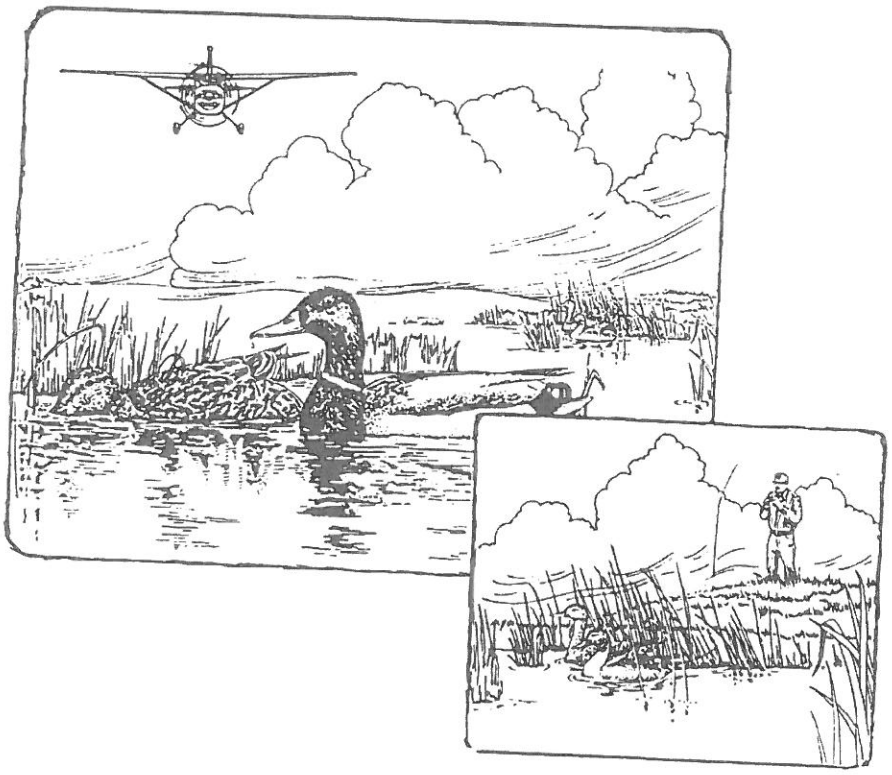
Robert M. Platte

Standard Operating Procedures

for

AERIAL WATERFOWL BREEDING GROUND POPULATION AND HABITAT SURVEYS

IN NORTH AMERICA



U.S. Department of the Interior
Fish and Wildlife Service

Environment Canada
Canadian Wildlife Service

April 1987

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SECTION I: INTRODUCTION

The Migratory Bird Treaty Act of 1918 (as amended) implements treaties between the United States of America and Great Britain (Canada, 1916), the United Mexican States (1936 as amended in 1972), Japan (1972 as amended in 1974), and the Soviet Union (1978). Under this Act, the Secretary of the Interior (United States) and the Minister of Environment (Canada) are responsible for the protection of migratory bird species.

In facilitating this task, an essential element has been the monitoring of various species population levels. In the late 1940's,the U.S. Fish and Wildlife Service developed aerial waterfowl breeding population and production surveys. These surveys were designed to provide annual breeding population and production indices covering changes over a major portion of the duck breeding range in North America. Today, these surveys continue to provide a basis for the management of most duck species on this continent.

The aerial Waterfowl Breeding Population and Habitat Survey was initiated experimentally in 1947 but was not fully operational until 1955. Similarly, the aerial Waterfowl Production and Habitat Survey was established experimentally in 1950 and became operational in 1956. Since their inception, these surveys have been conducted annually and without interruption. In 1959, air-ground comparison segments were started throughout most of the prairie crew areas to provide visibility correction factors for each species. The correction factors are applied to data obtained on the Waterfowl Breeding Population and Habitat Survey. These air-ground segments did not become operational until 1961. An attempt at developing air-ground comparison segments for the Waterfowl Production and Habitat Survey was initiated in 1950 but, because of many inherent problems, this work was discontinued in 1967. Consequently, the Waterfowl Production and Habitat Survey results are not adjusted for visibility bias.

Currently, the federal- and state-conducted surveys (utilizing the techniques outlined in this manual) monitor waterfowl population and habitat changes over nearly 1.4 million square miles (3.6 million km^2) of breeding habitat within portions of Alaska, the Yukon and Northwest territories, 5 western Canadian provinces, and 5 north-central states (Fig. 1). This area has been divided geographically into 9 federal and 2 state crew areas, each of which is surveyed by independent crews. Due to their general cover types, federal crew areas encompassing survey

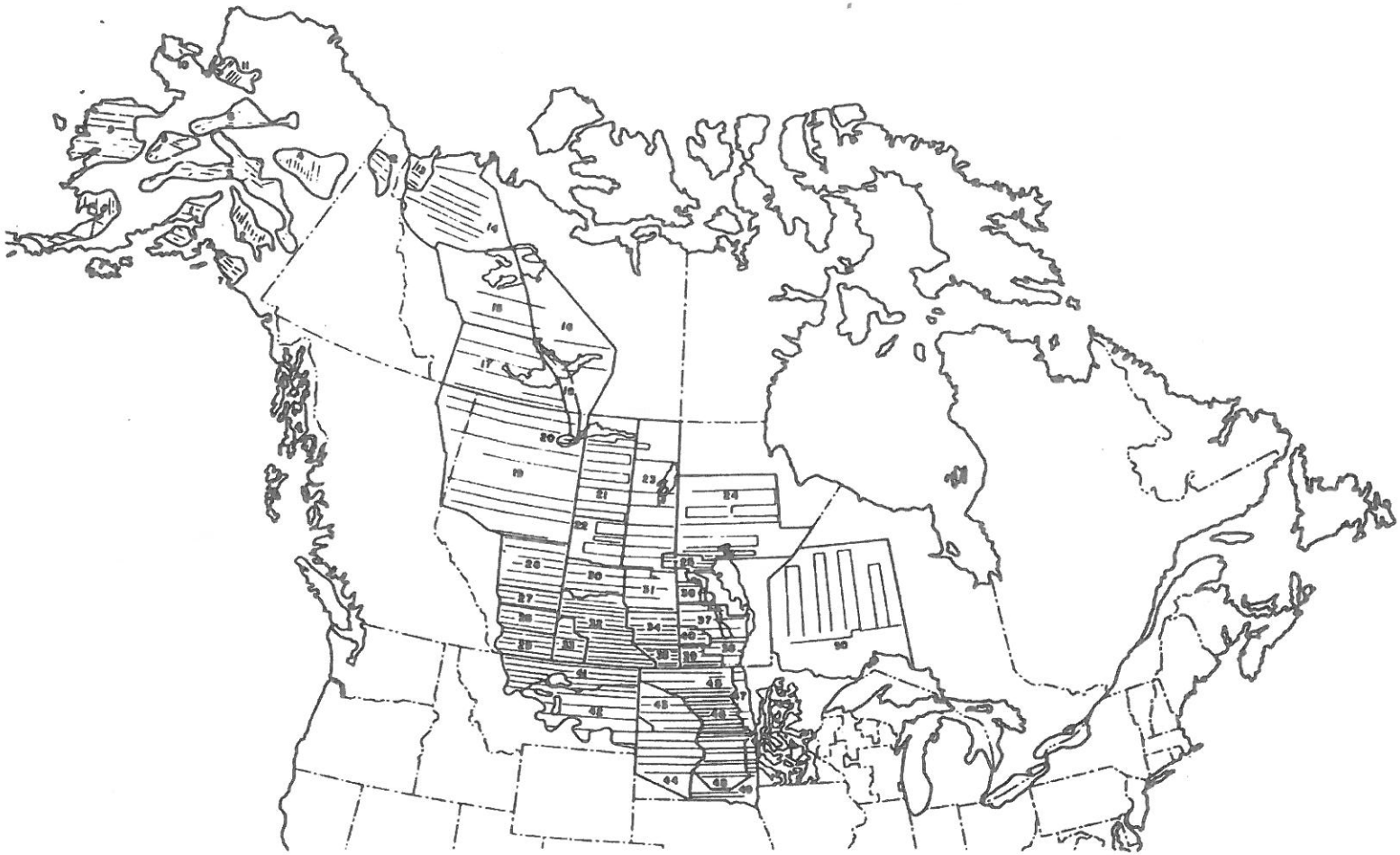


Figure 1. Survey strata and transects for principal areas of Waterfowl Breeding Population and Habitat Surveys in North America.

