wish them the best of luck.

Other Losses

We saw no evidence of botulism this summer in southern Saskatchewan, and no outbreaks had been reported prior to August 31 when the survey ended.

The Province suffered several serious hailstorms during the summer. Undoubtedly some birds were killed by these storms, although we had no opportunity to visit hail areas. The incidence of hailstorms is greatest in the most important waterfowl producing sections of the Province. This is pictured in Figure G. The path of greatest destruction in hailstorms is seldom more than five miles across, but may be hundreds of miles in length.

The late-summer drought in the west did not seriously affect the regions having high nesting populations. Three cloudbursts in the east, at Yorkton, Estevan and Wyndyard, undoubtedly flooded out many marginal and over-water nesters, but nesting populations in these regions were low to start with.

Predation was in evidence, but did not seem to be any more serious than usual. Duck nests that were moved by farmers during plowing of stubble were cash prey for crows. Heavy predation is to be expected on the grazing lands. Most of the cattle-and sheep-raising regions are grazed clean, with the exception of the more moderately-grazed P.F.R.A. Community Pastures. Patches of buck-brush and

prairie rose are the only cover available to early nesting ducks. It is comparatively easy for a human to locate duck-nests in this cover, and it should be a lot more easy for ground predators to do the same. Furthermore these same brush patches harbor many predators. Skunk and coyote dens, and badger and ground-squirrel holes are almost always located in such places.

Spring burning of stubble already has been mentioned. Such fires may be "spotty", and skip large areas of standing stubble. Narrow strips of broken and loose straw are noticeable in stubble-fields. These mark the edges of the binder or combine swath, and mallards and pintails seek these strips because of better cover and abundant nest material. Unfortunately fires have a habit of creeping down these strips of litter, even when the standing stubble is too wet to burn.

Spring burning is a regular practice in the brushy prairies near Estevan and west of Kerrobert. The degraded "blow-out" soils of these sections are unfit for agriculture, but produce some forage grasses. Appraisal of nest losses in these prairie fires would require special study, but burning at this season of year cannot help but destroy waterfowl nests, and is certainly disastrous to prairie chicken and other upland game birds.

Roadside mortality among ducks is probably much more noticeable than serious. We recorded 17 adult and 9 young ducks killed by cars this summer, in 10,000 miles of driving. Most of these were found on highways that cut across sloughs, or that were flanked by deep borrow-pits.

Food Habits of Young

Stomachs of 70 young ducks that had been killed or injured in banding traps were saved for food-habits study. Most of these stomachs were nearly empty since the birds fed but little during the long banding drives. However they give us some idea of general food preferences.

Young ducks are thought to feed largely on insects and other animal life. Our findings show that aquatic plants are quite important in all stages of growth, including downy young. The food preferences of Class II and Class III young closely approximate those of adults of the various species studied. The young shoveler proved to be the most consistent animal feeder, but adults of this species are known to have strong preference for animal foods. Most of our stomach material was collected during July and August. Early season broods of mallards and pintails might make greater use of insects and other animal items, since aquatic plants are not available in quantity until the middle of June. Proportion of animal to vegetable foods is tabulated below for all species. A more detailed tabulation is given in Table #5.

	Class I		Class II		Class III	
	Animal	Vegetable	Animal	Vegetable	Animal	Vegetable
All species	53%	46%	19%	81%	32%	68%

Animal foods included mollusks (Gasteropods), beetles (Coleoptera) weevils (Curculionids), dragonflies & damsels (Odonata and Zygoptera), and grasshoppers. Plant foods included foliage and seeds of sago (Potamogeton vaginatus) and other pondweeds (P. pusillus?), algae, unidentified grasses, and seeds of spikerush (Eleocharis), three-square (Scirpus americanus), and alkali bulrush (S. paludosus).

Banding Work.

Trapping of young and moulting adult ducks by "driving" proved practicable. We caught and banded 1316 adults and 2120 young this summer, making a total of 3,436. In addition, 211 coots were tagged. An analysis by age-classes of young banded is given in Table #4.

FIGURE F. SPAN OF NESTING SEASON

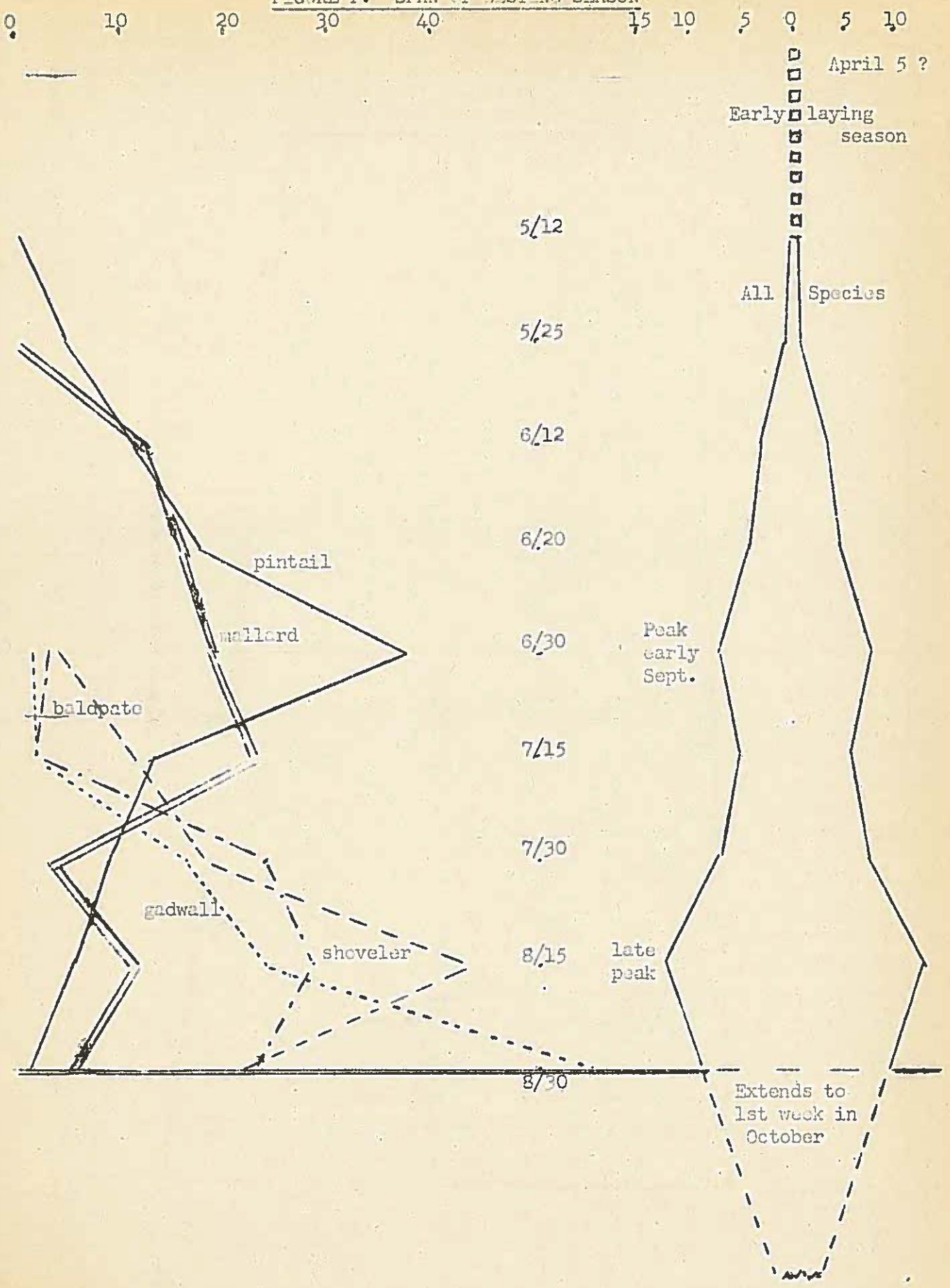
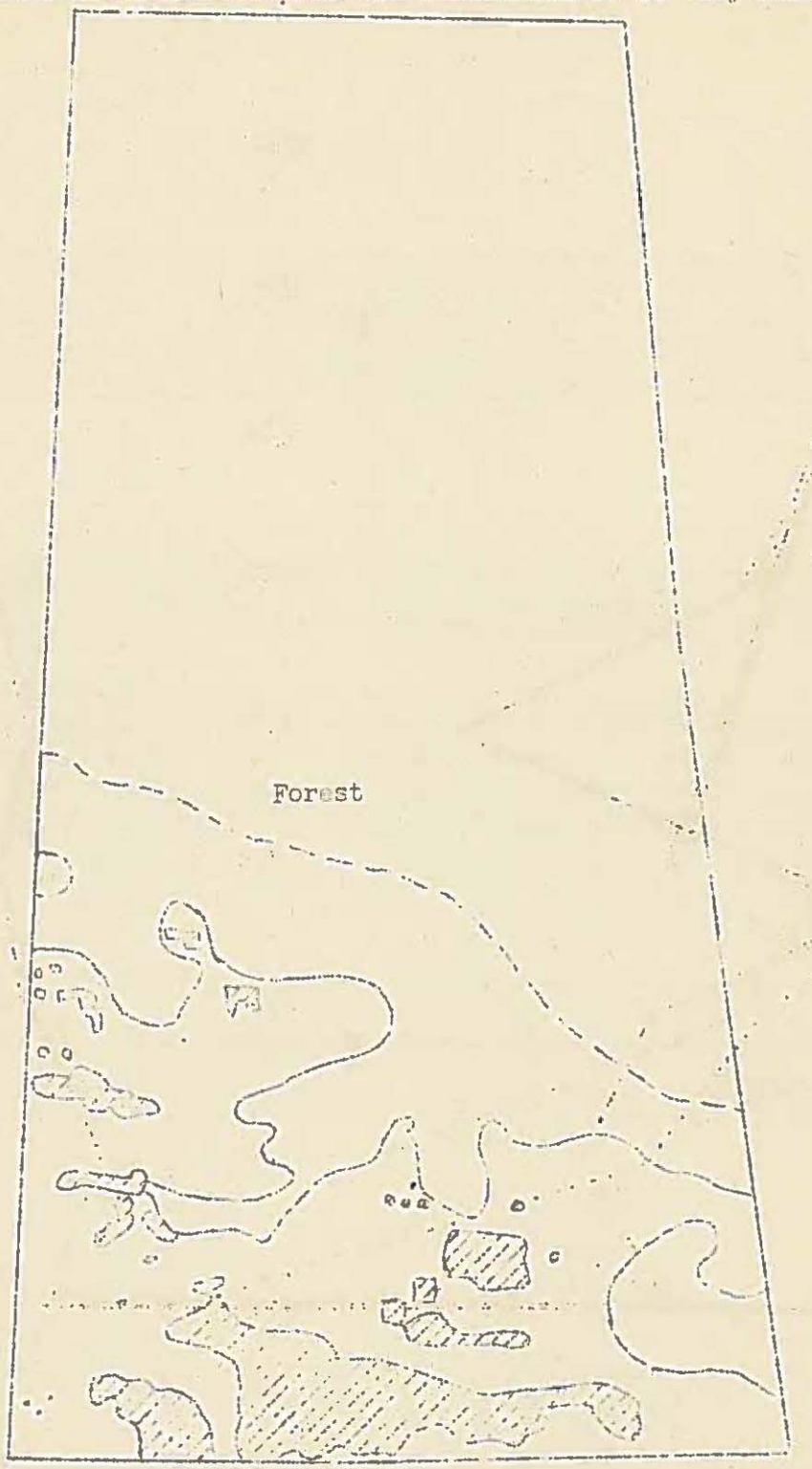


Figure G. Approximate Hail Danger Areas .

Taken from hail insurance rates. Since insurance rates are based on incidence of hail over a long period, they give us some idea of where danger from hailstorms is greatest. Areas within solid line show moderate danger, while blackened sections are considered to be very susceptible to hail.



70 young ducks were killed during banding operations. This represents a mortality of 1.9% of the 3,650 birds of all species that were handled. The loss was not serious, but can be reduced in future operations. Most of the mortality occurred in two ill-fated ventures. In one of these, we had part of the holding chamber of the trap in the water, and in the other case, the chamber was too small to accomodate the catch of nearly 300 ducks. These mistakes need not be repeated. Several ducks got tangled up in the net leads after being released from the trap. In the future, the bottom of the net should be lifted after the drive has been completed to allow these birds to swim under it.

One criticism of the driving method has been that it broke up duck broods. We find that using netting of a large enough mesh allows downy young that are too small to band to go right through the trap. These are quickly gathered up by the hens. Those that are held by the trap are usually big enough to take care of themselves, and when released, will either take up with the nearest brood, or form mixed groups of their own.

SUMMARY

The Prairies and Parklands of southern Saskatchewan had more water this spring than at any time in a decade. The nesting population for the Province as a whole was fair, although there were not nearly enough ducks to take advantage of the available water. Low populations prevailed near the Manitoba line, while the relatively high concentrations that showed up in the west and southwest are thought to have represented ducks that normally should have nested in the Far North.

We had reason to look forward to a successful hatch. While drought developed during the summer in the west, water held up pretty well in regions having heavy nesting populations. Broods were large, and suffered only about a 5% mortality.

But the Number of broods failed to come up to expectations. We have reason to believe that widespread loss of nests was the reason. While we do not have definite data on the extent of this loss, comparison of the number paired mallards and pintails with lone drakes shows that these species were attempting to renest throughout the latter part of their normal season, particularly in the agricultural sections. We suspect that stubble-nesters lost their first nests in fields that were replanted early this season, or that were burned over preparatory to summer-fallowing. Other nests, possibly second attempts in many instances, were destroyed when the regular summer-fallowing started.

Young of the species that do not nest in stubble-fields were more in evidence during the summer, and it would appear from our meager data that the gadwall and baldpate have enjoyed a very successful season.

The latter part of the summer was devoted to banding young ducks. Driving young into traps proved feasible, and the data from this banding will provide us with valuable data in the years to come. It is a relatively simple matter to appraise nesting populations, and determine brood size but no satisfactory method for determining the Number of broods each season has been devised as yet, and until this comes about we cannot tell definitely what our summer increment is. Every effort should be made to work out such a method during the 1948 survey.

APPENDIX

Table #1. Nesting Population Estimate, by Regions

(see Figure B for location of regions)

Region #	square mile of sample	nesting pair per square mile	area of region (square mile)	total number of nesting pairs
1	20	38.0	1,980	75,240
2	9	3.1	1,800	5,580
3	36	34.7	4,320	149,904
4	6	14.5	1,980	28,710
5	8	18.3	3,600	65,880
6	4	33.0	684	22,572
7	5	19.8	5,040	99,792
8	25	12.0	9,000	108,000
9	9	9.1	4,680	42,588
10	14	3.8	3,600	13,080
11	12	14.8	2,160	31,968
~~12~~	5	21.8	720	15,696
13	4	12.0	900	10,800
14	7	22.9	828	18,961
15	17	30.7	3,325	102,077
16	14	14.6	3,600	52,560
17	9	30.9	864	26,697
totals in regions			37,081	868,105
other trans.		13.0	37,919	492,947
TOTALS			75,000 sq. mi.	1,361,052 nesting pairs.

Table #2. Nesting Population Estimate, by Soil Associations

(Total area of each soil association taken from "Soil Survey of Saskatchewan". Number of nesting pairs per square mile computed from transects.)

Total area mapped = 96,000 square miles

Association	Average number nesting pairs per sq. mile	Area of Assoc. (square mile)	nesting population (in pairs)
Light Brown Ser.			
Haverhill	32.2	13,336	429,419
Echo	1.0	2,430	2,430
Chaplin	2.0	900	1,800
Fox Valley	12.3	1,760	21,748
Sceptre	33.8	3,343	112,993
Dark Brown			
Weyburn	12.8	12,270	157,056
Trossachs	2.0	1,260	2,520
Elstow	10.0	3,650	36,500
Regina	7.9	3,420	27,018
Black			
Oxbow	15.0	10,740	161,100
Ryerson	18.2	1,280	2,560
Yorkton	7.7	2,920	22,484
Gray			
Waitville	5.0	2,720	13,600
Misc. (alk, etc.)	20.3	10,000	203,000
Totals for recorded Associations		70,029	1,194,238
All other soils (aux transects)	5.0	26,000	130,000
GRAND TOTALS		96,000 sq.mi.	1,324,238 nesting pairs.

Table 3. Average Clutch and Brood (from brood counts)

SPECIES	Nests and eggs			Broods, Class I			Broods Class II			Broods Class III			TOTALS		
	No. of records	total, eggs	Average	No. of records	No. of indiv.	Average	No. of records	No. of indiv.	Average	No. of records	No. of indiv.	Average	No. of records	No. of indiv.	Average
Pintail	5	32	6.4	51	306	6.0	98	580	5.9	28	156	5.6	177	1042	5.8
Mallard	5	42	8.4	34	250	7.3	36	242	6.7	7	60	8.5	77	552	7.2
Baldpate				13	97	7.4	7	44	6.3	3	23	7.7	23	164	7.1
Shoveler	1	5	5.0	8	58	7.3	7	51	7.3	3	21	7.0	18	130	7.2
Gadwall	2	13	6.5	16	98	6.1	5	36	7.2	1	8	8.0	22	142	6.5
Bluewing				5	30	6.0	2	11	5.5	4	22	5.5	11	63	5.7
Greenwing				2	11	5.5							2	11	5.5
Scaup	2	22	11.0	2	20	10.0	3	22	7.3				5	42	8.4
Redhead	2	22	11.0	2	16	8.0							2	16	8.0
Canvasb.	12	105	8.7	6	45	7.5							6	45	7.5
TOTALS	29	241	8.3	139	931	6.7	158	986	6.2	46	290	6.3	343	2207	6.43

Table 4. Brood Age-Classes of banded Young.

SPECIES	July 1 to 14			July 15 to 31			Aug. 1 to 14			Aug. 15 to 30			TOTAL
	I	II	III	I	II	III	I	II	III	I	II	III	All Classes
Pintail	3	1	21	1	7	41	0	24	35		6	12	151
Mallard	0	0	0	0	2	16	7	49	23	0	11	17	125
Baldpate	0	0	0	4	7	49	17	83	157	17	38	73	445
Shoveler	0	0	0	9	22	38	4	149	89	3	70	62	446
Gadwall	0	0	0	38	37	2	13	82	30	39	191	127	559
Bluewing	0	0	0	0	0	15	0	22	126	0	22	22	207
Greenwing	0	0	0	0	0	0	0	0	7	0	0	10	17
Scaup	0	0	0	9	0	0	7	19	0	0	1	0	36
Redhead	0	0	0	1	3	0	5	1	2	1	0	1	14
Canvasb.	0	0	0	0	0	0	1	0	0	0	0	6	7
Ruddy	0	0	0	0	0	0	0	0	0	0	0	2	2
TOTALS	3	1	21	62	78	161	54	429	469	60	339	332	2009

Table 5. Food Habits of Young Ducks

(based on Preliminary analyses of 70 stomachs, and indicates % of animal and vegetable items in food of various Age-classes).

( ) = number of stomachs

SPECIES	Class I			Class II			Class III		
	% an.	% veg.	Chief Foods	% an.	% veg.	Chief Foods	% an.	% veg.	Chief Foods
Pintail			no records	2	98 (3)	Eleochar. Carex P. vagin			no records
Mallard	5%	95	P. vagin. (1)	0	100	P. vagin. (1)	0	100	P. foliosus (1)
Baldpate	40	60	Eleoch. Zygoptera (1)	28	72	Potamog. Eleochar. Coleopt. Grasshop. (6)	0	100	Potamogeton
Shoveler	100	0	Gasterop. Coleoptera Curculion (6)	31	69	Gasterop. Scirp. an Potamog. (7)	46	54	P. foliosus P. vaginatus Gasperopods (6)
Gadwall	20	80	Algae P. foliosus (5)	12	88	Carex Odonata (4)	0	100	(1)
Greenwing			no record	0	100 (2)	Eleochar. Scirp. pal	30	70	Eleocharis (1)
Scaup				47	53	Gasterop. (2)			
Bluewing				0	100	Eleo. & Sc (3)			
Canvasb.	0	100	P. fol. (1)						

WATERFOWL BREEDING CONDITIONS IN MANITOBA, 1947

By

Arthur S. Hawkins

Manitoba is usually rated below the other two prairie provinces, Saskatchewan and Alberta, as a duck producing area. To the waterfowl hunter of the Mississippi flyway, however, it is ofvital concern whether ducks in Manitoba have a good or poor hatch, for there originates a large part of Mississippi flight. Even in the Atlantic flyway duck hunters profit or lose depending upon the success of breeding canvasbacks and redheads in Manitoba. Because more than half of the nation's hunters live along these two flyways and since sound management depends on correctly balancing supply and demand, a careful appraisal of the waterfowl breeding trends in Manitoba is highly important.