strata 1 through 25 and stratum 50 have been termed "bush" crew areas, whereas those encompassing strata 26 through 49 have been termed "prairie" crew areas. About 44,200 miles (71,100 km) of transects are covered during the Waterfowl Breeding Population and Habitat Survey which provides about a 1 percent sample of the combined strata areas. The Waterfowl Production and Habitat Survey covers roughly 30,700 miles (49,400 km) of transects to provide about a 0.5 percent sample of 0.8 million square miles (2.1 million km^2) covered by this survey (Fig. 2).

The breeding ground surveys in Canada are a cooperative effort between the U.S. Fish and Wildlife Service and the Canadian Wildlife Service with the assistance of various other federal, state, provincial, and territorial resource management agencies. The standard operating procedures presented herein represent the latest refinement of survey methodology (Bowden 1973). Earlier contributors to these procedures are listed in the Bibliography. First-time readers of this document are cautioned to be aware that although there are great similarities between the Waterfowl Breeding Population and Habitat Survey and the Waterfowl Production and Habitat Survey, the methods and reporting procedures are described completely and separately without reference to each other.

The following Standard Operating Procedures Manual (henceforth referred to as the Waterfowl Breeding Ground Surveys Manual) has been prepared to standardize the procedures used in conducting these surveys. Involving more than 40 aerial and ground crew members in the federal survey units, these surveys require complex coordination effort. Although the procedures described here were formulated and finalized prior to 1955, minor revisions have become necessary with subsequent improvements in equipment and capabilities, organizational name changes, updating of long-term visibility rates, changes in survey coverage, etc. Therefore, this manual has been set up in loose-leaf form to facilitate periodic updates.

This revision supersedes the Standard Operating Procedures for Waterfowl Breeding Ground Population and Habitat Surveys, 1977. Copies of this edition are available on request from the Department of the Interior, U.S. Fish and Wildlife Service, Migratory Bird Management Office, Patuxent Wildlife Research Center, Laurel, Maryland 20708, and the Department of the Environment, Canadian Wildlife Service, Prairie Migratory Bird Research Centre, University of Saskatchewan, Saskatoon, Saskatchewan S7N OX4.

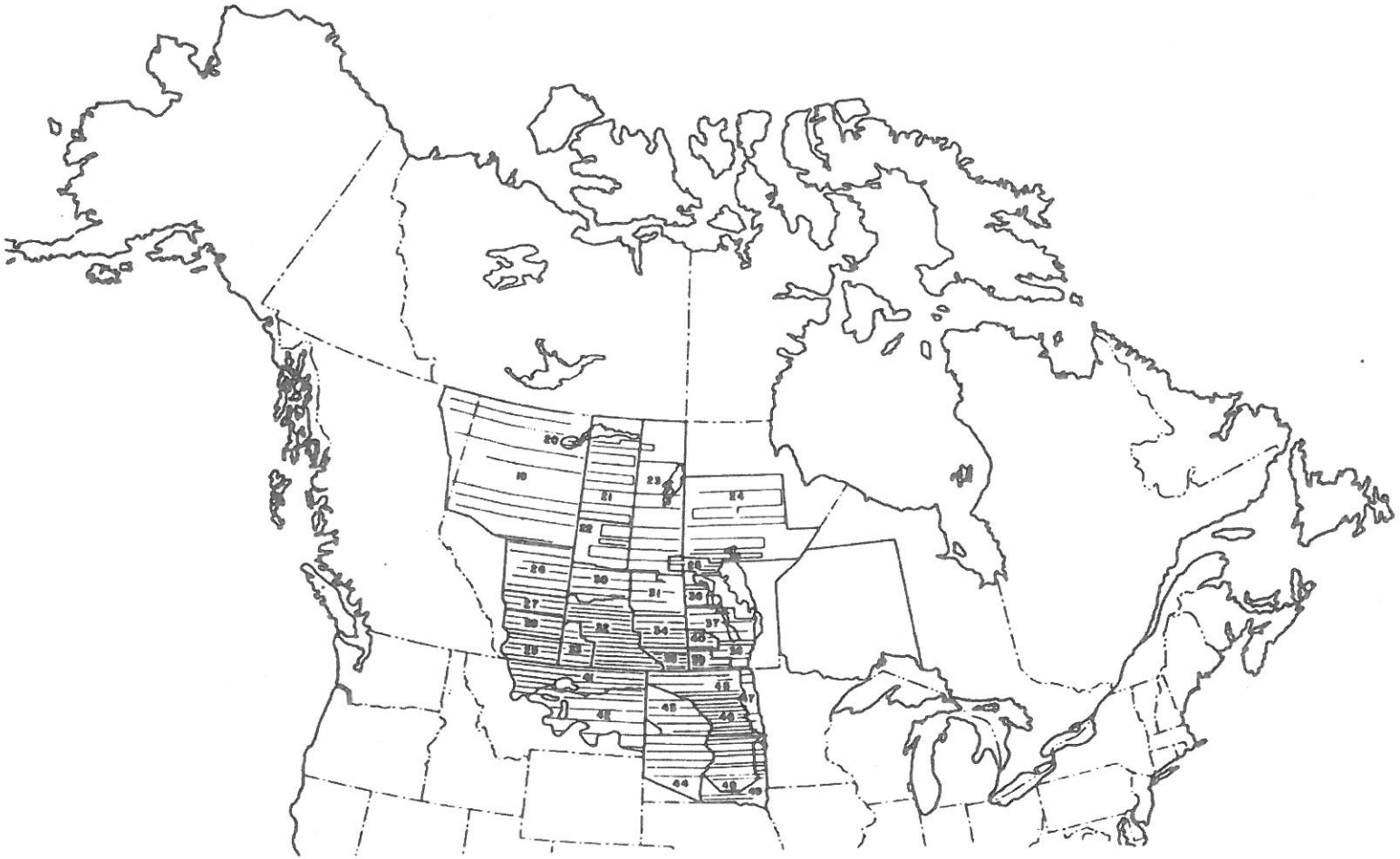


Figure 2. Survey strata and transects for principal areas of Waterfowl Production and Habitat Survey in North America.

SECTION II: RESPONSIBILITIES OF SURVEY PARTICIPANTS

A. U.S. Fish and Wildlife Service

1. Branch Chief-Surveys: The Branch Chief, Surveys, Migratory Bird Management Office (MBMO), United States Fish and Wildlife Service (FWS) is responsible for the compilation of survey data from all reporting units. This includes preparing the final waterfowl breeding population and production indices for the survey areas. These data become major components in the annual Fall Flight Forecast and Waterfowl Status Reports prepared by the FWS.

2. Section Chief - Waterfowl Population Surveys: The Section Chief-Waterfowl Population Surveys (WPS) is responsible for coordination of U.S. and Canadian personnel and insures the orderly conduct of the program in Canada and the United States. The Section Chief supervises all FWS personnel working on air and ground surveys in both the United States and Canada, and represents the FWS in all matters relating to the Canadian Wildlife Service (CWS), other Canadian officials, the Canadian public, and similar United States entities. The Section Chief is ultimately responsible to the Branch Chief-Surveys, FWS in reporting survey data.

3. Flyway Biologist: The Flyway Biologist is responsible to the Section Chief-WPS for the actual conduct of the waterfowl breeding ground population and habitat surveys in the assigned crew area. In this assigned crew area, the Flyway Biologist is in charge of the aerial and ground survey crews and coordinates the timing and sequence of ground surveys. The Flyway Biologist is the pilot-observer in the survey aircraft. Upon arrival in the assigned crew area, the Flyway Biologist contacts the appropriate state, provincial or territorial wildlife management agencies to inform them of planned activities and to offer an exchange of information. The Flyway Biologist, in cooperation with the Population Management Biologist (CWS) within the prairie provinces of Canada, compiles and analyzes the breeding population and habitat estimates to be included in the Waterfowl Breeding Population and Habitat Survey Report. The Flyway Biologist prepares and distributes the following reports to reach the addressees listed in the appendix by the established dates.

a. Waterfowl Breeding Population and Habitat Survey Report

b. Mid-May Habitat Conditions Report (submit only to Branch Chief-Surveys, FWS)

c. Waterfowl Production and Habitat Survey Report

d. Mid-July Habitat Conditions Report (submit only to Branch Chief-Surveys, FWS).

Flyway Biologists conduct surveys in specified portions of the Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Montana, North Dakota, and South Dakota.

4. Waterfowl Biologist-Waterfowl Investigations: The Waterfowl Biologist-Waterfowl Investigations stationed in Alaska conducts the surveys in specified portions of Alaska and the Yukon Territory. This individual performs the same duties outlined for Flyway Biologists and provides survey results (including photography) to the Assistant Branch Chief-Surveys, FWS by the required due dates.

B. Canadian Wildlife Service

1. Head-Population Management Section: The Head-Population Management Section (PMS), Western and Northern Region, is responsible for the coordination of activities between the 3 Canadian air-ground comparison survey crews (i.e. participation requirements, consistency of ground crew participants, procedural discrepancies, etc.), and the orderly conduct of the ground crew activities in Canada.

2. Population Management Biologist: The Population Management Biologist is responsible to the Head-PMS, for coordination of activities of the air-ground comparison survey crew, consistency in the adherence to survey procedures, and the compilation and analysis of ground survey data in the assigned area. In cooperation with the Flyway Biologist, FWS, this individual assists in the analysis of breeding population and habitat estimates to be included in the Waterfowl Breeding Population and Habitat Survey Report. The Population Management Biologist prepares and submits the Provincial Waterfowl Status Report in sufficient time to reach the Head-PMS by June 10.

C. State Wildlife Management Agencies

Waterfowl Biologist: The states of Minnesota and Wisconsin have participated in these cooperative surveys using comparable procedures since 1964 and 1973, respectively. Waterfowl Biologists for these states are responsible for surveys in specified portions of their respective states. These individuals perform the same duties as outlined for Flyway Biologists and provide survey results and appropriately labeled color slides as indicated to the Assistant Branch Chief-Surveys, FWS by the required due dates.

SECTION III: WATERFOWL BREEDING POPULATION AND HABITAT SURVEY

A. Methods

1. Survey Dates: The survey is performed in the prairie crew areas during the approximate period of 1 to 25 May. Differences exist in the chronology of the breeding season among years. In some years, most waterfowl en route farther north have departed the southern prairies by 1 May, and late-arriving waterfowl (e.g. blue-winged teal) have arrived and are occupying breeding territories. In other years, transient waterfowl in the southern prairies (e.g. scaup and certain other divers) may still be present in large mixed aggregations and blue-winged teal may not have arrived by 10 May. Therefore, to obtain the most representative breeding population information for the greatest number of duck species, the Breeding Population and Habitat Survey should not begin until the majority of more northern breeding species have moved through, and the bulk of late-nesting species have arrived and are dispersed into breeding territories. The survey should be initiated before early-nesting mallard and pintail drakes are commonly observed in post-breeding flocks of 3 and 4. In prairie Canada, the aerial crews coordinate closely with the CWS ground personnel to determine roughly when to plan crew arrival. Reconnaissance flights in each prairie crew area are conducted to determine the survey starting time.

The Breeding Population and Habitat Survey in the bush crew areas is performed during the approximate period 12 May to 12 June. Primary criteria used in bush crew areas for initiation of this survey are spring breakup, the build-up of representative waterfowl in traditional breeding areas, and the dispersal of paired waterfowl into breeding territories. As in the prairies, reconnaissance flights are made to determine the appropriate time for beginning the survey. The survey in Alaska begins about 18 May, depending entirely upon spring breakup.

2. Survey Flight Time: Daily survey flights begin no later than 1 hour after sunrise in prairie habitat and no later than 2 hours after sunrise in the parkland and southern bush habitats. The later start in parkland and bush areas allows for better light penetration into dense woodlands to improve visibility. In northern bush

habitats, survey flights are conducted during the mid-day period due to the extended daylight in northern latitudes at this time of year. Transect flying is completed by 12:00 noon (local standard time) each day in the prairies. Because of extended daylight and logistical problems associated with subarctic conditions, the completion time for bush operations is somewhat later in the day.

3. Survey Flight Conditions: Aerial surveys are not initiated when winds consistently exceed 15 mph (13 kts), if adverse weather conditions exist (i.e. snow, moderate to heavy rain, excessively rough air), or if visibility is poor for other reasons. Surveys are discontinued when winds exceed 25 mph (22 kts), turbulence is excessive, or if other adverse weather develops which is unsafe for flight or may compromise survey results.

4. Survey Flight Speed and Altitude: Transects are flown at ground speeds of 90-105 mph (78-90 kts). A stop watch is used to monitor aircraft ground speed and to aid in locating segment end points. Aircraft are normally flown at 100-150 feet (30-50 m) above ground level (AGL) to ensure accurate identification of waterfowl species under average light conditions and to assure safe obstacle clearance. Established known-width sample transects are flown at regular intervals to maintain consistency and accuracy of the aerial crew's transect width. Reference marks are applied to the aircraft's wing struts as guides for both pilot-observer and observer to indicate the approximate transect boundaries from the appropriate altitude.

5. Survey Flight Path: Transects are centered on section lines in the prairies and along degree lines of latitude or longitude in the bush. In Alaska, transects are oriented generally perpendicular to river valleys and coastlines. The transects are located as depicted in Fig. 1. The flight path is altered only to avoid flying directly over towns, game farms, poultry, livestock, or persons. The aircraft's flight path is not altered to facilitate identification of waterfowl. Transects are flown in the same direction each year as much as practical to minimize variance associated with changes between years.