Coverage

Between April 20 and September 10, the Fish and Wildlife Service ground crew assigned to Manitoba, covered approximately 9,000 miles in making its waterfowl appraisal of that province. The territory visited extended from Ontario to Saskatchewan and from the United States' border north to The Pas. A strip one-eighth mile wide on either side of the road was scrutinized and its waterfowl population recorded. An effort was made to inspect all important waterfowl areas at least twice during the nesting season. Some observation strips were surveyed as many as six times.

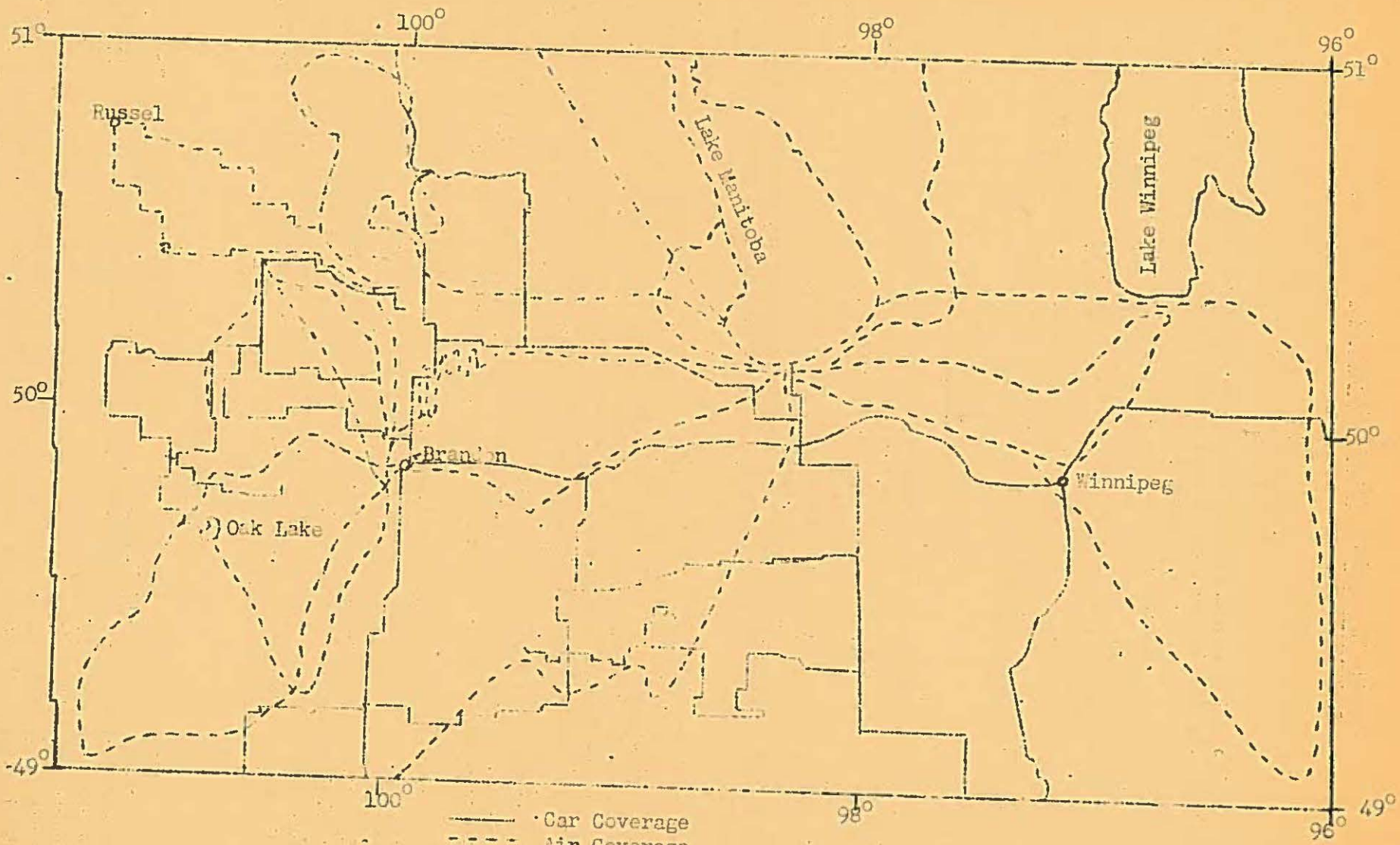
Roads in Manitoba service less than a quarter of the province, hence, it becomes necessary to find other means of locomotion over much of the waterfowl breeding grounds. Boats were used to inspect the large marshes and lakes. Fish and Wildlife Service personnel travelled more than 2,000 miles by boat in Manitoba. Most of the boat coverage was in the following areas: Saskatchewan River Delta, Cedar Lake, Lake Winnipegosis, Pelican Lake, Lake Manitoba, Lake St. Martin and Delta Marsh. Boat travel is too slow for extensive coverage during the limited span of the nesting season. Moreover, there are many land-locked lakes and marshes in Manitoba far from roads or water channels. These can be surveyed only from the air.

Forty-nine flights were made during the 1947 waterfowl inventory in Manitoba. Estimated mileage covered during 130 hours of flying time was 12,000. The first flight was made on May 12, the last on September 9. All parts of the province west of Lake Winnipeg and south of the 54th parallel were seen from the air one or more times. The two Fish and Wildlife Service planes covered 10,500 miles. A Manitoba Government "Norseman" furnished us 1,200 miles, while a chartered "Aeronica" provided the remaining 300 miles.

The Area

Physiographers divide Manitoba's 246,512 square miles into four principal regions: (1) Plains averaging 1,400 feet above sea level lying south and west of the Pembina-Riding-Duck Mountain and Porcupine Hill escarpment; (2) Plains averaging 800 feet above sea level east of the escarpment; (3) Rocky, forested lake country east and north of Lake Winnipeg; (4) Plains bordering Hudson Bay. Botanists also divide Manitoba into four principal regions: (1) Prairies, (2) Parklands, (3) Coniferous forests, and (4) Tundras. Whether the terminology of the

Manitoba Coverage - 1947



physiographer or that ofthe botanist is used, a waterfowl investigator must deal with the same four regions in Manitoba.

The plains and parklands are highly developed agriculturally and contain the centers of human population. The regions of tundra and coniferous forest have no agriculture and are the stamping ground of the Indian, Eskimo, fur trader, and prospector. Much of the plains and parklands is accessible by automobile but most of the other two regions is inaccessible and must be seen from the air, from a boat or on foot. The evidence which has come to light in past years indicates that the agricultural and parkland areas are the principal breeding grounds of most sport ducks in Manitoba. The only important exception to this rule so far as is known is that of the big river deltas, such as the Saskatchewan River. While the tundra and forested areas contain thousands of water areas, which in the aggregate may produce many waterfowl, the available information points to the agricultural and parkland area as the center of production.

Prairies and parklands occupy about a quarter of the province or in round numbers, 60,000 square miles. The boundaries are: on the south, Minnesota and North Dakota; on the west, Saskatchewan; on the north, the upper border of the Saskatchewan River Delta, eastward to Lake Winnipeg; and on the east, Lake Winnipeg, projecting its east shoreline south to the west border. This block is considered the cream of the duck nesting territory in Manitoba but it has many blanks so far as nesting ducks are concerned. From it must be deducted as useless or nearly so, as breeding grounds: (a) the open water of the large lakes including Winnipeg, Winnipegosis, Manitoba, Dauphin, Cedar, Swan St. Martin, Oak and many others. (These waters occupy an estimated 8,000 square miles); (b) plowed lands of the Red River Valley, Portage, Brandon, Waskada plains and other cultivated areas, removing about 10,000 square miles from the 60 000 square miles preferred duck nesting block; (c) mountains which occupy more than 3,000 square miles offer comparatively little suitable habitat for nesting ducks; (d) sand dunes eliminate another 3,000 square miles; (e) forests, muskeg, river valleys, towns, etc., take another sizeable slice from the block. Much of the remainder is subject to the whims of drought or floods and in this latter class comparatively little can ever be controlled by man, for the best interest of ducks.

There are several large areas in Manitoba containing duck habitat of a fairly uniform type and quality. The main groupings are as follows: (See also figure 1):

1. Plains
   - A. Southwestern Plains (short grass-long grass transition)
   - B. Central plains (Red River, Portage, Brandon and Gilbert Plains)
   - C. River Flood plains and ox-bows.

2. Parkland Potholes
   - A. Minnedosa areas
   - B. Elkhorn Area
   - C. Tiger Hills Area

3. Lake Basin Marshes
   - A. Marshes of the large lakes (Delta Marsh, Duck Bay, St. Rose Marsh, Sandy Bay)
   - B. Large interior marshes (Big Grass, Waterhen and marshes west of Lake Manitoba).

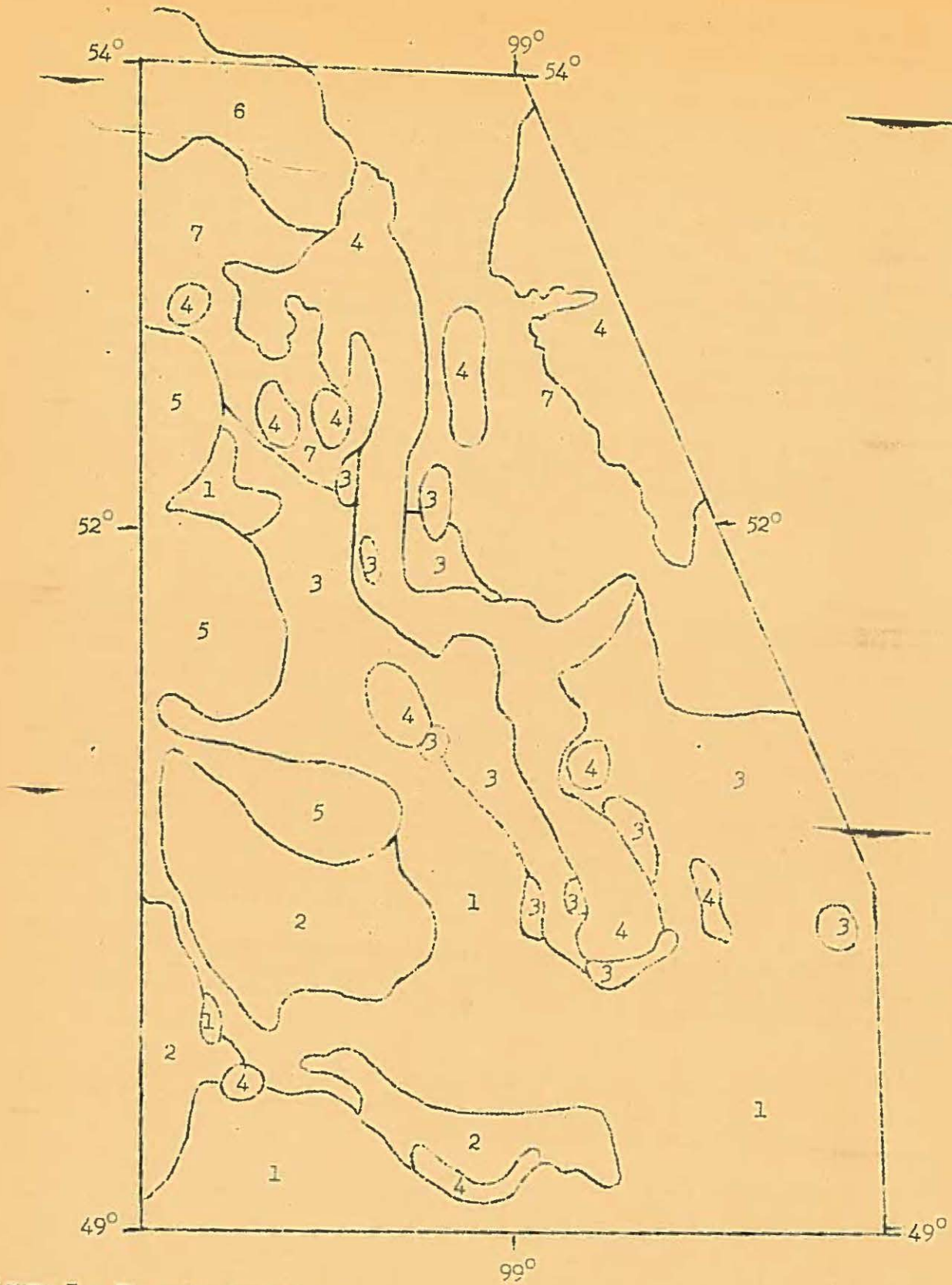


Figure I – The principal duck nesting area of Manitoba (Physiographic and botanical regions 1 & 2). The numbers refer to duck habitat types. (See outline).

C. Small interior marshes (Interlakes region).

4. Lakes
   A. Winnipeg - Manitoba, Winnipegosis, Cedar Lakes System.
   B. Other large lakes (Shoal lakes, Dog Lake, Sauphin, etc.)
   C. Smaller lakes (Pembina chain, Proulx, Sisib, etc., other than those of the Mountain Lakes area.

5. Mountain Lakes Area (the escarpments)
   A. Transition zone from marshes to Lakes (Proven, Jackfish)
   B. Forest and Muskeg Lakes (Clear, Singoosh, etc.).

6. Muskeg (spruce, tamarack swamps)
   A. Southeastern swamps
   B. Northern swamps

7. River Deltas
   A. Saskatchewan River
   B. Red River (Netley Marsh)

PLAINS

Heaviest duck nesting densities in North America occur in the arid short grass prairies, if surface water conditions and cover are favorable. The southwest corner of Manitoba is at the door of the short-grass country but most of the Manitoba prairie are of the long-grass type or in the transition zone between short and long grass. If nesting densities comparable to those in more westerly areas are to be reached in Manitoba, they should occur in the southwestern sections. Like many lakes farther west, some lakes in southwestern Manitoba are strongly alkaline.

Originally, the plains may have been heavy duck producers but that day is past except perhaps during unusually wet years. The Waskada plains of the southwestern part of Manitoba together with the Red River Valley, Portage Plains, and Brandon Plains to the east, comprise the breadbasket of the province. These are intensively farmed by modern methods. Some of the land is drained by ditches. Once or twice during the past decade unusually heavy rains permitted these plains to produce a duck crop but not in 1947.

River flood plains have developed forests of ash, box elder, willow, elm and poplar or ox-bows, in fact, which account for most of the broods produced within the plains' area during years of normal or low rainfall. Drainage ditches also are used by ducks to a limited extent. Neither ox-bows nor ditches were used by many nesting ducks in Manitoba in 1947.

On the plains the many roads permitted easy coverage by car. In this type, the airplane was used primarily for scouting purposes. In a sample of 146 square miles there was an average of two water areas per square mile. One-third of the water areas of the plains as a whole had one or more ducks; the rest were vacant. There were five ducks per square mile including migrants, but breeding pairs per square mile averaged less than two (1.65). Species using the plains in order of abundance were: pintail, mallard, bluewinged teal and shoveller. Diving ducks were poorly represented in this type.

PARKLAND POTHOLES

Numerous depressions (in places as many as 80 to the square mile) were the glacier's enormous contribution to the waterfowl habitat. These depressions, commonly called potholes, are best developed in Manitoba in the transition zone between grassland and deciduous forest. "Parklands" is the name assigned by botanists to this zone, so called because of an interspersion of aspen "islands" and openings created by cultivated fields, meadows or marshes depending on soil and topography. Some potholes retain water better than others. During drought years a high percentage go dry while in years of a good spring run-off augmented by occasional rains, the majority hold water throughout the nesting season. In 1947, water conditions were very good and although some depressions were dry by late summer, no extensive area within the parkland belt of Manitoba was dry enough to inhibit waterfowl production. In 1947, the parkland potholes were the backbone of duck production in Manitoba.

The inventory of the parkland pothole type furnished an interesting comparison between car and plane coverage. Comparable samples were taken in Manitoba by the two methods (114 square miles by car, 105 square miles by plane). Comparative averages per square mile are shown below:

	No. of ducks	No. of water areas	% occupied
Car	26.8	10.8	40.0
Plane	20.3	20.0	32.0

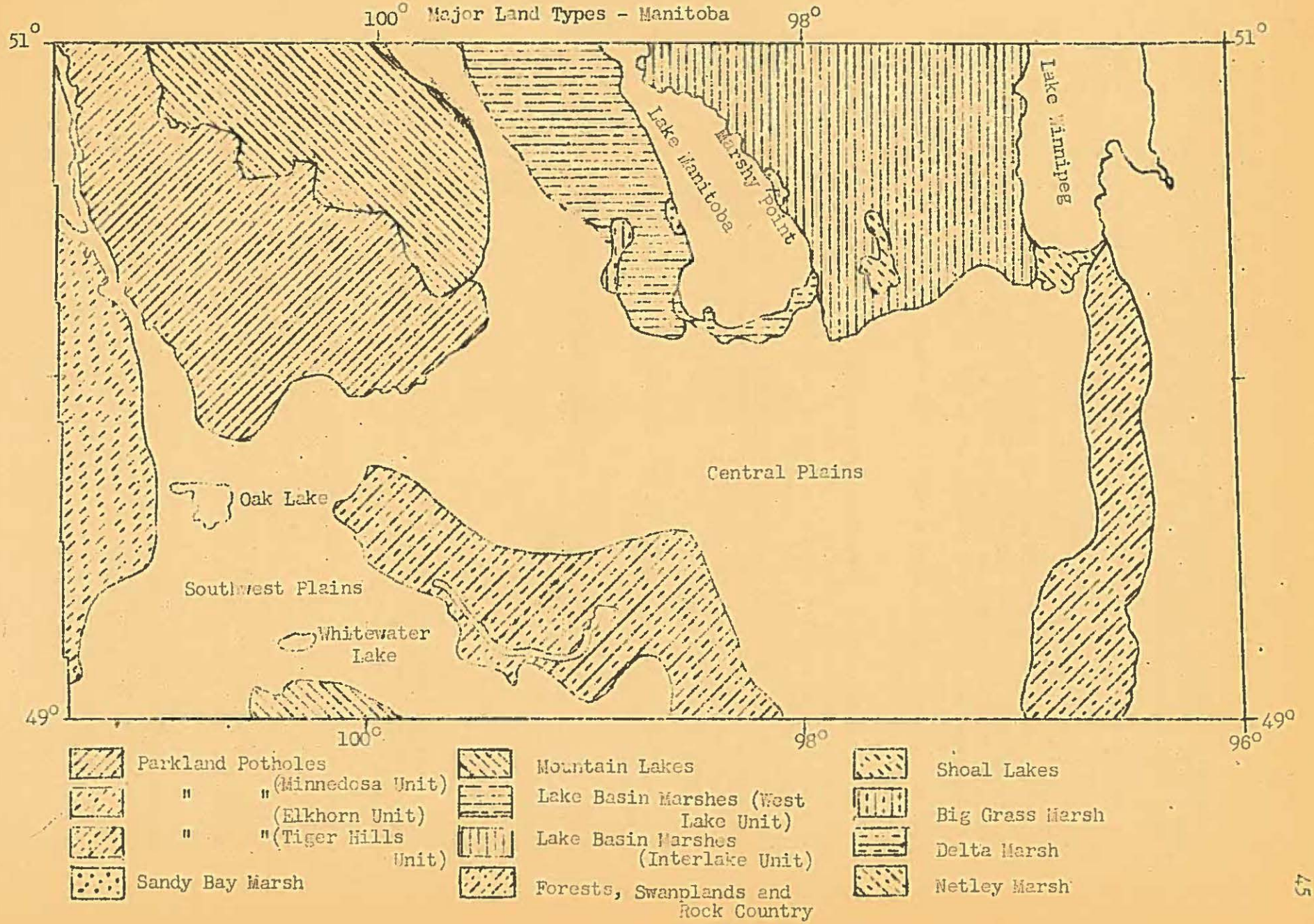
This table reveals that car coverage gave a 25 percent higher count of ducks than plane coverage for the entire pothole area, although, as is pointed out in another paper, the discrepancy between the two methods in some sections was only 15 percent. It will be noted that nearly twice as many water areas were recorded from the air as on the ground. Probable reasons are treated in Mr. Spencer's report. It is apparent from the "percent occupied" column that on some areas, ducks are completely overlooked from the air but fortunately this error is not serious enough to invalidate the method.

Breeding pairs per square mile could not be appraised from the air but from the ground the average was 10.6. Mallards were the leading breeding species, bluewinged teal second, pintails third. Diving ducks and coots were strongly represented in the pothole type. The figures (Table) show scaup to outnumber canvas-back as breeders. However, most of the scaup later continued northward giving canvasbacks the undisputed lead.

LAKE BASIN MARSHES

On large lakes, ice and wave action often builds up a ridge behind which a marsh forms. Lake Manitoba, for example, has four large and more than a half-dozen small marshes behind its shoreline.