6. Survey Sample: A segment is an 18-mile (29-km) sampling unit, 16-mile (26-km) in the Alaska crew area, having a total width of 1/4 mile (400 m), i.e. 1/8 mile (200 m) on each side of the aircraft for the waterfowl

sample, and a width of 1/8 mile (200 m) on the observer's side of the aircraft for the pond sample (Fig. 3). The pilot-observer in the left front seat counts all identifiable ducks, geese, and coots within 660 feet (200 m) on that side of the aircraft while the observer in the right front seat counts all identifiable ducks, geese, and coots within 660 feet (200 m) on that side of the aircraft. The observer also counts specified types of water areas (ponds) within 660 feet (200 m) on that side of the aircraft. All waterfowl and pond data are recorded for each individual segment.

A transect is a continuous series of segments. Most transects in this survey are oriented in an east-west direction and are parallel to the other transects at regular intervals within any given stratum. The survey employs a systematic random sampling of potential transect locations. The transect is the sampling unit.

A stratum is a specific geographic unit encompassing areas of similar waterfowl densities and is generally of a specific habitat type. The transects usually extend from one side of a stratum to the other. Beginning near the southern boundary of a stratum, the transects extend to or near the northern boundary. Spacing between transects varies depending upon waterfowl densities. Transect spacing within strata 1 through 50 varies between 14 miles (23 km) and 60 miles (97 km).

7. Reporting Units and Survey Crew Areas: Because it is desirable to report the data on a political unit basis and to maintain historical continuity in the various survey units, the survey data are compiled and analyzed by reporting unit (Fig. 4). Survey crew areas have been geographically organized on the basis of alignment with political boundaries, similarity in habitat, and equitable distribution of work load or flight time required to conduct the survey (Fig. 5). The strata surveyed and the strata reported on by each aerial survey crew for the Waterfowl Breeding Population and Habitat Survey are provided in Table 1.

For those instances where one aerial crew conducts the survey in a specified area and another crew reports on that area, it is the responsibility of the Flyway Biologist collecting the data to summarize the information and transmit it to the Flyway Biologist responsible for the report. The original and one copy of each Field Data Form, Field Data Form (stratum

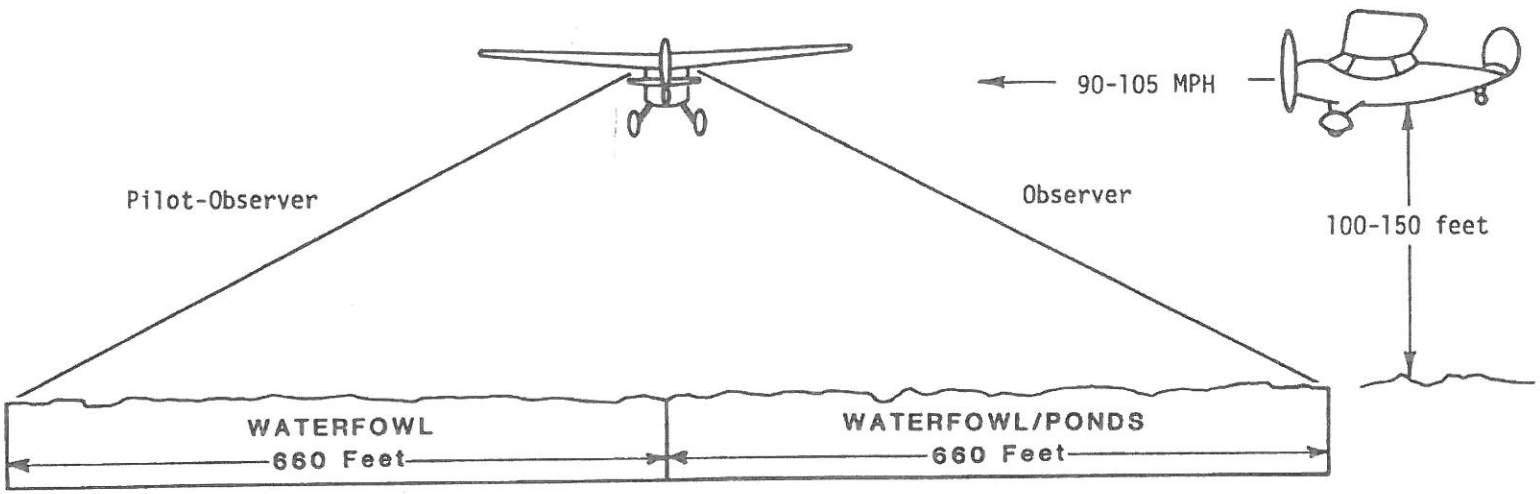


Figure 3. Survey sample for Waterfowl Breeding Population and Habitat Survey.

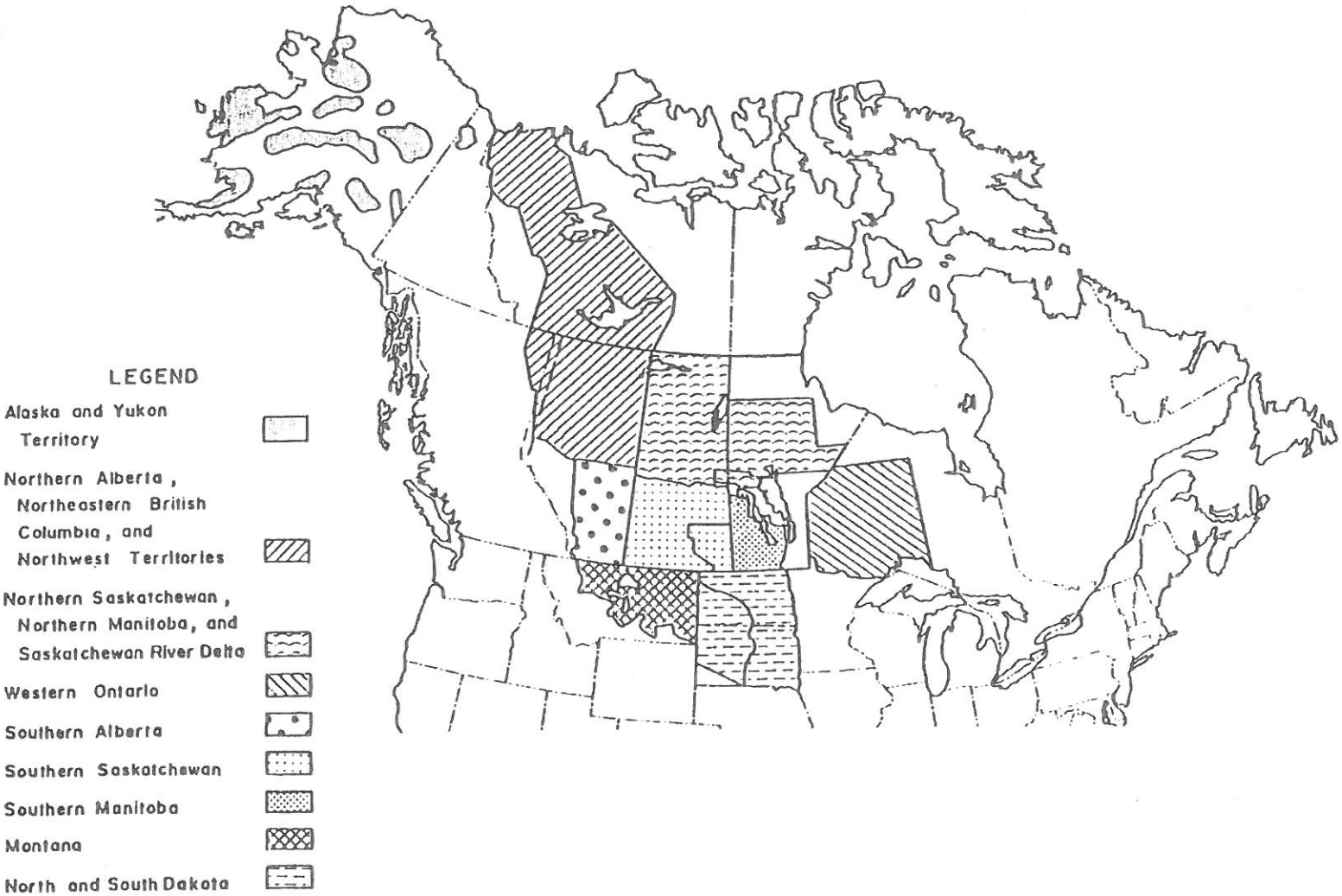


Figure 4. Reporting units for the federal aerial waterfowl breeding ground surveys.

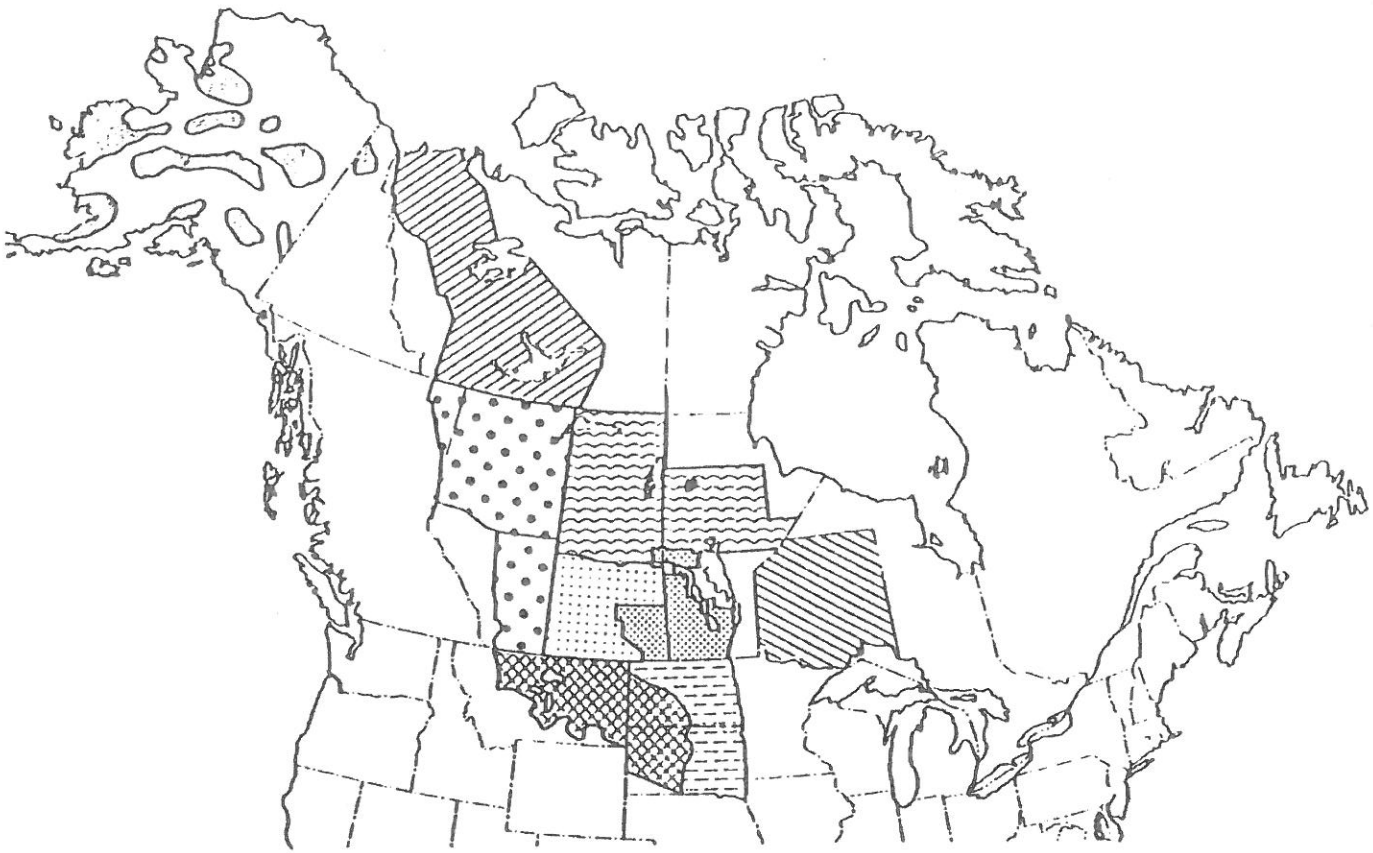


Figure 5. Crew areas for the federal aerial waterfowl breeding ground surveys.

Survey area	Crew Area Strata	Crew Area Area (Sq. mi.)	Crew Area Sample (Sq. mi.)	Crew Area Linear miles	Reporting Unit Strata	Reporting Unit Area (Sq. mi.)	Reporting Unit Sample (Sq. mi.)
FEDERAL							
Bush							
Alaska and Yukon Territory	1-12	81,770	912.0	3,648.0	1-12	81,770	912.0
Northern Alberta, Northeastern British Columbia, and Northwest Territories	13-18	273,201	927.0	3,708.0	13-20	438,687	1,669.5
Northern Saskatchewan, Northern Manitoba, and the Saskatchewan River Delta	21-24	217,314	1,417.5	5,670.0	21-25	224,130	1,534.5
Western Ontario	50	176,609	607.5	2,430.0	50	176,609	607.5
Bush subtotal		748,894	3,864.0	15,456.0		921,196	4,723.5
Prairies							
Southern Alberta	19,20,26-29	229,783	2,056.5	8,226.0	26-29	64,297	1,314.0
Southern Saskatchewan	30-33	88,912	967.5	3,870.0	30-35	111,120	1,269.0
Southern Manitoba	25,34-40	67,752	850.5	3,402.0	36-40	38,728	432.0
Montana	41-44	120,791	1,260.0	5,040.0	41-42	73,657	868.5
North and South Dakota	45-49	89,101	1,111.5	4,446.0	43-49	136,235	1,503.0
Prairie subtotal		596,339	6,246.0	24,984.0		424,037	5,386.5
FEDERAL total		1,345,233	10,110.0	40,440.0		1,345,233	10,110.0
STATE							
Minnesota		33,899	527.3	2,109.2		33,899	527.3
Wisconsin		43,359	412.5	1,650.0		43,359	412.5
STATE total		77,258	939.8	3,759.2		77,258	939.8
GRAND TOTAL (Federal and State)		1,422,491	11,049.8	44,199.2		1,422,491	11,049.8

Table 1. Waterfowl Breeding Population and Habitat Survey - crew area and reporting unit constants.

summary), and the original Segment Data Form are delivered to the Flyway Biologist responsible for that reporting unit as soon as possible following survey completion. Copies of the Field Data Forms and Field Data Form (stratum summaries) are retained by the aerial survey crew (aerial data) and the CWS ground crew leader (ground data) for referral should questions arise.