Delta marsh, the largest, totals more than 30,000 acres. Usually these areas are subject to wind tides. Strong off-shore winds drain the marshes while winds from the opposite direction floods them. (Delta marsh, which is protected by dams and dykes is an exception). Over-water and shoreline nests of ducks are vulnerable to these changes. This was a year of high water, low breeding densities, and poor success in all of these marshes.


Major Land Types - Manitoba
100°
98°
51°
49°
96°
Lake Manitoba
Marshy Point
Lake Winnipeg
Central Plains
Oak Lake
Southwest Plains
Whitewater Lake
Parkland Potholes
" "(Minnedosa Unit)
" "(Elkhorn Unit)
" "(Tiger Hills Unit)
Sandy Bay Marsh
Mountain Lakes
Lake Basin Marshes (West Lake Unit)
Lake Basin Marshes (Interlake Unit)
Forests, Swamplands and Rock Country
Shoal Lakes
Big Grass Marsh
Delta Marsh
Netley Marsh

Ancient Lake Agassiz, in retreating, left behind several large and many small marshes. Big Grass marsh and the marshes of Waterhen Lake are examples. Big Grass marsh, Ducks Unlimited's first restoration project, is fed by a stream which went on a rampage in June just at the time to do the greatest damage to nesting ducks. Result: production was extremely poor. Waterhen Lake was high, its vegetation of poor quality for nesting ducks and it, too, produced very few ducks in 1947.

The smaller interior marshes left by Lake Agassiz include wet meadows which usually dry out sufficiently to permit farmers to harvest marsh hay by late summer, semi-permanent sloughs which are unattractive to ducks presumably because they are short of food and become choked with vegetation by mid-summer, and permanent bulrush marshes which for some reason, as yet unexplained, were almost devoid of ducks in 1947. This area appeared filled with water almost to capacity when we flew over it in May. By August, most wet places had disappeared, but it is doubtful if the few ducks present suffered any losses due to the shrinkage of water. Permanent water is available within walking distance for a duck in most parts of the area affected.

An inventory of the lowlands such as those adjacent to Lakes Winnipeg Basin and Manitoba is largely a job for an airplane. However, the nearly 60 square miles sampled by car indicated clearly, as did the airplane coverage, that this type had extremely poor occupancy in 1947. Fewer than 2 ducks and one breeding pair per square mile were tallied along the road transects. The plane which sampled interior marshes found up to 20 small water areas per square mile but only 4 ducks (less than 2 breeding pairs) per square mile on them.

Inventories made by plane in mid-June on some of the larger lake basin marshes gave these counts:

Marsh	Areas censused (in sq. miles)	Adults counted	Ducks per sq. mile
Netley	23	2450	107
Delta	24	2150	90
Big Grass	10	925	92
Sandy Bay	5	400	80

On small marshes of the lowlands, mallards led followed by the pintails and blue-winged teal. On the large Lake Basin marshes, redheads led with the above dabblers strongly represented.

The system of lakes including Winnipeg, Cedar, Winnipegosis, Lake St. Martin, and Manitoba is the remnant of ancient Lake Agassiz. With the exception of the marshes already mentioned, these lakes are largely unattractive to nesting ducks because their shorelines are rocky or sandy or, if vegetated, subject to the effects of every change of the wind. Water levels in this system were the highest in several years during 1947.

Most of the many large lakes of the province are of limited value to breeding ducks for similar reasons. Ducks which nest early in the spring, upon arrival, find these lakes frozen shut while potholes are already open. That is another fact governing the relative utility of large and small water areas.

On large open lakes the unit of measurement was ducks per mile of shoreline when sampled either by plane or canoe. The last half of May inventory of several large lakes gave these results:

Cedar Lake. Less than a duck per mile along 90 miles of shoreline, 11 ducks per mile along 18 miles of the best habitat offered ducks.

Lake Winnipegosis. Along 368 miles, 4.7 ducks and geese per mile; best areas 22 per mile.

Upper Lake Manitoba. Three ducks per mile as an average for 120 miles.

Waterhen Lake. Eight ducks and geese per mile for 74 miles of strips.

Lower Lake Manitoba. Counting many ducks obviously migrating, 10 ducks per mile for 46 miles.

Lake Dauphin. Including off-shore gatherings of scaup, 12 ducks per mile for 20 miles (mostly mergansers, goldeneyes and scaup).

On lakes somewhat smaller, total counts were taken; for example, Pembina Lake had 250 ducks, Otter Lake 225 and Minnedosa Lake 30 during the second week in May. The three Shoal Lakes had 2500 geese, 350 swans and about 1,000 ducks at the same time but most of these waterfowl were migrants. (The population on some of the lakes and marshes was appraised several times). Many lakes andmarshes besides those listed were scoured from the air to determine how their population compared with the areas used as "yardsticks".

Mountain Lakes and Muskeg Areas

The Lake Agassiz escarpment, which in places rises to 2500 feet above sea level, includes the Pembina, Turtle, Riding, and Duck "Mountains" and the Tiger, Brandon, Porcupine and Pasquia Hills. South of the 50th parallel, the forested slopes are composed of deciduous species. To the northward, spruce, tamarack and typical north country flora is to be found in suitable sites. The lower levels which are flat enough are farmed and it is in this zone that parkland potholes are found. Higher up, farming peters out and forests take over, broken only by lakes and marshy meadows. Deer, elk, moose and bear inhabit these forests. Good fishing is to be had in the larger lakes. Many of the lakes are deep, rocky-shored and wooded to their edge. Clear Lake, one of the largest, is 9 miles long, up to 2 miles wide and 150 feet deep. Like the waters of the rock country east of Lake Winnipeg, these are not good duck producing lakes. The chief waterfowl species using them are goldeneyes, mallards and ringnecks.

There is a transition zone from farmland to forest which is fairly productive. Wet sedge meadows are replaced by a bulrush marsh as the water deepens. Ducks Unlimited's Proven Lake falls in this class. This marsh covers several square miles but in 1947 duck production on it was practically nil. Reason: flooding occurred in late June which caused considerable damage to nesting ducks.

Any swampy area vegetated by black spruce, tamarack and associated plants is as muskeg. Sedgewillow meadows also are commonly present in the vicinity; Spatter dock (lily) often composes a large part of the aquatic growth. There are extensivemuskeg areas in Manitoba. All are poor duck producers.

Lakes, wet meadows and marshes of the mountains, forests, and muskegs had low breeding densities in 1947. A ground sample of 31 square miles in these types revealed averages of between one and two breeding pairs per square mile respectively. Where these types adjoined parklands, potholes, the density was considerably higher but the average was lowered by large blocks nearly devoid of ducks.

These notes taken from a plane flying over mountain and muskeg in mid-May are indicative of these low densities:
"11:56 - Turtle Mountains -- 9 areas, 15 ducks, these are mountain lakes, deep, heavily wooded.
11:58 - Another deep lake -- 100 scaup; still another -- 250 scaup plus some canvasbacks. These are obviously migrants since they are gathered in large groups and are not common breeders here."
12:06 - deep lake with 70 ruddys, 15 baldpates and 10 miscellaneous. Breeders continue scarce.
12:09 - bulrush marsh with 5 mallards, 2 canvasbacks.
12:10-14 - Deep lake - none; another, 2 pairs; a third, 30 scaup and 7 others; one of 10 acres; 30 scaup; one of 50-50, mostly scaup; one covering a section, 100 scaup, 10 ruddies and 6 others. Lake used as summer resort.
12:17 -- 50 acre lake -- one mallard drake."

Later the same day the Riding Mountains were surveyed from the air for about half an hour.
"3:50 - Enter spruce belt. Ducks decline immediately.
4:17 - still over Riding Mountains. Have seen over 100 elk, 1 moose. Big game outnumber ducks by a wide margin although a few goldeneyes, scaup and especially mallards were seen in marsh west of Wasagaming."

Over muskeg, these notes were made:
"2:10 - First extensive muskeg (between Dog Lake and Lake Winnipeg), large marsh Sleeve Lake area, 5 pintails. A lake below has merganser and 5 other ducks.
2:27 - Sedge marsh surrounded by muskeg - 1 Canada goose, no ducks, 3 deer.
2:38 - Phragmites islands and muskeg edge; bad slash and burn -- no ducks.
2:40 - Deeper open lake - 30 scaup and goldeneyes.
2:42 - Shallow open lake -- 3 ducks, 1 moose.
2:44 - Large open meadow - no ducks.
2:47 - Moose in boggy meadow - no ducks.
2:50 - Pair of honkers but no ducks in miles of wet bog surrounded by muskeg."

RIVER DELTAS

Where large rivers terminate, they usually drop their load of rich silt, cut a finger-like network of channels and if the terrain is right, form delta marshes. The rich soil encourages lush plant growth which attracts many ducks. Manitoba has two deltas which are especially attractive to ducks, that of the Saskatchewan River which embraces

more than 1-1/4 million acres and that of the Red River including about 50,000 acres. The later is known as Netley Marsh. Both areas are managed intensively by the Provincial Game Branch for muskrat production. Ducks usually benefit by this management, although under certain conditions duck production is affected adversely. Ducks Unlimited has made important contributions to both delta areas.

In 1947 both areas were the victims of flood waters. The Saskatchewan was at flood stage when the ducks arrived forcing most of them to nest elsewhere. The Red River permitted ducks to start nesting, then drowned out practically all nests in the surrounding marshes. Some of the ducks renested and were again flooded out.

The unit of measurement used in the Saskatchewan Delta was ducks per mile traveled by boat. During late May when the firs survey was made, the marshes were flooded to near record heights. Little exposed land remained except the stream banks. Apparently most of the ducks had gathered along these banks instead of spreading out over the marshes. The later inventory suggested that many of the ducks seen during the first survey had gone elsewhere, apparently due to the scarcity of suitable resting habitat because of the high water.

In May, 51 miles of marshland and channels had 26 ducks per mile. In July, 211 miles of the same general area had 6 ducks per mile.

A report by J. Dewey Soper, Dominion Migratory bird officer for the Prairie Provinces had this to say about the Saskatchewan Delta in July 1947: "It is to be remembered that this region is potentially one of the finest to be found anywhere in the northwest. There is an abundance of water and emergent aquatic growth for the normal concealment of nests etc., and in most areas the quantity of subaqueous duck food plants is certainly a very prominent feature. One would ordinarily expect a heavy population of ducks in such a highly endowed environment. Instead, a notable scarcity existed in most areas. In the majority of instances, one experienced a sense of strange desertion in the face of excellent physical conditions" This, from a man who has much past experience in the area and is well qualified to appraise it.

The population of Netley Marsh, which is the delta of the Red River, has already been compared with that of several other large Lake Basin Marshes.

Leading species in the Saskatchewan Delta were bluewinged teal, Lesser scaup, baldpate, pintail and mallard. The redhead was the principal species at Netley Marsh.

Breeding Densities

A careful inspection from the ground of 1,674 small water areas in Manitoba revealed that nearly 3 out of 4 (74%) were completely devoid of ducks at the time of the survey. We do not know the rate of occupancy when the duck population is at a desired level but believe that the rate found in 1947 constitutes a serious degree of under-population. The average for all types of areas lumped together was 4.3 breeding pairs per square mile. This figure includes the cream of the duck nesting habitat of Manitoba and omits vast areas of nearly duckless country.

While this is an under figure and does not represent the total number of nesting birds per square mile, it is believed, because of the method used in getting it, to be a reasonable approach to the total potential breeding population per square mile of the range covered. If this assumption is acceptable and the figures were applied to include all of Manitoba's entire area the grand total would only amount to a million pairs, a figure not much greater than the number of hunters along the flyway for these ducks.

On two important large areas, Delta Marsh and the Saskatchewan Delta there is evidence that this year's breeding population was unusually low. The Delta Waterfowl Research Station and its forerunner have data on Delta Marsh spanning more than a decade which places this year's breeding numbers the lowest of all. The opinion of Mr. Soper after comparing this year's number on the Saskatchewan with those of the past has been quoted. In the Minnedosa pothole area Lyle Sowls of the Wildlife Management Institute obtained breeding density figures of Mr. Soper after comparing this year's numbers on the Saskatchewan with those of the past. In the Minnedosa pothole area Lyle Sowls of the Wildlife Management Institute obtained breeding density figures for Saskatchewan both in 1946 and 1947. He found 2.7 ducks per pothole in 1946 and 2.5 in 1947 on the same areas. He concluded, "the reduction in numbers of mallard, pintails, blue-winged teal, shovellers, canvasbacks and redheads is drastic."

It was clear by the time the present survey was completed that even a sensational hatch in 1947 could not bring Manitoba and the flyway fed by this breeding ground out of the duck depression.

General Conditions

Water conditions were spotty when the ducks reached Manitoba in 1947. The Plains had heavy snows but a gradual run-off which left little surface water. Parklands and lowland marshes, however, had ample water while the large lakes were fuller than they had been for several years. The Saskatchewan, Red, Assiniboine and Pipestone Rivers were at flood stages. Even in southern Manitoba lakes were frozen until the end of April and only small potholes and sloughs were free of ice when the first ducks arrived in early April. From the 54th parallel northward (north of the Saskatchewan Delta) ice still covered the lakes on June 1. The 1947 duck nesting chronology in Manitoba was retarded more than a week by the abnormally late spring.

There were two cold snaps of short duration after many ducks were nesting. At the end of the first week in May and again, on May 28, the temperature dropped to 24 or lower in southern Manitoba. No evidence was found, however, that duck nests had been affected.

In June, just as the first broods were appearing, wide-spread floods destroyed most nests at Netley Marsh and St. Rose Marsh and many nests on Proven Lake, Oak Lake, Whitewater Lake, to name a few of the places affected. At Netley Marsh renesting attempts were well under way when another flood occurred which insured almost a complete crop failure in 1947.

Farm practices which are adverse to nesting ducks,(plowing, burning, grazing, mowing, etc.) were a factor in reducing nesting success in 1947,

but apparently no more so than usual.

Predation may have been more severe than usual in areas inhabited by skunks, since low prices for skunk furs as compared to other furs has discouraged trapping. Skunks have increased markedly as a result. The late spring may have retarded the growth of vegetation enough so that predators had an easier time than usual finding early nests. On the other hand, the lush vegetation which lasted throughout the nesting period because of the summer rains provided better than usual concealment for late nesters.

Disease destroyed ducks on a large scale at Oak Lake (where at least 10,000 died) and at St. Rose Marsh (where at least 3,000 died). The Oak Lake outbreak appeared to be algal poisoning while that at St. Rose was undoubtedly botulism. There were minor losses due to disease in other areas including Whitewater Lake. At Oak Lake, 500 ducks were examined and only one percent were of this year's hatch, giving further evidence of a poor hatch in that area.

To summarize breeding conditions in 1947:

1. Water: Scarce on the plains, excellent on the potholes, too much in areas subject to flooding.
2. Temperatures: Two freezes may have damaged some nests. No evidence, however.
3. Cover: Considering the season as a whole - better than usual.
4. Farm Losses: Normal
5. Predator Losses: Possibly above normal in some areas.
6. Disease: No evidence that young birds suffered important losses, but birds in the molt were lost at several important areas.

Brood Counts

Brood counts and the juvenile-adult ratio in the take by hunters are the two methods used to evaluate production. Forecasting the flight, however, must depend on the first method.

The combined efforts of biologists in Manitoba during 1947 made it possible to count the size of 876 broods. These averaged 6.6 ducklings each. Diving duck broods, because they frequent open water, are more easily counted than those of dabbling ducks, hence the sample is top-heavy in divers (650:226). Diver broods in 1947 averaged slightly larger than those of dabblers (6.8 as compared to 6.5). Brood sizes are given by species in a table at the end of this phase of the report.

The brood average is applied as follows in appraising the production of a habitat type: By the peak of the brood season in mid-July, the parkland potholes had about 12 water areas per square mile. A survey revealed that the average was one brood per two potholes. Each section of land thus averaged 6 broods multiplied by 6.6 or 40 young ducks. There are approximately 6,200 square miles of the parkland pothole type in Manitoba. At that rate, the pothole type produced about a quarter million ducks in 1947.

During a 1,765 mile boat coverage of the marshes and shorelines of the lower Summerberry tract of the Saskatchewan Delta, Cedar Lake, Lakes

St. Martin, Manitoba and Winnipegosis, 672 broods were tallied during July and August. How many broods were overlooked is, of course, an unknown. The observers believe that they saw more than they missed but even if they failed to see nine out of every 10, the grand total would be very disappointing for such a large and supposedly important area.

Mr. Soper made a detailed nesting survey by canoe in the Saskatchewan Delta from July - 26. One statement from his report will suffice to describe conditions there: "Broods of ducklings were scarce."

At Delta Marsh, 13 people in canoes and an airplane with two observers saw a total of only 200 broods during a careful survey. Even if half the broods were overlooked, which is extremely unlikely, the total production for the entire marsh would amount to only 2,600.

During the same period, aerial observers who saw 196 broods on Delta Marsh saw only 36 on Netley, 18 on Big Grass, 181 on Marshy Point and Sandy Bay, 25 in the Oak-Plum Lake and Pipestone Creek area, 10 on Whitewater Lake, and 17 on Glenboro Marsh. While it is known that brood counting from the air produces unsatisfactory results in pothole country, the evidence is that the counts are fairly reliable on large marshes.

Summary

Without knowing "par" for any of the habitat types in Manitoba, our opinion is that considering the low breeding population at the start, the pothole country provided a good crop but that other types had from moderate to very poor success. It may be that the pothole country always has been the backbone of production. If so, Manitoba as a whole may have had a crop commensurable with the breeding stock. If, however, the production on the lake marshes and plains was as far below par as it appeared to be, then Manitoba in 1947 did little to alleviate the duck depression.

TABLE I

Car Transect Summary by Habitat Types

Plains

Transect Number	Sq. Miles Sampled	No Ducks	Ducks / sq. mile	Total Pairs	Total Pairs / sq. mile	No Areas	Areas / sq. mile	No. Occup.	Percent. Occup.
1	7.5	58	7.7	21	2.8	6	0.8	4	66
2	10.0	6	0.6	3	0.3	23	2.3	2	9
10	2.0	6	3.0	4	2.0	14	7.0	3	21
11	8.0	12	1.5	4	0.5	12	1.5	2	17
12	10.0	73	7.3	12	1.2	29	2.9	9	31
13	5.0	75	15.0	23	4.6	22	4.4	9	41
19	8.0	134	17.0	16	2.0	24	3.0	7	29
20	20.0	57	2.9	27	1.3	37	1.8	14	27
21	13.0	23	1.8	13	1.0	36	2.8	10	28
22	5.0	119	23.8	54	10.8	22	4.4	18	82
25	9.0	65	7.2	24	2.7	22	2.4	9	41
26	5.0	75	15.0	31	6.2	44	8.8	9	21
28	13.5	5	0.3	3	0.2	14	0.9	1	7
29	30.0	8	0.3	6	0.2	19	0.6	4	21
Sub-total	146.0	716	4.9	241	1.65	324	2.2	101	31

TABLE I – cont'd.

Potholes

Transect Number	Sq. Miles Sampled	No Ducks	Ducks / Sq. Mile	Total Pairs	Total Pairs/ Sq. Mile	No Areas	Areas / Sq. Mile	No. Occup.	Percent Occup.
3	4.0	43	10.7	25	6.2	62	15.5	13	21
4A	2.5	194	77.5	75	30.0	27	10.8	18	67
4B	5.0	220	44.0	99	19.8	42	8.4	25	60
5	3.0	26	8.6	4	1.3	23	7.6	6	26
6	3.0	189	630	42	14.0	58	19.3	25	43
7	3.0	209	69.6	101	33.3	103	34.0	41	40
8	0.5	66	132.0	20	40.0	14	28.0	10	71
9	2.0	47	23.5	25	12.5	40	20.0	16	40
14	4.0	331	82.7	85	21.5	33	8.2	27	82
15	8.0	221	27.6	68	8.5	57	7.1	27	48
15A	3.0	126	42.0	63	21.0	24	8.0	15	60
16	5.5	85	15.5	39	7.0	31	16.4	9	29
17	5.5	67	12.2	28	5.1	17	3.1	8	47
18	8.0	94	11.7	41	5.1	20	2.5	12	60
23	10.0	170	17.0	74	7.4	215	21.5	46	21
24	9.0	142	16.0	70	7.7	68	16.0	28	41
27	7.5	97	12.9	54	7.2	63	8.4	34	54
36	9.0	107	12.0	49	7.0	63	7.0	29	46
37	5.0	67	13.4	36	7.2	63	12.6	25	40
38	5.0	187	37.4	52	10.4	39	7.8	18	46
39	4.5	188	41.8	80	17.8	65	14.4	30	46
40	6.5	166	25.6	69	10.6	90	13.8	33	37
Sub-total	113.5	3042	26.8	1199	10.6	1217	10.8	495	40%

TABLE I – Cont'd.