B. Data Collection

1. General: The following instructions are generally applicable to both the aerial and ground crews.

a. Strict adherence to the instructions and procedures set forth in this manual is required unless changes are approved by the Section Chief-WPS prior to the initiation of the surveys.

b. Survey data are recorded daily on the appropriate Field Data Forms.

c. Field Data Forms must be prepared in duplicate. It is not necessary to prepare duplicates of the Segment Data Forms (discussed later in this section). Copies are stored and mailed separately to reduce the chance of losing any field data.

d. The original field records are prepared neatly and legibly to facilitate auditing, duplication, and data transfer. Black ink or dark pencil (#2 or darker) is used on all forms.

e. Survey records are double-checked by the survey crew to ensure that transcriptions and mathematical calculations are accurate.

f. Instructions for completing the various forms are printed on the back side of each form and should be strictly followed.

g. The Segment Data Forms and originals of all aerial and ground Field Data Forms as well as stratum summaries are submitted directly to the Assistant Branch Chief-Surveys at the conclusion of the survey. Express Mail is used for this purpose whenever possible.

h. Color slides are useful in depicting habitat changes through the years, particularly as they

relate to availability of surface water and specific land-use activities detrimental to waterfowl. It is the responsibility of the ground crew leader to obtain and send photo material representating habitat change to the crew area Flyway Biologist; this material includes the unprocessed slides and a photo log with appropriate labels. These slides are then processed and labeled by the Flyway Biologist. It is the responsibility of the Flyway Biologist to obtain and appropriately label aerial color slides. These are forwarded with the ground crew slides to the Assistant Branch Chief-Surveys as soon as possible following survey completion, via Express Mail if available.

2. Waterfowl Data: Within the transect boundaries, all ducks (except lone hens) that can be identified by the aerial crews are recorded by segment on a tape recorder. When water areas occur on the boundary of a transect, only those waterfowl judged to be within 1/8 mile boundary on each side of the aircraft are counted. A separate recorder is used by each aerial crew member. These data are then transcribed to Field Data Forms each afternoon following the survey flights. (Exhibit 8-prairie crews and Exhibit 9-bush crews). The data are then summarized by stratum using the same forms (Exhibit 10-prairie crews and Exhibit 11-bush crews). It is emphasized that only those ducks within the transect boundaries on water bodies cut by the transect boundary are recorded. Unidentified ducks should not be recorded. Identified ducks in flight are recorded only if their flight originates or terminates within the transect boundary. For all species of ducks observed and identified, the number in each of the following categories is recorded. Instructions appear on the reverse of the Field Data Form.

a. Lone drake--single isolated drake without a visible associated hen. (Lone hens are not recorded by the aerial crew.)

b. Flocked drakes--2 or more drakes in close association (for the purposes of this manual, flocked drakes recorded on the Field Data Form are limited to groupings of 2 to 4 drakes).

c. Pair--male and female in close association.

d. Group--3 or more of a mixed-sex grouping of the same species in close association which cannot be separated into singles and pairs (for the purposes of this manual, a hen and 2 drakes are recorded as a pair and a lone drake, and 5 or more flocked drakes are recorded as a group).

Coots are recorded as a total number for each observation. Geese observed on transect are recorded in the same manner as ducks.

It is emphasized that this is a breeding population survey and not a true breeding pair survey. The estimates derived include not only indicated pairs but also grouped birds, some of which are undoubtedly non-breeders and transient birds.

Table 1 (Exhibit 1) of the survey unit report contains a long-term trend in adjusted waterfowl breeding population estimates by species for the current year and all previous years of record. Table 2 (Exhibit 2) contains the current year's adjusted waterfowl breeding population estimates by species and stratum, showing comparisons of the current year with the previous year, the previous 10-year mean, and the long-term mean.

3. Water Data: Water data are collected only in the prairie and parkland habitats. The aerial observer records the number of individual water areas within 660 feet (200 m) on that side of the aircraft for each segment. The pilot-observer does not count ponds for reason of flight safety. Water areas intersected by the transect boundary are counted. A tape recorder is used for this purpose as is done for the waterfowl data. Two mechanical counters are often used to assist the observer in this task, particularly in high density pond areas. The number of natural water areas (e.g. ponds, lakes, rivers, streams) is recorded on one counter, while the number of artificial water areas (e.g. reservoirs, stock dams, dugouts, and large irrigation ditches) likely to contain water into mid-summer is recorded on the other. Natural and artificial water areas are identified as such to monitor human effects on natural wetlands over the history of the surveys. The number of ponds for each segment is the sum of the counter totals. Table 4 (Exhibit 4) contains the long-term trend in adjusted pond estimates by stratum, comparing the current year with the previous year, previous 10-year mean, and the long-term mean. Table 4 (Exhibit 4) represents types III, IV, and V wetlands (Shaw and Fredine 1956),

artificial areas, and streams only. Type I wetlands are tallied only on the ground crew field data and summary forms.

Natural water areas to be counted from the air include Type III, IV, and V wetlands, rivers, and streams. Type III ponds (seasonal wetlands) refer to hay meadows or basins containing natural aquatics which normally are dry by midsummer but are expected without additional precipitation to retain water for at least 3 weeks following the observation. These wetlands normally have a uniform vegetative cover and contain at least 6 inches (15 cm) of water. Under dry fall conditions, many ponds are plowed but refill with water in the spring. In these instances, no vegetation is present, but these wetlands should be counted if they have sufficient water depth and lasting qualities. To minimize subjectivity, it is stressed that water depth is the primary criterion. Type IV ponds (semi-permanent wetlands) have sufficient water depth that they will likely persist through the brood season but may become dry during late August or September. These wetlands usually contain water during at least 7 out of 10 years, and the vegetation is normally clumped, covering all but the center of the wetland. Type V ponds (permanent wetlands) are deep marshes or lakes having sufficient water depth to persist throughout the summer and fall. These wetlands normally are characterized by a peripheral rim of aquatic vegetation bordering an open body of water. Streams and rivers that meander through the transect are counted as separate water bodies each time they occur within the transect boundary. Dugouts that are inundated by a natural wetland are not recorded as artificial water areas, but if the dugout can be identified as a water area separately from the surrounding natural water area, both the dugout and the natural water area are counted.

The following water areas are not recorded by the aerial crew:

a. Type I ponds (temporary wetlands) refer to temporary water, sheet water, small wet areas in stubble or plowed fields, and wet depressions that have less than 6 inches (15 cm) of water depth and can be expected to last less than 3 weeks.

b. Roadside or borrow ditches where the water is confined entirely to the ditch and small ditches used for local irrigation.

c. Muskeg areas where water may glisten under a dense growth of grass. Open areas of water within muskeg are not counted.

4. Air-Ground Comparison Data: Aerial and ground crews conduct surveys of selected segments in each stratum to provide correction factors for visibility biases (waterfowl and ponds present but not observed by the aerial crew). Visibility biases are known to exist for all aerial observers. These biases change between years as a result of varying conditions (i.e. vegetative cover, cloud cover, light, wind, aircraft design and noise level, observer fatigue, observer experience, etc). These biases are not necessarily consistent between individual observers given the same set of circumstances. To minimize the effect of these factors, as many variables as possible are made consistent between years. Some variables cannot be controlled and must be dealt with annually. In the prairies, visibility rates for major species of ducks may vary significantly. Therefore, visibility rates are determined on an annual basis in each of the prairie crew areas. Although it is suspected that visibility rates for bush crews vary to a lesser degree, species visibility correction factors developed in prairie crew areas are applied to bush transects. (See Exhibit 12 for these visibility rates.) To develop more precise visibility correction factors applicable to bush crew areas, air-ground comparison segments are being established using helicopters.