Lake Basin

Transect Number	Sq. Miles Sampled	No Ducks	Ducks / Sq. Mile	Total Pairs	Total pairs / Sq. Mile	No Areas	Areas / Sq. Mile	No. Occup.	% Occup.
30	28.0	54	1.9	11	1.4	36	1.4	5	14
31	12.0	0	0	0	0	4	.3	0	0
33	9.5	42	4.4	21	2.2	31	3.3	8	26
34	10.0	14	1.4	6	0.6	18	1.8	4	22
Sub-total	59.5	110	1.85	38	0.64	89	1.45	17	19%
Mountain Lakes									
35	9.0	17	1.9	6	1.1	10	1.1	5	50
Muskeg									
32	25.0	95	3.8	43	1.7	34	1.4	16	47
Grand Total	353.0	3980	11.3	1527	4.3	1674	4.8	634	26

TABLE II

Species composition in various types as indicated by the ground transects

Type	Mallard	Pintail	Gadwall	Shoveller	B.W.Teal	Canvasback	Redhead	L.Scaup	Ruddy	Misc.	Coot
1 a.	49	56	5	24	37	2	0	1	1	33	
	104	140	15	73	114	4	3	60	8	50	16
1 b.	15	21	17	17	19	5	0	3		12	
	34	57	33	36	48	13	0	11		29	84
2 a.	241	172	59	94	182	145	77	170	123	131	
	518	328	108	165	408	360	170	478	369	336	884
2 b.	116	76	23	43	92	32	51	25	8	37	
	223	127	63	123	224	87	159	221	41	104	307
2 c.	24	20	4	37	64	0	3	1	3	23	
	61	43	7	68	135	0	4	2	7	42	110
3	11	6	1	5	5	0	0	0	0	3	0
	34	23	29	15	0	0	0	0	0	9	0
6	22	4	1	5	13	0	4	0	0	34	0
	41	17	2	9	25	0	10	0	0	70	0
TOTAL	478	355	110	225	412	184	135	200	135	242	
	1015	735	230	483	969	564	343	762	425	582	1101

Legend: Type 1 a — Central plains, 1 b — southwest plains; 2 a — Minnedosa potholes, 2 b — Tiger Hills potholes; 2 c — Elkhorn pothole; 3 — Manitoba lowlands; 6 — muskeg. The species ratings for the Manitoba lowlands here refer to the small water areas only. Larger marshes had a different composition.

The upper number equals pairs plus lone drakes or hens (ie. breeders). While the lower number is the total number of individuals of that species actually tallied including migrant groups.

TABLE III

Manitoba brood counts, 1947

	No. Broods	No. young	Average size
Mallard	65	401	6.2
Pintail	63	379	6.0
B. W. Teal	35	260	7.4
G. W. Teal	3	17	5.6
Widgeon	22	141	6.4
Gadwall	31	212	6.8
Shoveler	7	55	7.9
Dabblers	226	1465	6.5
Canvasback	271	1588	5.9
Redhead	62	380	6.1
L. Scaup	57	523	9.2
Ruddy	27	141	5.2
W.W. Scoter	6	54	9.0
Bufflehead	1	9	9.0
Goldeneye	174	1391	8.0
R. B. Merganser	33	195	5.9
?	19	107	5.6
Divers	650	4378	6.8
Both	876	5843	6.6

AERIAL RECONNAISSANCE OF THE PRAIRIE PROVINCES

by

Robert H. Smith

During the 1947 waterfowl inventory of the breeding ground, airplanes were used to supplement information obtained by ground crews, to cover the more inaccessible sections of the range, and to attempt to work out better appraisal techniques which would provide more extensive coverage in the limited breeding season. Inasmuch as the writer had covered by air most of the breeding sections in 1946, general comparison with 1947 conditions could be made. The following reports are summaries of observations in different sections of the prairie provinces of Canada and were prepared soon after the reconnaissance flights were completed.

Aerial Reconnaissance of Manitoba

The first 1947 aerial surveys of waterfowl numbers and nesting conditions in Manitoba were begun on May 12 and were concluded on May 19. A total of 24.4 hours were spent in actual aerial surveys covering approximately 2700 miles. The aircraft was based at Delta Manitoba and all flights originated and returned there, except the last flight when we were enroute to Regina, Saskatchewan. Our itinerary is as follows:

5/12/47 4.1 hours	- Delta - Portage - Long Lake - Grants Lake - Netley Marsh - Gull Lake south to Minnesota Boundary and return to Delta across Red River valley.
5/13/47 4.5 hours	- Delta - Portage - Shoal Lakes - Oak Island Marsh - Broad Valley - Montagao Lake - Sturgeon Bay L. - St. Michael - L. St. David - L - St. Martin - Portage Bay - Dog L. East shore of L - Manitoba and return to Delta.
5/15/47 6.6 hours	- Delta - Tiger hills Turtle Mts. - Whitewater Lake - Oak Lake - Brandon - Rivers - Riding Mts. - Big grass marsh and return to Delta.
5/16/47 3.0 hours	- Delta Marsh - Lake Francis Marsh - Oak Point Marsh and Sandy Bay Marsh.
5/17/47 4.7 hours	West shore L. Manitoba - Proulx L. - Mire L - Waterhen L. - Inland L. - L. Winnipegosis - Dauphin L. Return to Delta via Big grass Marsh.
5/19/47 1.5 hours in Manitoba.	- Delta west to Saskatchewan boundary across pot hole region south of Riding Mts.

There is a voice record of some of the flights to supplement this report which summarizes conditions throughout the province.

Weather

An extremely late and backward season. One of the latest on record. On May 13 the ice had not yet gone out of Lake Winnipeg, ice was still floating free on Lake Manitoba on May 17 and snow was still piled deep in some of the coulees on the Assiniboine River on May 19. On May 18 water froze in the quiet ponds at Delta and 24° F. was recorded at Regina.

This backward season unquestionably delayed the migration of waterfowl and the selection of territories by those ducks remaining to nest in the region.

Surface Water Conditions

The amount of surface water throughout the province is quite spotty even in the same general regions. It is ample in every unit, however, and should not have in any way adversely affect the production of waterfowl. East of the Red River water levels and surface water was only slightly less than last year. Netley Marsh is high due to floods on the Red River and water is backed up into all the adjacent hay fields. West of the Red River in the valley and in the Portage plains conditions were much drier and there was very little surface water. The Delta Marsh was also lower than a year ago. In the inter-lake region water levels were more nearly normal, i.e. all the sloughs are full but the water is not backed way up in the bush as it was a year ago. Shoal lakes continued to be low. In the Tiger Hills water was about the same as last year possible slightly lower in some sections and between the Tiger Hills and the Turtle Mountains surface water was less. In the Turtle Mountains water areas were as abundant as last year but levels have receded somewhat. Oak Lake and adjoining marshes were flooded to the edge of the hay land and Whitewater lake was slightly higher than in 1946. Surface waters in the pot hole region south of the Riding Mountains appeared to be as abundant as a year ago.

Most of the large lakes adjacent or connected to Lake Manitoba continue to be low. Lake St. Martin, Dog Lake, Waterhen and Inland Lake, but this condition has been prevalent for several years.

All in all, surface waters were slightly less than in 1946 despite considerable snow fall.

Cover Conditions

There was less cover in Manitoba than I have ever seen. Even though the season has been backward there was very little tillable land that had not been plowed as close to the water as it was possible to work. In addition much new land had been broken. This may be due in part at least to the subsidy being offered for the production of flax and every acre that can be planted is being worked.

There were very few fires in stubble noted, probably because most stubble fields are already plowed. A number of marsh fires have been seen, however, on the Delta Marsh, the Netley Marsh and on the marshes around Lake Manitoba. Most of these fires are set with the idea to improve haying and grazing.

With an overall reduction in cover, predation might be expected to be somewhat greater than usual.

Predation

It is impossible from the air to evaluate predator density or pressure on nesting ducks. Even with a normal predator population, however, the reduction in cover would operate to the disadvantage of waterfowl.

Waterfowl Populations

Populations of nesting waterfowl vary from bad to worse. In only three small areas did I see populations that appeared normal. The Oak Point Marshes, the Sandy Bay Marshes and a marsh of about 1000 acres near Beulah Manitoba. By normal I mean as abundant as last year but by no means filled to capacity. The Red River Valley and Portage Plains had almost no ducks, but of course there water was at a premium. The pot holes of the inter-lake region had an abundance of water but very few ducks, far less than last year. Shoal lakes had a few nesting ducks but North Shoal had a fair population of migrants. Delta Marsh and Lake Francis had

the fewest ducks I have ever seen there, not over 400 breeding ducks on Delta. The west Delta Marshes were somewhat better populated but were still below par. Netley was much better than Delta but most of the birds present were migrants. East of the Red River the marshes were the poorest quality and had the lowest populations. The Tiger Hills appeared to have ducks in about the same numbers as last year or slightly less. The Turtle Mountains contained a very low density of nesting birds but whether or not this was lower than last year cannot be stated. The pot hole region south of Riding Mountains was by comparison better than most areas, but was still lower than last year. Whitewater Lake and Oak Lake appear to be better than in 1946 as far as divers are concerned but are still far below carrying capacity. The Big Grass Marsh contained only a handful of ducks, far less than last year. Particularly disappointing were the Upper Lake Manitoba Marshes, Waterhen Lake and Lower Winnipegosis. While never having seen this area before, we had been led to believe that these areas, particularly Waterhen were fine canvasback and redhead nesting areas. We found the habitat relatively poor and populations worse.

It must be borne in mind that mallards and pintails were the only species that we could expect to find as nesting birds in numbers, although other species are becoming more abundant daily. Despite this, these were the least abundant species encountered. If populations in Manitoba are any indication of their numbers elsewhere they are in a bad way indeed. Small gatherings of males of both species were noted during the week, probably for moulting gatherings.

Gadwall, baldpate, blue-winged teal and shovellers were appearing in greater numbers as the week progressed and we hope that they will continue to do so, as their numbers are still far below normal. Green-winged teal were never abundant in this region.

Paradoxically redheads were the most abundant species encountered, relatively, that is. Other species were so scarce that redheads seemed abundant. They were the most abundant of what appeared to be nesting or resident ducks on Whitewater Lake, Oak Lake, Delta, Lake Francis, West Delta Marshes and in many of the pot holes and on some marshes of the Tiger Hills. Paired canvas back were encountered in fair numbers on some of the Upper Lake Manitoba Marshes, and Waterhen Lake but only on relatively small areas. Scaup were encountered mostly as migrants and when these pulled out few pairs were left. Ringnecked ducks were found in only small numbers and ruddies were still in small flocks, a few buffleheads and goldeneyes were seen.

Paired Canada geese were found as soon as we entered the muskey country of the interlake region and in the area north of Lake Manitoba. While not abundant several widely scattered pairs were seen. Blue and Snow geese and Hutchin's geese were still in the region as migrants in small numbers. Coots were scarce everywhere.

In summary, nesting conditions in Manitoba are fair to good but waterfowl populations discouraging. Mallards and Pintails appeared to be the least abundant of the common nesting ducks. There would have to be a considerable influx to bring the population up to last year, and that was an extremely low population. If at the present writing all the ducks had arrived that will come, Manitoba will produce far less ducks than last year, even with an entirely successful nesting season.

Aerial Waterfowl Reconnaissance in Southern Saskatchewan

Itinerary

May 19, 1947 – Enroute from Delta Manitoba to Regina, Saskatchewan.
1.5 hours Covered the Qu' Appelle Valley – Round Lake – Crooked Lake and the Fishing Lakes – Weather forced us into Regina just before we completed the survey.

May 22, 1947 – Regina – Moose Jaw – Johnstone Lake – Lake of the
7.2 hours Rivers – Montague Lake – Fife Lake – Big Muddy Lake – The Coteau Pothole area – Moose Mountains – Broadview – Yorkton – Quiell Lakes – Kutawagan Marshes – Lost Mountain Lake and return to Regina.

May 24, 1947 – Regina – Buffalo Pound Lake – Thunder Creek Marshes –
3.3 hours Vermillion Hills – Luck Lake – Chaplin Lake – North end of Coteau – Regina Flats return to Regina. (Forced back on account of weather).

May 25, 1947 – Regina – Coteau Region – Mossbank – Gravebourg –
7.3 hours Crane Lake–Maple Creek – Cypress Lake – Bitter Lake – Big Stick Lake – Sandhills – Antelope Lake – Swift Current – Barber Lake – Goose Lake – east across Saskatchewan River – south east across pothole region to Regina.

The above itinerary, totaling 19.3 hours of flying gave us approximately 2100 miles of coverage across the better waterfowl breeding areas of southern Saskatchewan north to the 52nd degree of North latitude.

Weather

As can be seen from our itinerary, the weather has been terrible, cold, windy, and rain. The temperature at Regina on the 25th was 37°F. Snow is still present in the Qu' Appelle Valley. There have been four cold fronts pass Regina in the past week. Even so the season is more advanced in Saskatchewan than in Manitoba – the vegetation is farther along and the ducks are farther along in their nesting activities. The season is also relatively farther advanced in the western part of the province – the first broods were seen there on the 25th.

Water Conditions

The amount and extent of surface water shows a considerable improvement as compared with 1946. This is particularly noticeable in the southwest where surface water was almost nil last year. For example the following areas that were dry last year now have surface water – Kutawagon marshes, Stalwart marsh, Mortlack marsh, Regina Flats, Lake of the Rivers, Goose Lake, Forgan Flats, Wood River Flats, Cypress Hills plateau, Crane Lake and the north flank of the Cypress Hills. Some of this is not permanent water, particularly in flat agricultural regions where water is lying in the fields in shallow depressions and in some of the large alkaline lakes of the southwest where the water occurs only as a thin sheet. We believe there will be enough permanent water in each region, however, to bring off any ducks produced to the flying stage.

In the eastern part of the region surface water is about the same or improved as compared with 1946.

Cover Conditions

There is relatively more cover in Saskatchewan than in Manitoba. This is particularly true in agricultural areas where cultivation does not seem so intensive. There is also less burning of marginal nesting cover.

Predator Populations

As stated previously it is impossible to estimate predator populations or to evaluate the pressure on nesting waterfowl from the air. We have noted, however, relatively more predators in Saskatchewan than in Manitoba. Gangs of crows have been frequently seen and occasional magpies observed. Only two coyotes were observed.

Waterfowl Populations

The situation in southern Saskatchewan is a puzzle to say the least. There are areas that are now producing ducks that have not been in production for several years for the obvious reason that they were dry. Other areas that have had surface water in the past have slightly more ducks than last year. Possibly improved water conditions account for this. Then there are many areas where conditions appear to be ideal where there are almost no ducks. For example in the Coteau region - rolling short grass pothole country - parts of it are fairly well populated, in other parts waterfowl occupancy of potholes is less than ten percent. In the pothole country north of the Moose Mountains, between the Mountains and the Qu' Appelle River a fair population was present - about like last year, just across the valley, in the same type of country with water conditions comparable the waterfowl population was almost nil. This condition obtained until the Luck Lake area near Yorkton was reached where good populations were again encountered. North of Yorkton the population again fell off to almost nothing. Similar situations were encountered in other parts of the province.

Why this should be is anybody's guess, with our present store of knowledge. We have a theory, however, which is purely a stab at trying to find a logical answer for the condition. This is as follows. In general, conditions in Saskatchewan are more advanced than in Manitoba - western Saskatchewan is more advanced than eastern Saskatchewan, better waterfowl populations are present at lower elevations than at higher elevations. Therefore, the season being abnormally late the waterfowl moved up as the country opened up, and being so late they took up territories where they were available, leaving the more northern, more backward and higher parts of the country unoccupied. There are exceptions, however, such as the Yorkton area, but this offers better habitat than the surrounding region. Any way the condition does exist regardless of how we try to explain it.

A comparison of areas or regions with 1946 follows:

Qu' Appelle Valley - More ducks in the valley but less in the lakes.
Moose Mtn. area - No change.
Pothole region between Moose mountain and Yorkton - less ducks.
Quill Lake area - No change.
Luck Lake area - Improved over 1946.
Coteau region - No change.
Regina Flats - Improved.
Forgan Flats - Improved.
Wood River Flats - Improved.
Goose Lake - Improved.
Kutawagon - Improved.
North Flank of Cypress Hills - Improved.
Cypress Hills Plateau - Improved.
Lost Mtn. Lake and the Big Arm - Less ducks.
Pothole area west of Lost Mtn. Lake - Less ducks.

Considering the entire region I think there has been a slight improvement over 1946 in numbers of breeding waterfowl.

A species analysis also leaves us puzzled in many cases. Practically all the canvasback we have seen have been flocks of males - very few pairs have been seen. Redheads are present in fair numbers everywhere the proper habitat exists. Pintail pairs are still very much in evidence - did something happen to early clutches? Very few blue-winged teal are being seen, possibly were missing many of these from the air but I doubt it. Shovellers and baldpate appear to be in good shape but gadwalls are relatively scarce. Very few green-winged teal are being seen. Ruddies, white-winged scoters, scaup and mallards appear to be present in good numbers, better than Manitoba.

Aerial Reconnaissance of Northern Saskatchewan and the Province of Alberta

Weather Conditions

For the most part the weather has been cloudy, cold but with only slight precipitation. This has no doubt held evaporation down to a minimum but even so, many of the intermittent waters are drying up. On May 27 a severe frost occurred, the temperature falling to 15° above zero in the northern part of the district while ice formed in the pools near Regina and snow flurries were common. It is not known what effect this freeze will have on nesting ducks.

Surface Water Conditions

In northern Saskatchewan (throughout the park belt north of 52°) surface water is about the same as in 1946. Some pothole areas are dry while others have water that were dry last year. Some of the larger lakes are slightly higher than a year ago, although still low. While in some districts, particularly south and west of Prince Albert the shallow lakes are completely dry.

In Alberta surface water conditions are better. The large lakes in the north are still low but slightly better than last year and throughout the park belt the potholes are holding water. Even on the plains many pothole areas hold water and on the flat prairie between Medicine Hate and Brooks the larger shallow sloughs are full. Even Many Island Lake is full of water!

Itinerary

5/28/47 3.7 hours	Regina - Lost Mountain - Manitou Lake - Meecham - Humbolt - Lake Lenore - Basin Lake - Waterhen - Prince Albert.
5/29/47 6.5 hours	Prince Albert - Redberry Lake - north to Witchikan Lake - Jackfish Lake - north Battleford - west to Edmonton - across park belt pothole region and Beaver Hills.
5/30/47 4.3 hours.	Edmonton - Flat Lake - Naubaman Lake - Lake St. Anne - Smoky Lake - Flat Lake - Lac La Biche - Rich Lake - Whiteford Marsh and return to Edmonton.
6/2/47 4.0 hours	Edmonton - Beaver Hills - Dried Meat Lake - Buffalo Lake - Cough Lake - Sullivan Lake - Irrigated areas - Lake Newell - Medicine Hat.
6/3/47	Medicine Hat - Many Island Lake - Bitter Lake - Viwa Creek - Wood River - Johnstone Lake - Regina.

(A total of 21.5 flight hours covering approximately 2,400 miles).

The Waterfowl Situation

Taking all things into consideration, northern Saskatchewan averaged out to a "no change" status. There were definite improvements in the western marsh area,

Basin Lake, and in the area just north of Humbolt. These gains were offset by losses elsewhere.

Of two transects made across pothole country, one was 8% occupied while the other was 12.5% occupied. Many pothole regions were completely dry.

The larger lakes - those that have water - are almost completely devoid of marsh vegetation which is generally stranded on the periphery high and dry. Some of these areas, however have good growths of submerged vegetation and such lakes support good populations of paired white-winged scoters and paired scaup. Several of these lakes had small groups of male canvasback and pairs of buffleheads and goldeneyes were quite common.

The puddle ducks were limited to potholes, small marshes and to a few large open lakes where there were gangs of male mallards, pair of gadwall and baldpate and a few blue-winged teal. The presence of droves of paired pintails on such areas continues to be a puzzle. One theory is certain - they have not yet produced any ducklings and if they are going to, they better get started as the first pintail broods have been off for over two weeks.

Redheads have been found wherever suitable habitat exists, for the most part in pairs.

In Alberta conditions are better. The irrigated districts have good populations and already there is a fair hatch of pintails and mallards in the southern plains area. In this area, outside of the irrigated districts, water is present in potholes and sloughs that were formerly dry. These have a few ducks - density does not begin to compare with the ponds of the irrigated areas but these areas were formerly completely dry and produced nothing. Of course, there is always the possibility of these areas drying up before the current crop is able to fly. In the Alberta park belt, occupancy of potholes is higher than similar areas of Saskatchewan and Manitoba but is still very low - two transects in the Buffalo Lake area came out 22% and 27% respectively. Some of the larger lakes and marshes in the park belt have better populations that in 1946. Others are definitely down, the Whiteford Marsh is down, the area south of Vaubamun is down. Rich Lake has only a fraction of its former number.