a. Aerial Crew: The aerial crew covers each air-ground comparison segment in the same manner as other segments. Each air-ground segment is flown within a day of the time the immediately adjacent transects are flown (preferably on the same day). The aerial crew flies air-ground segments in early, mid-, and late-morning to obtain an even distrubtion of sampling effort. Likewise, the aerial crew distributes the number of eastbound and westbound air-ground segment flights proportionately to the transect flights flown within that stratum. The data are recorded on the Aerial Crew Field Data Form in the same manner that other segment data are recorded, but is prepared on a separate Field Data Form (Exhibit 13) from the operational transect data.

b. Ground Crew: The ground crew consists of no less than 2 and no more than 4 individuals. The

ground crew initiates segment coverage within 1-1/2 to 2 hours of sunrise. Every effort is made to complete the ground segment by 12:00 noon (local standard time). However, coverage will be completed within one day. Ground coverage of all air-ground segments is from east to west to minimize visibility problems associated with sun glare. The ground crew covers each segment on the same day or within 2 days following aerial coverage. Every effort is made to begin the segment on the morning of the day immediately following aerial coverage. Ground coverage is not initiated until at least 1/2 hour after aerial coverage has been completed if conducted the same day. Ground coverage is not initiated or continued when winds are in excess of 25 mph (40 kph) or if other adverse weather conditions exist (e.g. moderate to heavy snow, heavy rain, thick smoke, heavy fog). If the ground crew cannot complete coverage within the 3-day specified period, a second aerial count is required. The ground coverage, as before, is completed on the same day or within 2 days following aerial coverage. Landowners are contacted whenever possible prior to entry upon their land.

It is emphasized that the primary objective of the ground work is to get a <u>complete count</u> of all waterfowl present on the air-ground comparison segment. Whenever there is any doubt regarding the ground crew member's ability to see the entire surface of a water body and all waterfowl that might be resting on its shore, the ground crew member walks around the pothole to the extent necessary to ensure sighting and identifying all waterfowl. In instances where there are large potholes with open shorelines and large numbers of waterfowl, the ground crew member refrains from flushing the waterfowl since this may result in counting error due to "roll-up" (counting the same waterfowl at 2 or more locations) or inability to identify all the birds in flight due to poor positioning or dealing with too many birds at one time (mass flights). Waterfowl that are flushed will be recorded and watched to the extent necessary to rule out duplicate counting further along the segment.

When a pothole falls on the boundary of a segment only those waterfowl are counted that are judged to be within the segment at the time the ground

crew arrives at the wetland. Waterfowl in flight over the segment are counted only when they are obviously associated with the segment. Waterfowl are recorded in the same manner as by the aerial crew. However, all waterfowl present on the segment must be identified and included in the count. Unlike the aerial crew, the ground crew records certain lone hen data. Lone hen redhead, scaup, ring-necked duck, and ruddy duck are recorded. Lone hens of other species are <u>not</u> recorded (Bowden 1973). This is explained in the Data Adjustment Section to follow. To minimize "roll-up" and inability of the ground crew to identify all waterfowl during mass flights, firecrackers, shellcrackers, uncontrolled dogs, and other scare devices are not used.

All-terrain vehicle use is minimized for the same reason. However, <u>limited</u> use may be warranted in situations where access would not otherwise be possible. Direct inspection of ponds while on these vehicles is avoided. The noise produced by these vehicles masks the ability of ground crew members from cuing to ducks by sound. For reason of safety, all crews using all-terrain vehicles strictly adhere to prescribed operating guidelines.

The ground crew tabulates and classifies all water areas within the entire segment width of 1/4 mile (400 m). In addition to the kinds of water areas counted by the aerial crew, Type I wetlands are recorded by the ground crew. These temporary wetlands are sheet water, small wet areas in stubble or plowed fields, and wet depressions that are less than 6 inches (15 cm) deep and can be expected to last less than 3 weeks under normal conditions. Type I ponds are important to the ground survey for the purpose of monitoring specific habitat condition changes that cannot be readily measured by the aerial crew. In cases where ponds join because of high water levels, the ponds are recorded as one pond and are noted as such on the data forms.

Additionally, pond water level data can be gathered in a qualitative manner by the ground crew. A system for doing this was developed by Millar in 1980. For this system he defined a <u>basin</u> as the total physical depression capable of holding water and a <u>wetland</u> as the portion of the

basin which contains any wetland vegetation. He further defined specific water level as follows:

Stage 1 DRY- surface water has disappeared completely due to seepage, evaporation, or drainage.

Stage 2 VESTIGIAL - water occurs only as small pools or puddles within the central vegetative zone of the wetland and can be expected to dry up within a matter of days.

Stage 3 RECESSIONAL - water levels have receded within the central zone but still cover a fairly extensive area. In Open Water type of wetlands there is a drawdown mudflat between the water edge and the emergent vegetation. In Emergent Deep marshes and Shallow marshes, a fairly wide band of the central zone is DRY.

Stage 4 INTERMEDIATE - in Open Deep marshes and Shallow Open Water wetlands, the central open water zone is completely flooded and the water extends into the inner edge of the emergent vegetation. In Emergent Deep marshes and Shallow marshes, the water extends throughout most of the central zone.

Stage 5 FULL - the wetland is filled to the outer limit of the wet meadow zone.

Stage 6 FLOODED - water has spilled out of the wetland proper and floods the upland vegetative communities in the basin.

Stage 7 OVERFLOWING - water is at full supply level (FSL) of the basin and is spilling over. FSL can vary greatly from basin to basin. In some basins it is at the level of the outer edge of the wet meadow zone and in others FSL is so high that it will never be attained (e.g. terminal wetlands).

Stage 8 DUGOUT-RECESSIONAL - water has receded well below the rim of the dugout.

Stage 9 DUGOUT-FULL - water level is at or close to the rim of the dugout.

Pond and waterfowl data collected by the ground crew for each water area include the following:

(1) pond number--designated from potential basins when the transects were established.

(2) pond type (Shaw and Fredine 1956).

(3) water level (Millar 1980).

(4) margin width--the area extending up to 33 feet (10 m) beyond the outer edge of the wet meadow zone.

(5) type and percentage of impaction to wetland basin (burned - autumn or spring, cultivated, drained, filled, grazed, hayed, or impacted by construction)--the basin is defined as that area from the center of the wetland to the outer edge of the wet meadow zone.