Throughout the park belt the pintail problem is most pronounced. Thousands of paired pintails ganged up on a few large lakes, while to the south, pintail broods are common but few paired birds in evidence. Something has happened to the pintail hatch - what? - is anybody's guess. They were present before as well as after the freeze, so it could hardly be laid to that. Paired mallards are still in evidence but not to the extent of the pintails. Then, too, mallard males are flocking - a normal procedure for this time of year, whereas there are a few flocks of male pintails.

Blue-winged teal are more in evidence now than a week ago but relatively few have been seen. Baldpate and gadwall are still paired which is normal, as are scaup, white-winged scoters, buffleheads and redheads. Paired canvasback are relatively scarce, although flocks of males are quite common. Only a handful of green-winged teal have been seen. Shovelers are paired for the most part but the males are beginning to gather in the south.

Canada geese have been hatching off in good shape, although quite a few pairs have been seen without young.

Summary of the three Prairie Provinces

Generally, water conditions are better than in 1946. There are large areas in southwestern Saskatchewan and southern Alberta now in production that haven't produced ducks since 1943. In a few areas water conditions are worse than in 1946. Waterfowl populations in Manitoba are way under 1946 populations which in itself was a low year. Saskatchewan is somewhat better. Some areas are producing

ducks the first time since 1943. In other areas, notably the Aspen Park belt, pothole regions, and water is good but the density is down. Averaging everything up the Saskatchewan population probably equals that of last year, but no more. In Alberta, populations are relatively better than in Saskatchewan, more areas in production than in 1946 with density about the same as in 1946, in formerly occupied areas.

Averaging the three provinces together, if that can be done, we arrive at a "no change" status. It is hardly proper to do this as different flyways are involved, and obviously, the Mississippi and Atlantic flyways are the hardest hit. There is also the danger that large areas will dry up before the ducklings are awing and it also looks as if the pintail hatch would be poor. Even though populations are better to the west: It must be remembered that the density of breeding waterfowl is exceedingly low. It would, therefore, seem that extreme caution would be in order in proposing shooting regulations for 1947. We certainly must take less ducks than we did in 1946 if it is desired to build up the population to a figure approaching carrying capacity. It also appears that what might be a reasonable take for the central flyway might be too much for the Mississippi.

Waterfowl Conditions in The Canadian Northwest

Surveys in the region served a dual purpose - . study of waterfowl populations and conditions affecting production was combined with the search for nesting Whooping Cranes. Robert P. Allen, representing the National Audubon Society, and collaborating with the Fish and Wildlife Service, assisted materially in the waterfowl surveys.

A twin motored amphibian with a range of 700 miles made it possible to give complete coverage to all areas within the boundaries of the study area, which consisted of low level aerial surveys over all the areas within the region that would support waterfowl or Whooping Cranes. As it was necessary to carry a considerable amount of emergency gear, the crew was limited to pilot and observer, the pilot acting as observer on the port side of the aircraft. It might appear to some that observing waterfowl from an aircraft moving at the rate of 100 miles per hour would be extremely impractical if not altogether impossible, particularly for the pilot. Such, however, is not the case. Waterfowl are more readily seen from the air than from the ground and identification and ability to estimate numbers is purely a matter of practice. As far as the pilot is concerned, an occasional glance at the instrument panel is all that is required - the aircraft is flown by "feel". For remote areas any other type of survey is highly impractical.

Just north of the Aspen Park lands - beyond the fringe of settlement, is a belt of mixed forest dotted with lakes large and small and having extensive areas of muskeg. This zone trends northwest - southeast as do the physiographical and climatographical zones of northwestern Canada. The pre-Cambrian shield forms the boundaries of the mixed forest zone on the north and east.

This mixed forest belt was reputed to be fair to good waterfowl breeding territory and was the most logical area in which to search for Whooping Cranes. The pre-cambrain shield, on the other hand, has the reputation of being almost sterile as far as waterfowl production is concerned, consequently our search was confined to the mixed forest zone.

Specifically, we covered an area north and west from a line running through Prince Albert, Saskatchewan to Lac La Ronge, Saskatchewan, bounded by the pre-Cambrian on the north and east, the settled areas on the south and the Northern Alberta railway on the west as far as Fort McMurray. Beyond McMurray the western limit of the search was roughly west longitude 114° in Alberta and west longitude 117° in the District of Mackenzie. The northern limit of the search was approximately north latitude 62°.

The area south of the Clearwater River was worked from a base at Flotten Lake, Saskatchewan, where we had a cache of gas and oil. North of the Clearwater we worked out of Fort McMurray, Alberta and Fort Smith and Hay River northwest territories. Surveys were begun on June 6 and suspended June 30.

The amount of desirable waterfowl habitat was exceedingly limited in the area covered. Viewed on a map it appears limitless but when examined in the field most areas are very disappointing. The majority of the lakes are relatively deep with bush growing to the edge of the water. Many of the smaller lakes are muskeg lakes - shallow acid waters bordered by a narrow zone of sedge (carex) and supporting little if any emergent vegetation. Still others have exposed sandy shores with no marginal or emergent vegetation whatsoever. The good waterfowl marshes and lakes are so few that they are named here; - the marsh adjacent to Peter Pond Lake just north of the settlement of Dillon; marsh back of the Canoe Lake settlement; marsh south of the settlement of La Loche; marshes of the Beaver River in the vicinity of La Plonge settlement; Waterhen Lake, Kazan Lake and Gordon Lake; a few marshy bays in Lac Ile a la Crosse and Frobisher Lake; the north shore of Primrose Lake; the Lake Claire marshes and the delta of the Athabaska; the salt plains west of the Slave River and similar park like areas between the Slave and Taltson Rivers north to Great Slave Lake. In addition there are a number of small un-named lakes and marshes that appeared to be desirable habitat but their numbers were relatively small in comparison to those lakes that would have few ducks even under the best of conditions.

Surface Water and Climatic Factors

Water levels and amount of surface water varied within the region due not only to uneven precipitation and run off but to the ability of the underlying soils to hold water. Wherever sandy soils were encountered water levels were low. The largest area of this type was north and east of Fort McMurray - an area of sandhills and clear shallow lakes having barren shores and little or no vegetation. Water levels were also low and many small lakes were dry in the area directly south of the Prince Albert National Park, this being one of the drought regions of western Canada. Many of the larger lakes north of Great Slave Lake were also low.

Conversely, many areas had too much water. The Lake Claire marshes and the delta of the Athabaska River were flooded - water over most of the meadows and in some places backed up into the willows, the levels being higher than in the previous eight years. Similarly, Buffalo Lake and adjacent waters were extremely high - water out of the banks and back into the bush.

Over the remainder of the area, however, by far the greater part, surface water conditions were ideal, i. e. the lakes and ponds had ample water for the production of waterfowl if water was all that waterfowl needed.

Climatically the season was extremely backward. On June 10, ice was observed floating in Peter Pond Lake. Snow was still to be seen in the coulees tributary to the Athabaska gorge below McMurray as late as June 21 and on June 25 Great Slave Lake was still closed to Navigation - great pans of ice were floating on the west arm and the north arm was completely closed.

Thunder showers were prevalent throughout June and there, in combination with better than average water levels, reduced fires to a minimum. Not a fire was seen and the atmosphere was clear of smoke at all times - an unusual condition. East of the study area, in the Fort La Corne Forest Reserve, fires were said to be severe.

Waterfowl Populations

Only a relatively small section of the area covered had been studied previously, yet the scarcity of waterfowl throughout the region was striking. As stated before, much of the habitat is low grade at the best and one would not expect to find much in the way of waterfowl populations. In this low grade type of habitat such as the muskeg ponds and lakes without emergent vegetation, lesser scaup, mallards, baldpate, a few buffleheads goldeneyes and ring-necked ducks were found in limited numbers. Many of these lakes had no ducks at all, others two or three pairs at the most.

In the best areas, those named previously, populations were way down to what one would expect. Waterhen Lake, a famed canvasback and redhead breeding area had almost no ducks - a few scaup, mallards and baldpate, but the hundreds of acres of bullrush marsh were practically vacant. The marshes at Dillon, Canoe Lake and La Loche were also without many birds - ducks of any kind were extremely scarce. A scattering of ducks were found in the marshy bays of Lac Ile a la Crosse and at the north end of Primrose Lake but the best populations, i.e. the heaviest densities were found in the Beaver River, Gordon Lake and Kazan Lake. Here were found the usual scaup, baldpate and mallards and in addition ruddy ducks, canvasback, redheads, blue-winged teal and green-winged teal. On Kazan Lake, white-winged scoters and buffleheads outnumbered all other species.

The Lake Claire marshes and the delta of the Athabaska, famed waterfowl producing areas were a great disappointment. Every acre of this extensive marsh was seen, but only 4000 ducks were estimated to be in the area. These were pintails, mallards, baldpate, lesser scaup, blue and green winged teal, shovelers, canvasback, redheads and ruddy ducks - all the prairie nesting species except gadwall. No doubt the scarcity of ducks was due in part to the flooded condition of the marsh.

The salt plains and the area between the Taltson and Slave Rivers appeared to be on ideal breeding ground, prairie type sloughs and swales with ample cover and food where the waters were not too saline. There were only two small lakes within this area where ducks were found in any numbers; elsewhere the population density was extremely thin. The only brood of ducks seen during the entire month of June was found in this area. Buffalo Lake, to the west of the Salt Plains, had no ducks at all although reputed to be a good duck lake. Here too, the water was backed into the bush which was no doubt responsible for the complete lack of ducks.

North of Great Slave Lake to north latitude 62° the lakes were low and appeared quite alkaline. Only one appeared attractive to waterfowl and on this a small number of ducks were present.

A few pairs of Canada geese were found scattered throughout the region. Many of the pairs had broods and the hatch appeared to be good. On the larger marshes and better feeding areas flocks of non-breeders were seen.

There are probably many factors that contributed to the low population of ducks in the north. In the first place there were fewer ducks that went north in the spring. Secondly, the extremely late season may have discouraged those ducks that normally go north from migrating beyond the prairies and the parks, giving the impression of abundance in a few localities there. The high water of the Athabaska delta and a few other lesser areas put a considerable area out of production.

Conditions similar to those described were reported for the entire Northwest Territories, including the Mackenzie delta region, by Mr. Oldham, Superintendent of Wildlife Management for the Northwest Territories. He maintains that this decrease in the waterfowl population has been progressive for several years and attributes this in part to the uncontrolled fires that burn the bush and marshes almost every spring.

Another factor to be considered is that practically every desirable marsh of any size has a settlement nearby. While the duck population was high it could stand local pressure exerted by the resident half-breeds and Indians but with the population down, constant sniping takes a relatively heavy toll.

Summary For Canadian Northwest

Low level aerial surveys were conducted over northern Alberta, Saskatchewan and in the Northwest Territories as far north as latitude 62 during June 1947.

The purpose of the surveys was a waterfowl reconnaissance combined with a search for nesting Whooping Cranes.

Climatic factors probably restrained many ducks from following their usual migration north.

Water levels were too high in some areas, too low in others. In the main, however, conditions were favorable.

Most habitat is low quality and would support but few ducks under the best of conditions. However, even the best areas had few ducks.

Low waterfowl populations were reported for the entire Northwest Territories by Canadian officials.

Waterfowl Breeding Conditions, 1947

Maritime Region, Eastern Canada, Newfoundland, and Labrador

by

Bruce S. Wright, Director
Northeastern Wildlife Station, Wildlife Management Institute.

The program of waterfowl research in the northeast in 1947 is a continuation and extension of the Black Duck Study initiated by Ducks Unlimited in 1945. This study was taken over by the Wildlife Management Institute in May 1947, with Ducks Unlimited contributing to the cost of the program. The work was again centered on the Study Area in the estuary of the St. John River in New Brunswick, but banding stations were operated in the three major sub-divisions of the northern breeding grounds of the Eastern Section of the Atlantic Flyway. These sub-divisions are the Labrador Coast, the North Shore of the Gulf of St. Lawrence, and Newfoundland.

The breeding population on the Study Area in New Brunswick has been measured by means of a shoreline cruise for the past three years. The breeding population present on the area in 1945, the first year of the study, has been taken as the base datum from which to measure the trend in the two succeeding years. These trends are shown graphically by species in Figure 1.

The area to which these figures apply is a 32,500 acre tract in the estuary of the St. John River, which is one of the best areas of waterfowl habitat in eastern Canada. The species trends from 1945 are as follows:-

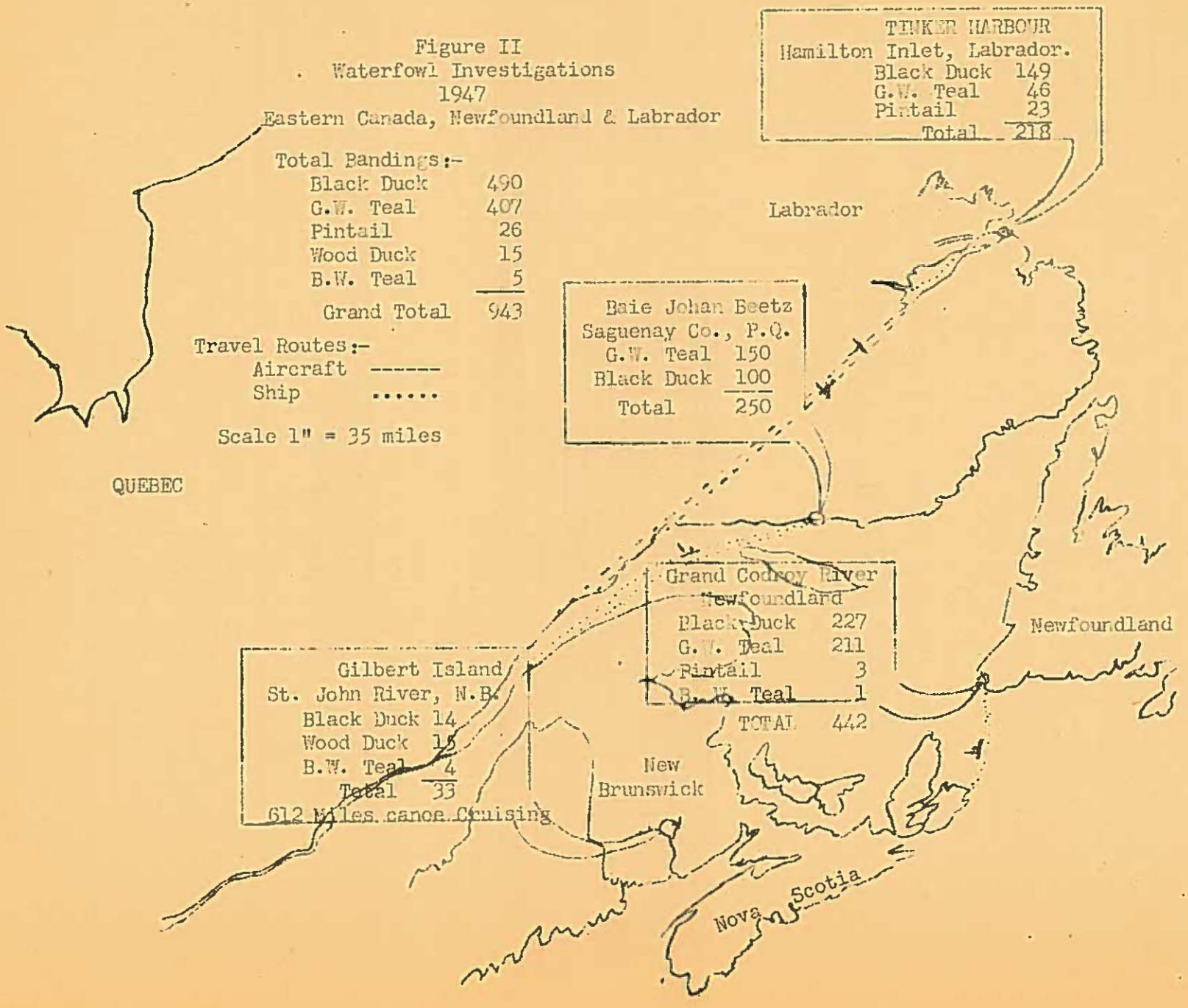
	Trend from 1945	
SPECIES	1946	1947
Black Duck	-49%	-9%
B. W. Teal	-88%	-87%
Wood Duck	-80%	-68%
Ring-necked Duck	+3%	-49%
G. W. Teal	-14%	-78%
Golden-Eye	-63%	+189%
Unidentified	-27%	-----
Average	-54%	-42%

Black Duck drakes moulted on the area in 1945 and 1947, but not in 1946, so that the 1946 figure is low.

The results of this cruise show that therewere slightly less than half as many ducks on the area at the end of the brood season in 1946 as there was in 1945, and in 1947 there was only slightly more than half as many as in 1945.

For the first time this year New Brunswick was zoned for duck shooting, and the opening date in the central zone was set back to October 1st, two weeks later than in previous years. This has resulted in a considerable saving in local breeding stock as the northern zone birds were driven down by shooting, and the two-week setback allowed many more migrants to be on the marshes by opening day. Thus the kill on opening day in the St. John River was increased from 4.2 to 4.9 ducks per gun day, but it was not composed of nearly such a high percentage of local breeders. The increased kill per gun day means many more migrants present, together with a net increase in local breeders of about 12% over 1946. The total kill, however, is believed to be less than last year. Many hunters went out for

Figure II
Waterfowl Investigations
1947
Eastern Canada, Newfoundland & Labrador



Comparison
of
BREEDING POPULATION

1945 - 1947

1945 and 1947 data reduced to 51% Cruise

1945

1946

1947

Average Decrease from 1945

1946 = 54%

1947 = 42%

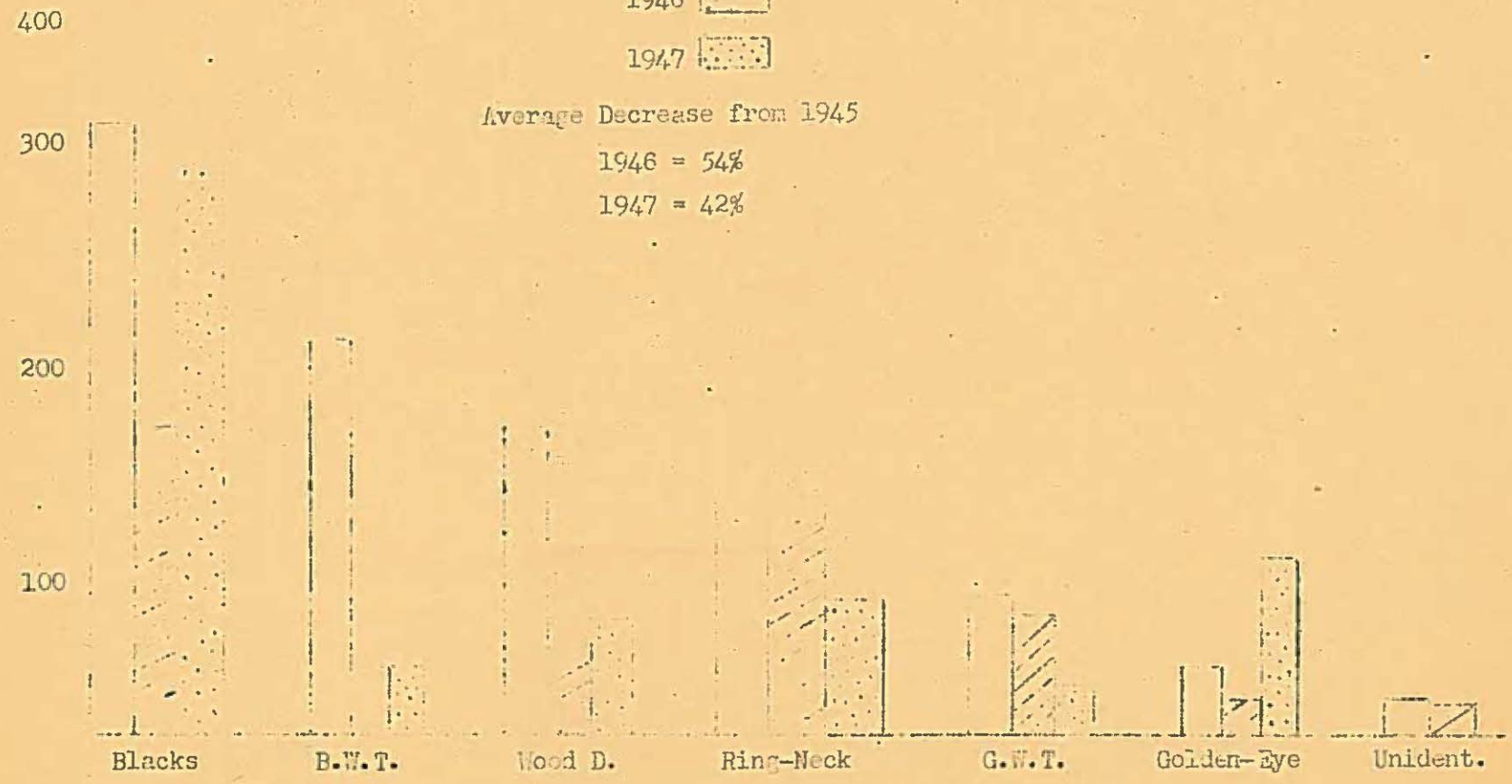


FIGURE 1.

Cruise Tally 51% Cruise.

partridge and woodcock who would usually have hunted ducks as the upland game season opened on the same day as the duck season.

Breeding Black Ducks showed a very big decrease in 1946, but came back strongly in 1947. The reason for this is partly because the drakes once more moutled on the area in 1947. They left the area entirely in 1946. Blue-Winged Teal, Green-Winged Teal, and Wood Duck all show big decreases from 1945. Golden-Eyes and Ring-Necked Ducks show evidence of ebb and flow between Maine and New Brunswick, with the Golden-Eyes up in New Brunswick and down in Maine this year, and the Ring-Necked Ducks in the reverse order.

In addition to the census and breeding ecology study, an attempt was made to band ducks on the Study Area. This was only partly successful because the abundance of natural food present made it very difficult to induce the birds to take the bait. Fourteen Black Ducks, fifteen Wood Ducks, and four Blue-Winged Teal were banded for a total of thirty-three birds. The Study Area program was operated by B. C. Carter and A. W. Skead who covered over 600 miles by canoe in the course of the season.

The Northern Banding Stations

1. Tinker Harbour, Hamilton Inlet, Labrador. This station was operated by A. J. Reeve who lived in a chartered boat with two local assistants. They used Rigolet Post as headquarters. Bad weather forced them out of Hamilton Inlet on September 23rd, by which date 218 ducks had been banded. These were made up of 149 Black Ducks, 46 Green-winged Teal, and 23 Pintails. One Greater Yellow-Legs, and one Labrador Jay were also banded.
2. Baie Johan Beetz, Saguenay Co., P. Q. This station was operated by E. D. Fowler, working alone. He banded 150 Green-Winged Teal, and 100 Black Ducks before running out of bands. A further supply did not reach him before he closed his traps October 1st. The large number of Green-Winged Teal at this station suggests a heavy fall migration of this species along the north shore of the Gulf of St. Lawrence. No Blue-Winged Teal were seen either here or at Hamilton Inlet, and only one in Newfoundland, so that the breeding range of this species does not appear to reach the North Shore of the Gulf of St. Lawrence.
3. Grand Codroy River, West Coast, Newfoundland. This station was operated by D. A. Benson, working alone. He banded 227 Black Ducks, 211 Green-Winged Teal, 2 Pintail, and 1 Blue-Winged Teal. This was the most successful station for banding Black Ducks, although Baie Johan Beetz and Tinker Harbour might have proved just as good had not the operator run out of bands just as the migration was reaching its peak at the former station, and had the latter station been opened two weeks earlier. These deficiencies will be remedied next year. The banding program was started from scratch this year with inexperienced operators working in regions they had never seen before, and about which no detailed information was available. Considering these handicaps, and the fact that the operators were withdrawn on October 1st in order to return to college, when the migration was still at its height in both Newfoundland and the North Shore, the total of 943 ducks banded, out of the original 1,000 bands issued, is regarded as a satisfactory start. It can be confidently predicted that, when the experience gained this year is applied to next year's program, this figure may well be doubled.

   The results of the banding program and the areas covered in the season's travel are shown in Figure II. The final report on the season's operations will be forthcoming after the data have been analysed and will be available at the end of the winter season.

WATERFOWL BROOD CENSUS - COMPARATIVE STUDY
CHIPPEWA NATIONAL FOREST - MINNESOTA

1937 to 1941 and 1947

Jerome H. Stoudt

Introduction. In 1937 the author conducted a waterfowl brood count on the Chippewa National Forest in Northern Minnesota which consisted of counting broods and adult ducks along the shorelines of ten per cent of the water area on the Forest. Lakes were classified into three classes, II, III, and IV, according to the limological type and ten per cent of each type was censused in addition to ten per cent of the streams and rivers. The following year (1938) instead of checking ten per cent of the area which necessitated censusing many non-productive, Class III lakes, certain key areas were chosen which actually gave an eight per cent coverage of the waterfowl population with a minimum amount of shoreline coverage. The nine census areas chosen also yielded the same comparative abundance between species as the entire ten per cent shoreline coverage had. In 1939 two more census areas were added to give an even better sample of the duck population.

Total population estimates for the Chippewa Forest based on these eleven census areas are as follows:

1937	1938	1939	1940	1941	1947
29,600	46,650	40,300	46,400	26,150*	28,500

*Due to water conditions in 1941 it was felt that the census that year did not give a true picture of the waterfowl population. The water was very high due to heavy rains and many meadows and wooded areas were flooded at the time of the census with the result that many broods were too well hidden to make complete coverage possible.

A good average population for the Chippewa during the period 1937-1941 would probably be a little over 40,000 and as the same eleven areas were censused in 1939, 1940, and again in 1947 these years were chosen for comparison.

Using this comparison the 1947 census showed a decrease from the 1939-1940 figure of 43,350 to 28,500 or a drop of 34 per cent.

Brood Census Data.

The 1947 census was taken from July 13 to July 18 inclusive. Water levels were as high as in 1941 but an overall increase in the water table since 1940 had helped to stabilize marsh vegetation and shoreline "edge" so that censusing in 1947 was fairly easy and it is felt than an accurate count resulted. Table I gives a picture of the total ducks seen on the eleven census areas during 1939 - 1940 and again in 1947.

TABLE I

Comparative Census Data by Areas

	1939-40	1947	Change
Bowstring Lake *	519	498	-21
Burns Lake	215	107	-108
Kitchi Lake	241	168	-73
Long Lake	382	58	-324
Lower Pigeon Lake	28	5	-23
Mud Lake	181	230	+49
Rabideau Lake	94	119	+25
Raven Lake	198	33	-165
Round Lake	580	490	-90
Third River Flowage	650	420	-230
Lake Winnibigoshish**	568	262	-306
Totals	3656	2390	-1266

* East shore only, excluding Muskrat Bay

** North shore from mouth of Pigeon River to Third River.

Most of the census areas which showed serious decreases were areas which are affected by changes in water levels caused by the War Department dam at Lake Winnibigoshish, either directly or indirectly. During the brood count in July the water was much higher than it was during the nesting season in April and May and some drowning out of nests may have occurred. It is doubtful however, if this factor was very important due to the lack of adults seen on the census areas which would have been the case had much re-nesting occurred.

Table II shows comparative abundance between species and loss or gain since 1939-40.

TABLE II

Total Duck Population on Census Areas by Species.

	1939-40	1947	Increase	Decrease
Mallard	1597	1176		26%
Black Duck	3	2		*
Baldpate	225	355	37%	
Pintail	13	24	*	
Green-winged Teal	15	3		*
Blue-winged Teal	883	174		80%
Shoveller	0	9	*	
Wood Duck	0	25	*	
Redhead	49	23		53%
Ring-necked Duck	291	93		68%
Lesser Scaup **	3	36	*	
Golden-eye	517	461		11%
Ruddy Duck	15	0		*
Hooded Merganser	19	9		*
Unidentified	24	0		*
Totals:	3656	2390		34%

* Data not significant.

** Lesser Scaup never a breeder on this area, all ducks seen were adults.

From the above table we find that the ducks which showed the greatest decrease were the blue-winged teal, ring-necked duck and redhead. All of these ducks are over-the-water nesters or nest in meadows close to the water's edge. Higher water levels since 1940 have destroyed much of this type of habitat but all three of these ducks showed a big decrease on a spring migration check made in late April and May 1947 so it is doubtful if the breeding stock was available to normally populate the area.

Although no records were kept on coot during previous censuses these waterfowl were fairly common on most census areas from 1937 - 1941 but not a single coot was observed in 1947.

Comparative abundance between species changed considerable as follows:

	1937-1941	1947
Mallard	32 - 49%	49%
Blue-winged Teal	14 - 22%	7%
Golden-eye	10 - 20%	19%
Ringed-necked Duck	6 - 13%	4%
Baldpate	5 - 12%	15%
All Others	3 - 8%	6%

Thus it is seen that while mallards more than held their, comparatively speaking, the blue-winged teal and ring-necked ducks both showed a big decrease and were replaced by the golden-eye and baldpate.

Table III shows adult-juvenile ratios for the five main breeding species.

TABLE III

Adult - Juvenile Ratio - 1947

	Adults	Juveniles	Ratio
Mallard	358	818	1 : 2.3
Baldpate	85	270	1 : 3.2
Blue-winged Teal	34	140	1 : 4.1
Ring-necked Duck	33	60	1 : 1.8
Golden-eye	152	309	1 : 2.0
All others	69	62	1 : 0.9
Totals:	1659	731	1 : 2.25

The ratio of all adults to juveniles for 1947 can be compared to ratios of other years as follows:

1937	1938	1939	1940	1941	1947
1 : 3.0	1 : 2.2	1 : 3.4	1 : 1.5	1 : 2.7	1 : 2.2

The 1947 ratio of 1 adult to 2.2 juvenile ducks seems to indicate good hatching success for the ducks that were on the area. There may have been a brood or two of flying, juvenile mallards included in the adult population but this is doubtful, inasmuch as the females of these broods would have had to start nesting before April 1.

Brood Averages

Each brood was counted where possible and recorded according to age classes I, II, III. Brood averages follow:

	Age Class I	Age Class II	Age Class III	Average All Age Classes
Mallards	7.75 (8)	7.91 (32)	7.00 (27)	7.50 (67)
Baldpate	8.44 (16)	6.00 (3)	6.00 (1)	8.00 (20)
Pintail	6.50 (2)			6.50 (2)
Blue-winged Teal	8.90 (10)	8.00 (2)		8.75 (12)
Shoveller	8.00 (1)			8.00 (1)
Ring-necked Duck	7.57 (7)	4.00 (1)		7.10 (8)
Golden-eye	6.82 (11)	8.50 (22)	8.00 (3)	8.00 (36)

These brood averages are very high and compare favorably, in fact are a bit higher than, the average for this area. This is another indication the season has been favorable for the breeding stock present on the area.

The numbers in parenthesis indicate the actual number of broods counted in which a full brood count could be made.

Brood averages for the five previous seasons of duck census on the Chippewa area are compared as follows:

	Average Number Per Brood - All Age Classes	
	1937 - 1941 (1404 broods)	1947 (146 broods)
Mallard	7.5	7.5
Baldpate	7.0	8.0
Blue-winged Teal	8.0	8.75
Ring-necked Duck	7.5	7.1
Golden-eye	7.5	8.0

To summarize the 1947 brood census on the Chippewa National Forest, it seems that the resident population had a successful nesting season and juvenile mortality appeared to be very low. The obvious conclusion is that a less than normal breeding stock returned to the Chippewa in 1947.

Continuous high water levels throughout the Central flyway during the past several years may have caused a shift of blue-winged teal and ring-necked ducks to prairie areas, which could easily explain the lack of these species on the Chippewa.

Breeding Potential Estimates VS Brood Counts

Where it is essential to get an early estimate of breeding populations it may be necessary at times to make estimates of breeding pairs, etc., and it was with this idea in mind that a check was made of nine of the eleven census areas during the week of May 11 to 17.

The check was made by covering census area shorelines by canoe and recording all breeding ducks seen as follows:

(Pairs) (Two drakes and one hen) (Single hens) (Single drakes)

Then the breeding potential was arrived at by two methods:

Maximum potential: Total of all groups listed above.
Minimum potential: All groups excepting the single drakes.

Table IV shows the results of the breeding potential survey as compared with actual brood counts on the nine census areas.

TABLE IV

Estimated Breeding Potentials VS Brood Counts - 1947

	Brood Potential (Maximum)	Brood Potential (Minimum)	Actual Number Broods
Mallard	182	70	74
Black Duck	0	1	0
Baldpate	81	69	26
Pintail	8	5	2
Green-winged Teal	7	3	0
Blue-winged Teal	69	59	13
Shoveller	2	1	1
Wood Duck	1	1	2
Redhead	4	4	3
Ring-necked Duck	28	28	7
Golden-eye	55	45	35
Totals	435	285	162

The only species for which the breeding potential and the actual brood count agree closely are the mallard and the golden-eye and in both cases it was the minimum potential that came the closest to being a correct prediction of breeding populations. This may have been due to the fact that only the mallard and the golden-eye were at the peak of nesting at the time the first check was made. If this were true, then in order to apply this method of inventory to all species several checks would have to be made on each area in order to catch each species of waterfowl during their nesting peak, or at the time when only breeding birds were on the area and transients had passed on northward.

Actually on individual areas the breeding potential survey was very far off in most cases. A good example is Lower Pigeon Lake which yielded the following counts:

	Breeding Potential (Minimum)	Actual Brood Count
Mallard	8	0
Baldpate	2	0
Blue-winged Teal	1	0
Goldeneye	2	1
Total	13	1

Another example of great disparity between the two types of inventories was found on the Third River Flowage, as follows:

Mallard	36	12
Baldpate	34	2
Blue-winged Teal	17	0
Ring-necked Duck	2	0
Golden-eye	6	7
	95	21

Thus it appears very doubtful if an accurate estimate of breeding populations can be made at or before the nesting season at least on the Chippewa area. A check made during the latter part of May or the first of June might have eliminated all chance of counting transients but at that time many hens would have been on their nests and drakes bunched up on areas which might conceivably have been far from census areas.

WATERFOWL BREEDING CONDITIONS IN MAINE, 1947

Howard L. Mendall

In view of the present critical condition of many species of ducks, and the urgent requests of State and Federal Administrators for specific information on the status of breeding birds, the Maine Cooperative Research Unit's waterfowl studies were intensified this year. Field work in Maine was supplemented by about 3 week's observations in western New Brunswick. From April until October, Mendall devoted all the time that could be spared from the office to the project. He received considerable assistance from Messers. Gashwiler, Coulter, and Glasgow; also Merwin Marston, State Federal Aid Coordinator, and John M. Dudley, President of the Calais Rod and Gun Club, assisted in the field work for about a week during the height of the nesting season. The activities herein summarized constitute a seasonal progress report covering the entire breeding season.

Breeding Census

Final compilation of all the pre-nesting population data showed a few changes from figures previously reported so it seems desirable to present the complete tabulations at this time. Data for the black duck and the ring-necked duck represent actual counts of breeding pairs on the Unit's census areas which are well distributed throughout central, eastern, and northern Maine, and western New Brunswick. Figures for the other species of breeding ducks are based partly on estimates; although they are not as accurate as those for black ducks and ring-necks, they are believed to be sufficiently trustworthy to show the approximate annual trends of the ducks.

The following table shows the status of breeding game ducks in 1947 as compared with 1946:

Species	Maine	Western N. B.	Combined Areas
Black	30% increase	15% increase	25% increase
Green-winged teal	5% increase	No change	2% increase
Ring-necked duck	11% increase	22% decrease	1% increase
Blue-winged teal	No change	No change	No change
Golden-eye	5% decrease	No change	2% decrease
Wood Duck	10% decrease	No change	5% decrease

Nesting Success

In spite of unusual water levels that made nest hunting difficult, a total of 59 was located, of which 55 were kept under observation until successfully hatched or destroyed. These were distributed as follows: ring-necked duck - 32; black duck - 17; wood duck - 5; and green-winged teal - 1. Two-thirds of the nests hatched successfully but species success ranged from only 41% for the black duck to 81% for the ring-neck. Floods constituted the chief factor in nesting losses. The nesting study was supplemented by additional data obtained by correlating the number of breeding pairs on a given marsh with the number of broods subsequently appearing. This resulted in a slightly higher degree of success for blacks and slightly lower percentage for ring-necks, but even so it was apparent that the former had an unusually poor nesting season and the latter enjoyed remarkably high success. In general the two earliest nesters (black duck and golden-eye) fared badly while the late nesters (ring-neck, green-winged teal, and the blue-winged teal) were very successful. Nesting success for the wood duck was about average. The reasons for these extremes in species were apparently closely related to water levels. By the time the teal and ring-necks were ready to nest, the waters were fairly well stabilized except in some of the New Brunswick marshes.

Two very serious floods occurred during the nesting season. One was about the first of May and water levels were the highest recorded in 15 years. Even the hole-nesting golden-eyes and wood ducks were affected somewhat, and black ducks suffered heavy losses. The first of June another flood, nearly as bad as the first one, occurred. Again, black ducks--many of them being birds which were renesting--suffered heavily and a few ring-necks and teal also lost nests. Fortunately because of the extremely cold and retarded spring only a small number of teal and ring-necks had actually started to nest at the time of the June flood. According to present knowledge of black duck nesting requirements, approximately half of these birds select upland sites in this region. This fact undoubtedly prevented an almost complete failure of their 1947 nesting season in Maine and New Brunswick. Very few black ducks renested after the June flood.

Nest losses from predation were comparatively light in 1947 with the raccoon being the worst offender.

Brood Success

The 1947 brood season was quite successful for all species. The average brood size of downy young was lower than in 1946 but this would be expected in view of the late nesting season and the large number of renestings that were necessary as a result of the floods. The brood size for young at or near the flying age was close to the ten year average, thus indicating fewer than usual brood losses. Golden-eyes fared the poorest in raising young. Favorable water levels prevailed throughout July and August on most of the important rearing marshes.

Summary

The season's waterfowl studies may be summarized as follows:

1. The general status of waterfowl at the start of the breeding season was somewhat improved in 1947 over 1946, with a very substantial increase in the black duck.

2. Serious floods the first of May and the first of June caused heavy losses to the black duck, and--to a lesser extent--the golden-eye and wood duck. The late nesting species (ring-necked duck and the two teal) suffered few losses. Predation was less than usual this year.

3. Brood success was good in 1947 for all species except the golden-eye.

WATERFOWL POPULATIONS IN NORTH CENTRAL NORTH DAKOTA - 1947

M. C. Hammond

These notes summarize investigations in the north central part of North Dakota during the spring and summer of 1947. The work on Federal refuges was part of a study to evaluate nesting-grazing relationships on them. Managers at Upper Souris (F. Sheldon Dart), Des Lacs (Forrest Carpenter), and Lostwood (Burns Carter) assisted with population inventories and made brood counts. (Other refuge personnel assisted with brood counts).

1. Waterfowl Chronology.

In 1947, migration peaks, followed shortly but relatively stable populations were reached on the dates given in the following table in the section of North Dakota under consideration. Other chronological data are included.

Waterfowl Chronology—1947
North Central N. Dakota [2]

Species	Arrival Date	Migration Peak	First Nesting	Last Broods Hatched	Male flocking and pre-moult movement
Pintail	Mar. 27	May 2-10	Apr. 28	July 23	May 23-June 20
Mallard	Mar. 25	May 2	May 9	Aug. 12	May 23-June 30
Blue-wing	Apr. 19	May 6-20	May 17	July 31	June 6-July 11
Gadwall	Apr. 18	May 7-12	May 26	Aug. 23	July 6, 13-?
Shoveller	Apr. 2	May 6-21	May 21	July 31	June 7-July 11
Widgeon	Apr. 7	May 2-10	June 7	Aug. 8 [3]	June 20-July 6
Greenwing	Apr. 5	May 2-7	May 29 [3]	June 28 [3]	June 20-July 6
Redhead	Apr. 8	Apr. 21?	May 28	Aug. 12	----
Canvasback	Apr. 4	Apr. 21?	May 9	Aug. 9	----
Scaup	Apr. 2	Apr. 18-30	June 23 [3]	July 23 [3]	----
Ruddy	Apr. 18	Apr. 30?	June 9	Sept. 6	----
Canada goose	Mar. 27	April	Apr. 26	----	----

2. Based on observations at Lower Souris, Upper Souris, Des Lacs, Lostwood. Arrival dates from Lower Souris records.
3. Only one brood recorded.

The waterfowl population dropped off considerably during several days of southeast wind prior to May 12. Movement of male pintails and mallards and initial flocking began by May 23.

There is no time when refuge waterfowl populations are stable, particularly those areas attractive to male birds as a place to pass the flightless period. The nearest approach to a stable population fell immediately after the principal migration peak, this year the period between May 20 and 30.

It is probably that high early nest mortality (with considerable destruction during the laying period) extends the time during which breeding pairs can be accurately counted on water bodies, due to the fact that many male birds will not have deserted the female at the early nesting stages.

The attraction of certain type areas for flightless birds is illustrated by the following figures from Lower Souris:

August 25 aerial census	150,000 ducks
Resident adults and young	47,000 ducks
Summer movement	103,000 ducks

Part of this total for summer movement actually represented the beginning of fall migration, but the major portion was probably male birds and young which had moved in from surrounding, and possibly distant, breeding areas.

II. Relative Abundance of Waterfowl.

Relative Abundance of Waterfowl - Lower Souris Refuge.

Species	May 23-26 1947	June 7-10 1946	1938*	1940*
Blue-wing	35%	29.4%	19%	39%
Mallard	2	15.1	16	10
Shoveller	4	12.0	12	8
Redhead	4	10.7	6	1
Gadwall	29	10.5	12	17
Pintail	13	10.0	22	16
Ruddy	5	6.6	1	.4
Widgeon	5	2.4	8	6.5
Canvasback	1	1.6	1	.4
Scaup	1	1.0	.5	0
Greenwing	1 (or less)	.3	1.6	1.1

* From nesting studies.

The relative values in this table are roughly accurate, but we believe the reduction in mallards between 1946 and 1947 may not have been as great as indicated.

III. Brood Counts.

We did not have sufficient counts to make significant comparisons between species on each of the 4 refuges. The totals and averages are given for the data available at this writing:

	Class I			Class II			Class III		
Refuge	No. Counts	No. Birds	Aver.	No. Counts	No. Birds	Aver.	No. Counts	No. Birds	Aver.
Lower Souris	126	903	7.17	59	448	7.59	15	121	8.07
Upper Souris	53	339	6.4	23	135	5.9	16	82	5.1
Lostwood	31	241	7.8	20	131	6.55	14	93	6.65
Des Lacs	13	103	7.93	10	61	6.1	-	-	-
Total	223	1586	7.11	112	775	6.92	45	296	6.57

The apparent increase in brood size at Lower Souris was recorded for each of the river ducks, but not for the divers. We can attribute the increase only to possible combination of broods in the older age classes. The increase has occurred each year that counts have been made since 1937.

A tabulation by species for the four refuges combined follows:

Brood Total - All Refuges

1947

Species	Class I No. Counts	Class I No. Birds	Class I Aver.	Class II No. Counts	Class II No. Birds	Class II Aver.	Class III No. Counts	Class III No. Birds	Class III Aver.
Mallard	28	192	6.86	29	175	6.03	9	76	8.45
Pintail	22	125	5.68	12	82	6.83	26	151	5.81
Bluewing	14	113	8.07	11	103	9.37	3	21	7.0
Shoveller	11	105	9.54	5	41	8.20	2	19	9.5
Gadwall	51	392	7.69	20	170	8.5	-	-	-
Widgeon	4	31	7.75	2	16	8.0	-	-	-
Greenwing	1	4	4.0	-	-	-	-	-	-
Redhead	30	219	7.30	7	45	6.42	-	-	-
Canvasback	11	73	6.64	12	60	5.0	2	9	4.5
Ruddy	39	251	6.43	6	32	5.33	-	-	-
Scaup	1	6	6.0	-	-	-	-	-	-
Unidentified	11	75	6.81	8	51	6.38	3	20	6.67
Total	223	1586	7.11	112	775	6.92	45	296	6.57
Total Divers	81	549	6.77	25	137	5.48	2	9	4.50
River Ducks & Unidentified	142	1037	7.30	87	638	7.33	43	287	6.67

The high proportion of diving duck broods sampled results from the selection of open water areas as brood habitat by the divers as well as their tendency to go into open water rather than emergent vegetation when first disturbed. As a result a much higher proportion of the broods are seen than of the river ducks.

IV. Factors Influencing Production.

Nest predation was higher than during earlier study years (1937-1941). We believe that a reduction in predator habitat on non-refuge areas results in a tendency for animals to move into the refuges during the summer. Buffer foods such as grasshoppers and mice were low on study areas and it is probable that the increased activity in search for food resulted in a higher nest loss. The nesting success on the refuges studied probably did not exceed 45% (including renestings.)

A late spring freeze and heavy June rains were possibly responsible for a significant egg loss. We were able to find definite evidence of loss of diving duck nests on the study areas, and are convinced that the rains flooded many river duck nests on low poorly drained land.

It has been our impression, based on dates most newly hatched broods were observed, that there was an appreciable amount of renesting this year, especially with redheads and canvasbacks, but also with river ducks.

V. Ground Counts of Waterfowl Populations.

Date	Area Sampled	Length of Sample	Square Miles Sampled	Birds per Square Mile	Birds Counted
April 25	Lower Souris to Des Lacs	59 miles	11.8	6.2	73
April 28	Lower Souris to Sheyenne easement via #14 highway	105.3 miles	21	24.2	508
May 2	Lower Souris to Upper Souris to Des Lacs	68.4 miles	13.7	3.7	51
May 3	Lower Souris to Lords Lake	37 miles	7.4	2.8	21
May 3	Turtle Mountains	38 miles	7.6	56.0	425
May 3	#14 - Peace Garden Road to #5 highway	9.8 miles	2.0	1.5	3
Total		317.5 miles	63.5	17.0	1081

There was an average decrease of 60% in the waterfowl population on refuge samples between the end of April and the period between May 20 and 30. Should a similar decrease have likewise occurred on the areas covered by the counts above, the population in late May would have been 10 birds per square mile rather than 17. Mr. Wellein counted 13.1 birds per square mile on his aerial survey May 18-20, 1947.

AERIAL CENSUS OF WATERFOWL IN NORTH DAKOTA

SPRING-1947

Edward S. Wellein

Introduction.

This year was the second successive year in which a waterfowl strip count was made in North Dakota. The count was conducted in exactly the same manner as the one last year, and over precisely the same routes. In 1946 the count was conducted from May 6 thru 12; this year it was made somewhat later—May 18 through 20. It is believed, however, that because later migration this year and a later spring in general resulted in little difference in dates for the two years from a phenological standpoint.

Because of the experience obtained last year in setting up and standardizing the procedure it was possible to conduct the survey in much less time this year than was required in 1946. Almost a week was used last year in this count; the time required this year was about 2 1/2 days.

Data was recorded in the same manner to facilitate comparison with that obtained in the previous count.

Technique.

Preliminary flying was not necessary this year as the same technique was employed. The five routes were flown in exactly the same order and in the same manner.

A strip was covered 1/8 of a mile on each side of the plane, the observer covering the right side and the pilot the left side. The plane was flown at an airspeed of 70 m.p.h. and at an altitude of approximately 100 feet. Fairly consistent identification is possible at this speed, distance, and altitude.

A column captioned "Unidentified" was used for those ducks not positively identified. This does not mean that it was not possible to identify these individuals. By maneuvering and circling it is always possible to make positive identification but this procedure materially affects efficiency of operation. At times waterfowl occur in large enough numbers in potholes so that it is not possible to obtain a total count by species in one "pass" over the area. When this occurred one of two procedures was followed—either a total count was obtained in the first pass and the entire group thrown into "Unidentified" or a second "pass" was made over the area and the species composition was then estimated by percentage. The second procedure was avoided as much as possible to save time. Actually it is not exceedingly important to obtain 100 percent identification. The comparative abundance can be computed by using the total count and the comparative abundance data obtained from those individuals which were positively identified. This year only 6.1% of the waterfowl counted were listed as unidentified.

All observations were reduced to a per square mile basis to facilitate comparison. It is not only possible to compare these data year to year but to compare it with data obtained by different methods in different areas--provided these data is reduced to a unit area basis.

The aircraft used in 1946 was a Stinson-Vultee L5; this year a 100 h.p. Cub Cruiser was used. Both airplanes were satisfactory for the work. In fact any high wing plane with good down visibility which is capable of safely flying at an airspeed of about 70 m.p.h. would be satisfactory.

Comparison of Data.

The five census routes used are a fairly good sample of waterfowl conditions in Central North Dakota. The two areas with low waterfowl populations—the Red River Valley and the area west of the Missouri River were not sampled. Six hundred and four linear miles were flown with a resulting coverage of approximately 151 square miles.

There follows by routes a comparison of counts made in 1946 and 1947 (Tables I, II, III, IV, and V).

TABLE I

Route 1. Devils Lake north to Rock Lake, East to Rolla, south to Devils Lake. Date: May 18, 1947. Distance: 157 miles. (1/4 mile strip). Number of square miles: 39.2

Species	No. Ducks Observed 1946	1947	Comparative Abund. (%) 1946	1947
Pintail	187	139	35.4	37.5
Blue-winged Teal	89	35	17.1	9.4
Shoveller	88	28	16.8	7.5
Mallard	84	47	16.2	12.6
Scaup	34	48	6.5	12.9
Baldpate	19	15	3.7	4.1
Gadwall	7	18	1.3	4.8
Redhead	2	2	.4	.5
Canvasback	4	28	.9	7.8
Ruddy	0	2	0.0	.5
Unidentified	9	9	1.7	2.4
Total	523	371		

TABLE II

Route 2: Balta north to Rugby, West to Berwick, north to Willow City to Bottineau. Date: May 18, 1947. Distance: 67 miles. (1/4 mile strip). Number of square miles: 16.7

Species	No. Ducks Observed 1946	1947	Comparative Abund. (%) 1946	1947
Pintail	53	52	27.7	39.4
Blue-winged Teal	26	24	13.6	17.8
Shoveller	19	14	9.9	10.4
Mallard	47	12	24.6	8.9
Scaup	24	—	12.6	—
Baldpate	14	—	7.3	—
Gadwall	6	9	3.2	6.7
Redhead	2	2	1.1	1.4
Canvasback	—	2	—	1.4
Ruddy	—	4	—	2.9
Unidentified	—	15	—	11.1
Total	191	134		

TABLE III

Route 3: Upham to Wilton, East to Tuttle, north to Harvey. Date: May 19, 1947. Distance: 175 miles. (1/4 mile strip). Number of square miles: 43.7.

Species	No. Ducks Observed 1946	1947	Comparative Abund. (%) 1946	1947
Pintail	161	258	21.3	31.7
Blue-winged Teal	86	141	11.4	17.3
Shoveller	90	89	11.9	10.9
Mallard	76	115	10.1	14.1
Scaup	--	28	--	3.5
Baldpate	84	24	11.2	3.0
Gadwall	71	63	9.5	7.7
Redhead	11	6	1.5	.8
Canvasback	--	9	--	1.1
Ruddy	140	9	18.5	1.1
Unidentified	35	72	4.6	8.8
Total	754	814		

TABLE IV

Route 4: Maddock south to Pettibone, East to Pingree, south to Jamestown. Date: May 20, 1947. Distance: 119 miles. (1/4 mile strip). Number of square miles: 29.7.

Species	No. Ducks Observed 1946	1947	Comparative Abund. (%) 1946	1947
Pintail	87	97	24.3	31.6
Blue-winged Teal	42	64	11.8	20.9
Shoveller	40	24	11.2	7.8
Mallard	60	40	16.8	13.1
Scaup	3	11	.9	3.6
Baldpate	12	18	3.4	5.9
Gadwall	9	25	2.5	8.1
Redhead	--	2	--	.6
Canvasback	6	4	1.7	1.3
Ruddy	5	6	1.4	1.9
Unidentified	90	16	25.0	5.2
Total	354	307		

TABLE V

Route 5: Jamestown west to Medina, south to 8 miles south of Streeter, east to Nortonville. Date: May 20, 1947. Distance: 86 miles. (1/4 mile strip) Number of square miles: 21.5

Species	No. Ducks 1946	Observed 1947	Comparative 1946	Abund. (%) 1947
Pintail	100	122	19.7	35.1
Blue-winged Teal	80	45	15.8	12.9
Shoveller	22	25	4.6	7.5
Mallard	55	60	10.9	17.3
Scaup	—	12	—	3.5
Baldpate	22	2	4.6	.6
Gadwall	44	38	8.6	10.9
Redhead	—	14	—	4.0
Canvasback	2	—	.4	—
Ruddy	—	12	—	3.4
Green-winged Teal	—	6	—	1.7
Unidentified	181	11	35.4	3.1
Total	506	347		

Shown below (Table VI) is a summation of the five routes censused together with the percentage increase or decrease over 1946 by species.

TABLE VI

Total of 5 census routes.

Species	No. Ducks 1946	Observed 1947	Compar. 1946 (%)	Abund. 1947	Increase - Decrease (%)
Pintail	588	668	25.3	33.9	13.6
Blue-winged Teal	323	309	13.9	15.5	4.3
Shoveller	259	180	11.2	9.2	30.5
Mallard	322	274	13.9	13.9	14.9
Scaup	61	99	2.6	5.1	62.3
Baldpate	151	59	6.5	2.9	60.9
Gadwall	137	153	5.8	7.8	11.6
Redhead	15	26	.6	1.3	42.3
Canvasback	12	43	.5	2.3	258.3
Ruddy	145	33	6.2	1.7	77.2
Green-winged Teal	—	6	—	.3	—
Unidentified	315	123	13.5	6.1	60.9
Total	2329	1973			19.6

The Pintail was again the highest in comparative abundance, followed by the blue-winged teal, mallard and shoveller. Only two dabbling duck showed an increase over 1946—the pintail and gadwall. Blue-winged teal, shoveller, mallard, and baldpate all showed a decrease. The greatest decrease was apparent in the shoveller and baldpate. All divers except the ruddy duck showed an increase. The overall picture was a total decrease in the waterfowl population of 19.6 percent. In Table VII is shown the percentage of increase or decrease by routes.

TABLE VII

Route No.	Percentage increase or decrease in 1947 over 1946	
	Increase	Decrease
1	—	29.2
2	—	29.8
3	7.4	—
4	—	13.2
5	—	31.4
	Average	19.2

The difference in the figures 19.6 (Table VI) and 19.2 (Table VII) is a result of dropping the second decimal. The actual decrease is 19.6 percent computed from the total population in 1946 and 1947. Only one route showed any increase (Route No. 3).

The ducks per square mile (Table VIII) varied from a low of 8.0 to a high of 18.6 as compared to a low and high of 11.4 and 23.5 obtained last year.

TABLE VIII

Ducks per Square Mile

Route No.	1946	1947
1	13.3	9.5
2	11.4	8.0
3	17.2	18.6
4	11.9	10.3
5	23.5	16.2
Average.	15.4	13.1

The average number of ducks per square mile decreased in all routes except one (Route 3) where an increase of 1.4 ducks per square mile was recorded. An overall decrease of 2.3 ducks per square mile occurred.

Unfortunately, there was no opportunity to fly the same route several times to check the consistency of counts. On three of the routes, however, the observations of the observer and the pilot were recorded separately. Theoretically in a fair sample the counts of the observer and the pilot should, on the average, be the same. Table IX shows a comparison of the count of the observer and the pilot over three routes.

TABLE IX

Route No.	No. Ducks Counted		Percentage Difference
	Right Side	Left Side	
3	417	397	4.8
4	149	158	5.6
5	173	174	.5
Total	739	729	1.3

The percentage difference varied from .5 percent to 5.6 percent. On the total of the three routes the percentage difference was 1.3 percent. An analysis on the percentage differences (an admittedly small sample) results in a standard deviation of 2.7. With a mean of 3.6 this indicates that 68.2% of samples of

this type can be expected to have a percentage difference between .8 to 6.3.

Flying Time Required.

A record was kept of the flying time necessary to cover the five routes. This information is shown below (Table X) together with information on distance and coverage.

TABLE X

Flight Time

Route No.	No. Linear Miles	No. Square Miles	Flight Time
1	157	39.2	2:20
2	67	16.7	1:35
3	175	43.7	2:30
4	119	29.7	1:30
5	86	21.5	1:20
Total	604	150.8	9:15

The total cost for the aircraft on this project (computed at $4.00 per hour) was $37.00. The cost per linear mile—$0.061. The cost per square mile—$0.25.

The average ground speed was computed to be 64.5 miles per hour. Sixteen and three tenths square miles were covered per hour. On the basis of the above figures a pilot and observer could cover about 489 square miles per week flying 30 hours per week. The total cost for the aircraft to cover 1,000 square miles would be $250. This is obviously a very economical system of sampling.

Recommendations.

1. It is very desirable to expand the survey made in this area to a point where a sufficient number of observations can be obtained on the less abundant species of waterfowl to give more dependable figures. This would probably require sampling approximately 500 to 700 square miles. One way of accomplishing this would be to lay out four routes running north and south across the state in such a way the representative sampling would result. Some consideration should, of course, be given gas and oil supplies to ensure efficiency of operation.

2. The basic research should be performed. A route should be set up and flown a number of times and a statistical analysis run on the results. The same route should be flown several times a week over a two or three week period to determine at what time of the year the wave of migration has subsided and the population has become comparatively static. The time that this occurs should be linked with phenological data.

3. If this system of waterfowl survey proves to supply the required information for management it should be expanded to include other areas and the information thus obtained should be coordinated to obtain as complete an overall picture as possible.

Summary and Conclusions.

1. The pintail is consistently the most abundant duck in the area involved.
2. Only two dabbling ducks showed an increase—the pintail and gadwall.
3. The blue-winged teal, shoveller, mallard, and baldpate showed a decrease. The largest decrease was shown for the shoveller and baldpate.
4. All diving ducks (scaup, redhead, canvasback) except the ruddy duck showed some increase.

5. The decrease on the total count in 1947 compared to 1946 was 19.6 percent.

6. The average number of ducks per square mile dropped from 15.4 in 1946 to 13.1 in 1947.

There seems to be little doubt, from the observations obtained in this survey, that there has been a considerable decrease in the total waterfowl population in the area in the past year. The greatest share of the decrease was borne by the blue-winged teal, mallard, shoveller, and baldpate.

WATERFOWL BREEDING CONDITIONS - NATIONAL WILDLIFE REFUGES, 1947

R. E. Griffith

The following information is a brief summary of the waterfowl situation on the major nesting grounds in the refuge system, based upon reports received from field personnel.

The flight in the spring of 1947 was a further reflection of the general decline in ducks and geese that was very strikingly evident during the preceding fall migration. The spring migration is, of course, always considerably below that of the fall season and in many instances 50 percent, or even less, waterfowl may be recorded during the spring flight as compared with the fall flight at the same location. A summary of waterfowl reports from waterfowl refuges in the four flyways indicates the trend to be as follows:

Atlantic Flyway	Down 25%
Mississippi Flyway	Down 35%
Central Flyway	Up 137%
Pacific Flyway	Down 25%

In the refuge system, the largest numbers of waterfowl are reported from areas in the Mississippi and Pacific flyways. The Atlantic and Central Flyway refuges both accommodate about the same number of waterfowl during migration and winter seasons. The number and distribution of refuges in these latter two flyways should be borne in mind in considering the general utilization of refuge areas in those flight lanes.

In general, water conditions were good on all of the refuges lying within important nesting territories. In some instances, abnormally high levels interferred seriously with full utilization of nesting habitat.

The following reports from specific refuges will serve best to illustrate the general trend of both the spring flight and production resulting from this past nesting season:

Sand Lake, South Dakota. Waterfowl useage of the refuge during the past summer was 89 per cent below 1946. Production was 65 per cent below last year. The greatest decline was evident in the following species and in the order listed: Green-winged teal, redhead, ruddy, mallard, and pintail. Some birds began concentrating on the refuge by mid-June and some of the movement is considered reflecting the drying up of potholes which earlier in the season had held sufficient water to attract nesting ducks.

Upper Souris, North Dakota. The manager reported that this season was the worst since 1938, with fewer waterfowl occurring there during the spring migration, as well as production being considerably below that of other years. The decline here cannot be associated with water conditions and is rather a reflection of a sharp reduction in waterfowl numbers in that immediate locality.

Valentine, Nebraska. Water conditions were generally satisfactory throughout this refuge, which is located in the sandhills. As compared with the spring of 1946, there was a sharp reduction in numbers of waterfowl frequenting the refuge this past spring. The greatest decline was noted among the following species: Mallard, canvasbacks, redhead, and gadwall. Waterfowl production was down 40 per cent from 1946. It was reported that there was an abundance of nesting cover unoccupied. Predation was the heaviest this year than it has been for some time.

Des Lacs, North Dakota. The spring flight was below that of 1946 and production was down 25 per cent from last year. The average brood size was slightly larger than in 1946, though this did not in any measure compensate for the smaller nesting population.

Mud Lake, Minnesota. About 31 per cent fewer waterfowl used this refuge in the spring of 1947 than during the same period in 1946. The greatest decline was evident among the following species in the order listed: Shoveller, ruddy, blue-winged teal, gadwall, and pintail. Production was down 74 per cent from last year. This decline is attributed to late nesting and abnormally high water levels.

Lower Souris, North Dakota. The spring population was about 20 per cent above that of last year. Production was down 30 per cent. Water levels were good throughout the spring and summer season and the decreased nesting appears to be related more closely with a general decline of the continental waterfowl population than with conditions on the refuge.

Malheur, Oregon. As in the case of a large portion of the breeding range in eastern Oregon, the water supply of the Malheur Refuge this spring was considerably below normal. As a result, much of the nesting habitat on the refuge was unoccupied and it was estimated that there is a 20 per cent reduction in the total number of broods as compared with the 1946 season. For the second successive year, the spring migration reflected a substantial decline.

Lacreek, South Dakota. Water conditions here were excellent throughout the breeding season. Field reports indicate the spring flight to be about 30 per cent better than that of 1946. Production was estimated to be up 20 per cent from last year.

Bowdoin, Montana. Water conditions were good here and may have had some bearing on the three-fold increase in pintail production reported by the refuge manager. The field report indicates there is no decrease in the spring population as compared with 1946.

WATERFOWL RECONNAISSANCE OF THE YUKON-KUSKOKWIM-DELTA

R. E. Griffith

The aerial reconnaissance which Mr. John Ball and I made of the Yukon-Kuskokwim-Delta and other waterfowl breeding areas in Alaska this past August failed to reveal any concentrations of note. The greatest numbers of ducks and geese were observed along the coast where these two rivers and numerous channels empty into the sea. Where we had expected to see several hundred thousand waterfowl, we saw no more than 100 thousand. Most of the ponds and lakes in the interior of western Alaska

were devoid of waterfowl, except for whistling swans and may of the swans were unaccompanied by cygnets. In fact, only about one out of every four pairs reflected a successful nesting season. It was clearly evident from our aerial reconnaissance that much of the area in Alaska generally referred to as important breeding territory has a far smaller capacity to accommodate breeding populations than the prairie nesting grounds. The water areas are generally lacking in emergent growth and aquatic vegetation, particularly of the types generally represented on the lakes and potholes in the prairie country where it is common to find waterfowl well distributed from early spring through mid-summer and where each pothole supports at least one brood. It is believed that some of the ducks, as well as geese, migrated from the breeding grounds prior to our arrival and this, no doubt, is the reason why no birds were seen on some of the areas that we covered. This conjecture is further supported by the arrival of white-fronted geese at the Tule Lake Refuge in the early part of August. The fact that sizeable numbers of waterfowl may migrate southward early in the season is further reflected by the presence of over 10,000 pintails on the Muleshoe Refuge in Texas during August.

Refuge brood counts for this last season which are now being tabulated indicate considerable variation in average brood sizes on different refuge areas from the preceding season. These differences, however, tend to balance one another so as to reflect about the same average brood size for the last two seasons. Inasmuch as there is considerable bunching of broods toward the latter part of the season, it is difficult to obtain a representative figure for the size of broods in age class "3". The data at hand reflects about the same percentage of loss from age class "1" to "3" for the past two seasons. On some areas, however, such as Valentine, predation was far heavier this year than had been noted for the past several seasons.

AERIAL WATERFOWL BREEDING GROUND SURVEY METHODS

By David L. Spencer

With the increasing use of aircraft for waterfowl surveys, it is evident that procedures, methods and results must be closely analyzed in order to secure the most effective utilization of the planes assigned to this work. It has been found that aircraft are desirable in waterfowl survey work, both by reasons of speed and extent of coverage possible and for the checking of many areas which are inaccessible by any other means. Experience has shown, however, that use of airplanes in surveys has limitations and that aerial inventories are subject to various sources of error. With a view toward learning the extent of these limitations and errors, the aerial breeding-ground surveys made in the summer of 1947 were conducted in a manner which would check methods and improve them. The following discussion intends to comment on aerial survey methods and report the results of the various checks made for accuracy and efficiency. It embodies the work and observations of the Fish and Wildlife Service personnel participating in breeding ground surveys during the summer of 1947.

Some of the best waterfowl breeding areas on the continent are in the vast stretches of pothole country on the prairies of Canada and the Northern United States. Evaluating the waterfowl use of these areas can be done accurately by car and afoot, but such a method is time consuming. A more efficient method which would give increased coverage and shorten the time required to sample any given area is desirable. The extensive country to the north of agricultural areas in Canada differs from typical pothole country, yet it is composed of great numbers of small and large water bodies. It can, within limits, be sampled in the same manner as the prairie pothole areas. The far North is inaccessible by automobile and the plane must be used entirely. In all of these general types of areas, prairies, bush and far north, the airplane has a definite place in waterfowl surveys, but the problem is to find a means of correlating airplane data with ground information. In order to do this, aerial surveys must first be conducted in the territories where results may be checked by means of a car. Such was accomplished as opportunity permitted during the breeding-ground survey period of 1947.

Aerial Survey Methods:

Briefly, the method employed in surveying a sample strip of pothole territory by plane was as follows: All waterfowl and water areas were tallied within a strip extending 1/8 mile each side of the line of flight. The pilot recorded observations on one side of the plane, and the observer recorded the other. Transects started and stopped at definite points, usually towns. The waterfowl and water areas recorded were then placed on the square mile basis for comparative purposes.

The flight altitude was about 100 feet, since this was found to be the best altitude for observation on an eighth of a mile strip. For the purpose of achieving optimum accuracy in the estimation of the strips on either side of the plane, an area was marked off along a road near the base of operations. This marked strip was flown before each transect

survey flight, for the observers to become familiar with the appearance of a strip of land an eighth of a mile in width. Only the total number of ducks was counted as it proved impossible to tally pairs accurately, as was done by car survey. When possible, ducks were identified and recorded; however, identification was only recorded on 47% of the total ducks observed on aerial pothole transects.

In surveying extensive marshes and large lakes which are not too large, and time is available, a systematic coverage in the effort to see all waterfowl present will result in a figure close to the actual population, differences resulting only from errors in estimating numbers in flocks. However, on most large lake and marsh areas, for example, the Saskatchewan River Delta, it is impossible to make a complete coverage. Here the strip cruise appears most efficient. By this method, all waterfowl are tallied on a 1/4 mile strip (1/8 mile on each side of the line of flight), time spent within the area is recorded, and an estimate made of the average ground speed. Using these figures and an accurate map of the area, it is possible to determine the per cent coverage of the area and thus the total estimated population.

The larger lakes where birds are not found in the open water are best surveyed by shoreline counts. This can be done fairly accurately by flushing the birds with the plane along the shoreline. A large percentage of the shoreline should be covered since the ducks are frequently in concentrations at various points.

Where time is restricted and moderately large areas which are familiar to the pilot and observer are being covered, it may be desirable to cover only a part of the area; yet record waterfowl over an area much greater than 1/8 mile on each side of the line of flight. Here it is necessary for the observer to make a visual estimate of the per cent of the waterfowl population seen on the area. This is the least accurate method, yet may yield good results if the area is well known.

Some of the streams within the prairie area were found to be used by brooding waterfowl. These streams assumed greatest importance where there were few marshes and potholes and where drought conditions were in evidence. Streams seem best handled by tabulating the important ones within a region, then keeping records on the linear mile basis. Aerial waterfowl counts are easily made along most of these streams. Indications are that brood counts may also be reliably made. The function of these streams in waterfowl production may well be further investigated. A survey on Mina Creek and Wood River in Saskatchewan on June 3 revealed 370 total waterfowl. On August 12, a coverage of the same area showed about 275 broods to be present. The earlier survey would not account for this number of broods. It may be that these streams are of high importance in areas where the drying out of potholes occurs.

Ground and Air Counts Compared

In attempts to arrive at the difference between the ducks which would be seen and recorded from a plane and the ground, ground transects were run and later covered by plane. One such area within the Minnedosa

pothole country of Manitoba was covered intensively by car and on foot on June 7th and 8th in the attempt to secure a total count of the duck population. On June 12th, the same area was covered by plane. This transect totaled 164 linear miles of 1/4 mile strip (1/8 mile on either side of the road), or 41 square miles. The comparison between the two surveys is shown in the following table:

	Total Water Areas	Water Areas Per Sq.Mile	Total Waterfowl	No. Pot-holes occ.	Ducks per Sq. Mile
Car Survey	533	13	1,110	232	27.2
Plane Survey	823	20	941	239	23

Since it was impossible on this occasion to cover the transect at the same time both by car and by air, there was undoubtedly some change in the population between the two counts. However, ground observations indicate this change may have been slight, and it can be assumed that the populations on the different dates were near comparable.

Assuming the car and foot survey to be as accurate as possible, it was found that 85% of the ducks on the transect were observed by air.

It will be noted that only 65% as many potholes were counted by car as were counted by air. This is attributed to various causes, namely: (1) a rain between the two counts which may have caused additional water areas; and (2) recording potholes by air which were obscured by terrain or vegetation by car; differences in recording of connected potholes as a single or several units.

Over a broader area, a total of 155 square miles of air transect samples were made within a 3,600 sq. mile area in Manitoba (4.5% sample). This same area had wide coverage by car. In computing nesting populations by car, the figure used is that of nesting pairs to the square mile and analysis of the survey records shows that 1.53 ducks were seen for every pair tallied, this being due to the inclusion of single drakes as evidence of a pair. The plane survey average for the Minnedosa sample area was 20.3 ducks to the square mile. The car survey average for the same area was 15 pairs to the square mile or, as explained above, using the ratio 1 pair: 1.53 ducks, 23 ducks to the square mile. Here, over this wide area, the count by plane there was 87% of that by car.

In another phase of the study, a 100 square mile block of the Minnedosa pothole country in Manitoba was laid out, photographed by air and an aerial photographic map constructed for the area. This block was then surveyed by air on June 24th with a 50% sample in transects 1/2 mile apart. On the 50 square mile sample 964 ducks were counted, or an estimated 1,928 ducks for the entire block, (19.3 ducks per square mile). The following items were learned from this study:

1. The area was not uniform in its duck population (some strips tallied three or four times as many ducks as others). This points the need for statistical anaylsis of transect data to

determine the percent coverage of an area required to obtain a given degree of accuracy. On this same thesis, an appraisal could not very well be satisfactory if it dealt with only a few sample check areas.

2. Observer's individual estimates for the area were comparable. Each observer surveyed 25% of the area. Based on counts, one observer's estimate for the total area was 2,000 ducks; the other's, 1,860 ducks--or a difference of only 7%.

3. Figures on the numbers of potholes recorded from the air vary considerably with the observer. One observer recorded a total of twice as many potholes on the survey as the other in the main due to different concepts as to what constituted a pothole. Examination of the aerial photograph revealed the lower count to be more accurate when a pothole was regarded as necessarily having water and not being dry depressions. Yet even the lower count varied from the actual number of water areas on the strip. Just what should be regarded as a pothole must be clarified.

4. A transect along a main highway had the highest waterfowl count of the 20 transects. This is of interest, since it is strips similar to this which are covered by car. It demonstrates that the presence of the highway may not be a disturbing factor causing a lowered population on these strips.

5. Brood counts made on aerial pothole transects appear to be of little value under the present method of survey. The total broods recorded on the area (25) were only a fraction of the number that ground studies indicated to be present. This idea was further brought out in studies made early in July in Saskatchewan, where sample blocks totaling 50 square miles in the best breeding areas had brood counts varying from .16 to 1.7 broods per square mile. The failure of the air surveys to get reliable brood counts on these pothole areas is suspected to be caused by broods resting out on the banks where they are passed unnoticed, whereas a large adult duck would be seen. A method of censusing broods, however, may be possible if effort is made to fly specifically for that purpose. Experiments need to be conducted over varied terrain with this in mind.

Some interesting information on comparison of aerial and canoe methods was obtained by making two surveys in the Delta Marsh, Manitoba area. A canoe count was made at the same time as the aerial count. Results of these counts were as follows:

1, Cadham Bay Count, June 12th of Total Ducks
Total count by canoe - - - - 414 ducks
Total count by air - - - - 430 ducks

2. Delta Marsh Brood Count, July 25th.
Two hours and fifteen minutes flight time were spent over the marsh in the attempt to cover the area completely and count all broods. During the day, five canoeing parties covered the same area. The day was cloudy, calm, and ideal for observing. Total

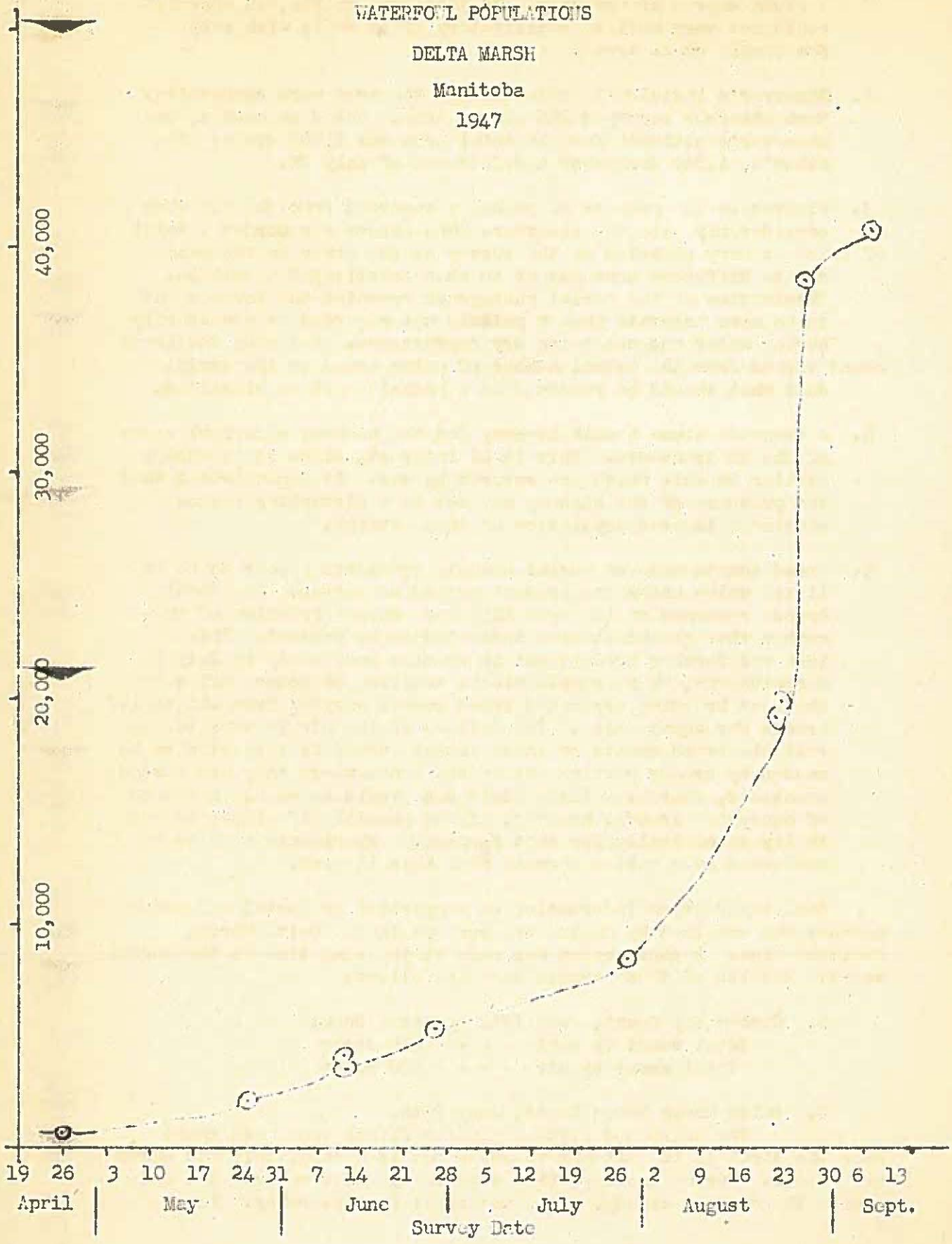
Figure I

WATERFOWL POPULATIONS

DELTA MARSH

Manitoba

1947



count by air was 190 broods; and by canoe, 167 broods. A higher count by air was to be expected, since some broods were counted in small, enclosed ponds in the marsh which were inaccessible to a canoe. Eleven per cent of the broods seen by canoe were unidentified. Over half the broods seen by air were unidentified, since it was not found practical for the pilot to tally species and numbers. The average number of young to the brood by canoe was 5.9; by air the figure was 6.5. Since a count of the number of young by air must be made very rapidly, it is likely that it would be much less accurate than if made from the ground providing coverage of the same areas could be made.

From the foregoing it would appear that an air survey will give accurate total counts, although identification of broods and other detailed information are best secured by more intensive methods.

The time of the breeding season at which censuses are made makes considerable difference in the population figures. Ten careful aerial counts were made on the Delta Marsh, Manitoba, during the summer of 1947 by American Wildlife Institute and Fish & Wildlife Personnel. These counts, when plotted on a graph, show a gradual rise until shortly after the middle of August, after which the population "build-up" becomes abrupt. They show that in making late summer estimates over a large region by covering lakes and marshes alone, it is of importance to know just when this "build-up" occurs and the maximum population is reached. In indicating trends from year to year, for example, the Delta Marsh population for the first week in September for one year cannot properly be compared with a count made the third week in August for another year. This idea is readily apparent in the Figure I.

Comparison of Observers' Counts

Fifteen instances were recorded during the summer in which two experienced observers made estimates of the total birds on identical areas. For these 15 cases, the average deviation from the mean of the two observers was 5%. Variation between the two estimates in individual cases was never great. It may be noted that in all these cases the total number of birds estimated was small (300-500). It is also desirable to make this check on larger concentrations to determine if observation error increases with the increase in numbers.

In a series of 25 instances in which strip counts were made on marshes, one observer recording on either side of the plane, the total count by the pilot was 97,000 and the observer's count 78,000. These figures merely raise some questions. Is it necessary to fly a geometric pattern in order to obtain a representative sample over a large marsh area? The pilot's count was high. Since the tandem-seated L-5 plane was used, is it possible that the pilot in the front seat has a greater advantage by better visibility and the opportunity to see birds further ahead of the line of flight? Checks made in side-by-side seated aircraft would determine if this advantage exists.

Use of Photography in Making Estimates

Perhaps the greatest source of error in making waterfowl surveys is in the estimation of the number of birds in large flocks. Under ideal conditions and with suitable equipment, it is often possible to photograph concentration of birds so that they may be accurately counted. It is of considerable value for the individual observer to check his estimates from the air by the taking of photographs of the estimated flocks. This is one of the few ways in which an accurate count can be made and thus improve observers' estimates.

Use of Waterfowl Habitat Region Maps

The rough mapping of areas into regions which are more or less homogenous for waterfowl use is a pre-requisite for any extended program of aerial surveys. Without a map defining the limits of these regions it is impossible to lay out survey flights that will give proper coverage to an area. This has now been done for many areas in southern Canada. With these maps, it is now possible to plan long transects which will be rather uniform throughout. Such transects may be organized in a way that will reduce lost motion in flying from place to place without recording data.

CONCLUSIONS AND RECOMMENDATIONS

1. Aerial marsh counts can be made with good accuracy.

2. The use of aerial transects is a feasible method for obtaining quantitative population data over pothole country and areas having large numbers of small water bodies. Detailed information such as nesting pairs and productivity must be obtained on the ground.

3. Until further corrected by additional test, 85% of the birds are seen on aerial pothole transects.

4. Present methods of making aerial brood counts on pothole areas need to be improved. Over marshes, they seem quite accurate.

5. In estimates based on late summer marsh counts of a region, an accurate knowledge of marsh population "build-up" is required.

6. Prospective survey areas should be roughly mapped into regions having homogeneous waterfowl conditions.

7. Aerial photography is a valuable aid in breeding ground surveys, both as a means of improving estimates and to study water conditions from year to year.

8. Additional checks are recommended on the following items:

   a. Ground vs. air counts on pothole transects.
   b. Ground vs. air counts on marshes.
   c. Comparison between observers on identical areas.

d. Geometric flight pattern vs. random pattern in surveying large marshes by the strip method.

9. A statistical examination of transect data would be of value in determining the degree of sample required to reach a desired degree of accuracy.

10. The nature of waterfowl surveys may roughly be divided into two classes for the purpose of aircraft requirements:

a. Long-range surveys over uninhabited country.
For this purpose, the Grumman Widgeon has been found most suitable since it combines the following features:

1. Twin engine and amphibious safety.
2. Can operate from either land or water base.
3. Good visibility.
4. Good flight characteristics.
5. Relative economy of operation.
6. Dependability.
7. Good range and load capacity.

b. Surveys of a more intensive nature where it is necessary to move about within a region having good aircraft facilities. Here also an amphibian would be most suitable. Lacking a good small amphibian, an aircraft for this work should have the following features:

1. A dependable, thoroughly developed aircraft, requiring a minimum of maintenance.
2. Good range - $4\frac{1}{2}$ to 5 hours.
3. Carry two persons and baggage with max. gas load.
4. Good visibility, preferably side-by-side seating arrangement. High wing.
5. Economy of operation.
6. Good flight characteristics at slow operating speeds.
7. Suitable for small field operation.