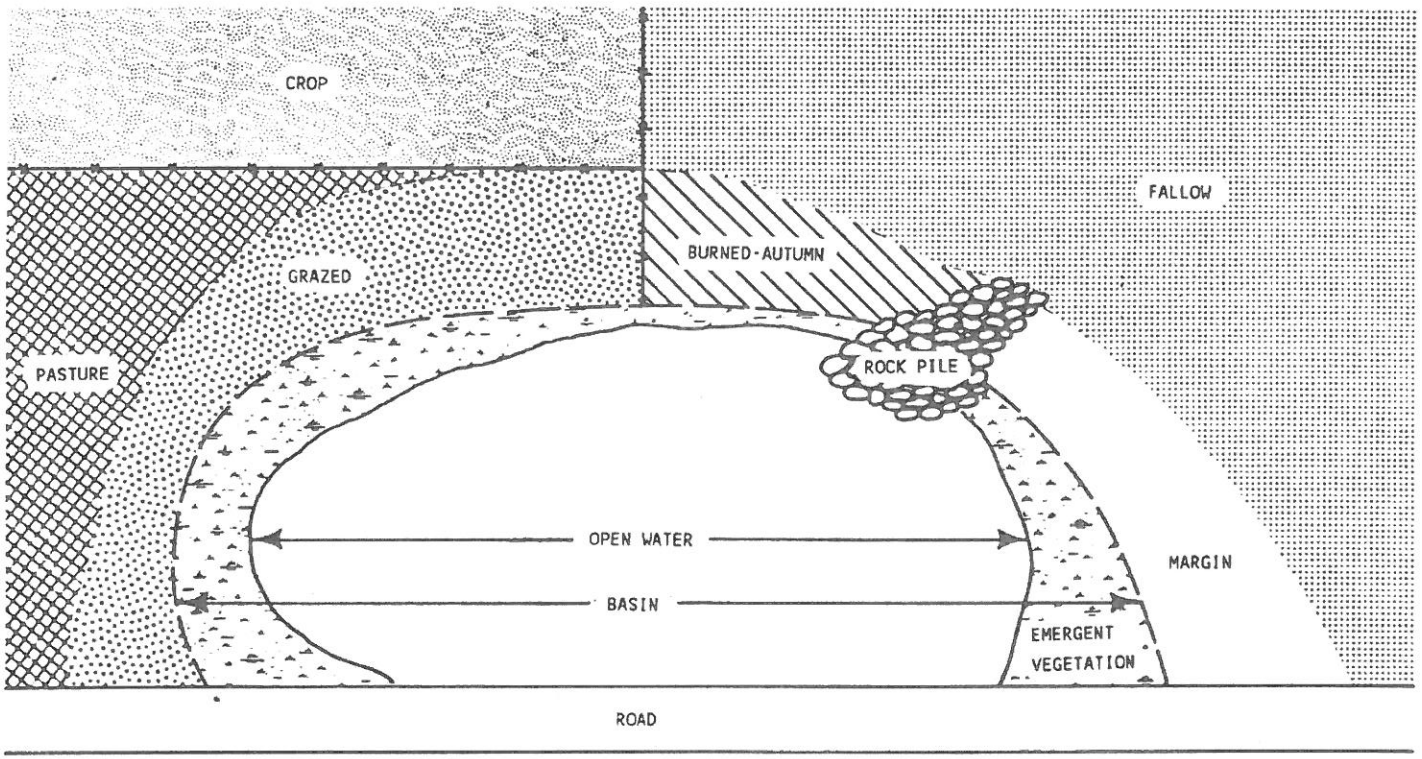
(6) type and percentage of impaction to wetland margin (burned - autumn or spring, cultivated, cleared, grazed, hayed, or impacted by construction).

(7) type and percentage of impaction to the uplands (crop, fallow, grassland, hayland, pasture, stubble, or woodland)--the upland is defined as the area contiguous with the margin.

Note: Fig. 6 provides a sample diagram of various types of wetland impacts as discussed in items 5, 6, and 7 above.

(8) the number of lone drakes, certain lone hens (redhead, scaups, ring-necked duck, and ruddy duck), flocked drakes, pairs, and grouped waterfowl of each species observed.

The starting and finishing time and certain weather data are recorded for each segment. These data are entered on the Air-Ground Comparison Segment--Ground Crew Field Data Form and the Ground Crew Summary Form (Exhibits 14 and 15).



Wetlands						
Pond No.	Pond Type	Water Level	Margin Width	Impaction (%/type)		
				Basin	Margin	Uplands
1	5	3	8	5F 20I	50G 20BA	40P 10C 50F

Figure 6. Wetland impaction diagram .

The original Field Data Forms and Summary Forms are delivered to the Flyway Biologist in charge of the reporting unit at the completion of the ground survey. These data become part of the Waterfowl Breeding Population and Habitat Survey Report for that reporting unit.

C. Data Adjustment

1. Prairies: Data collected by the ground and aerial survey crews are entered on the Air-Ground Visibility Rate Calculation Form (Exhibit 5) to calculate the visibility rate for each species. It is necessary to combine air-ground segment data from all strata within a crew area to develop reliable visibility rates for each specific crew area. This pooling of data is necessary to reduce the variance associated with small sample sizes. The following table lists all prairie crew areas and strata in the first and second columns and strata used for adjustment purposes in the third column:

Table 2. Strata used for adjustment of data by crew area on air-ground segments.

Crew areas	For stratum	Combine air-ground data from strata
Prairie		
Southern Alberta	26	26-29
	27	26-29
	28	26-29
	29	26-29
Southern Saskatchewan	30	30-33
	31	30-33
	32	30-33
	33	30-33
Southern Manitoba	34	34-40
	35	34-40
	36	34-40
	37	34-40
	38	34-40
	39	34-40
	40	34-40
Montana	41	41-44
	42	41-44
	43	41-44
	44	41-44
North and South Dakota	45	45-49
	46	45-49
	47	45-49
	48	45-49
	49	45-49

When the current year's calculated visibility rate for a particular species falls within the specified range (Exhibit 12), the current year's rate is used; when the current year's calculated visibility rate for a particular species falls outside the specified range (Exhibit 12), the long-term average crew area visibility rate is used in calculating the species index. In such cases, the substituted visibility rate is entered on the Air-Ground Visibility Rate Calculation Form as well as the Stratum Summary Form with appropriate footnotes. The long-term average species visibility correction factors developed in the combined prairie crew areas are always used for American black duck, goldeneyes, bufflehead, oldsquaw, eiders, scoters, and mergansers, as these species are rarely sampled in sufficient numbers during any given survey. Table 5 (Exhibit 5) of the survey unit report is the Air-Ground Visibility Rate Calculation Form and contains the current year's air-ground data along with any appropriately noted exceptions.

In preparing the Waterfowl Breeding Population and Habitat Stratum Summary Forms and the Air-Ground Comparison Segment--Ground Crew Summary Forms, lone and flocked drake redheads, scaups, ring-necked ducks, and ruddy ducks are multiplied by 1 to determine total indicated birds, rather than by doubling as is done for all other species. This procedure is used because these species are known to be late nesters and have significant disproportionate sex ratios leaning heavily towards males. Similarly, lone hens of these species observed by the ground crew are multiplied by 1 on the Ground Crew Summary Form.

In strata 34 through 40, ground crews have demonstrated that an positive relationship exists between mallard visibility rates and pond densities. To correct for this phenomenon, an adjusted mallard visibility rate is used in these strata. The method of calculating this rate was derived from work done by Bowden (1973) and is presented in Exhibit 16. This phenomenon has not been consistently demonstrated for any other species or in any other crew area.

2. Bush: As previously indicated, the average species visibility correction factors developed in the prairie crew areas over the history of the survey are applied in the bush crew areas. Work is continuing to develop more appropriate visibility rates in all bush units.

D. Data Analysis

Field Data Forms designed for the prairie crew areas and bush crew areas are used to tabulate waterfowl and water data for each segment, transect, and stratum. Data collected for each stratum are summarized on the Waterfowl Breeding Population and Habitat Survey Stratum Summary Form (Exhibit 17). Each stratum expansion factor is determined by dividing the total area (mi^2) in the stratum design by the total (mi^2) sampled within the stratum (current year). This factor is then used as a multiplier in obtaining the expanded waterfowl and pond indices. Waterfowl and pond visibility rates obtained from the Air-Ground Visibility Rate Calculation Form (Exhibit 5) are an integral part of the calculation on the Stratum Summary Form to obtain the adjusted waterfowl population and pond estimates. A copy of the Stratum Summary Form for each stratum becomes a part of the survey report and follows Table 7 (Exhibit 7).

In the prairies, a lone drake index (LDI) is used as a relative measure of the nesting season progress at the time of the survey. The survey is conducted at the most appropriate time when the LDI is highest for a given breeding season. A low LDI would indicate an early or late survey or even a poor nesting effort regardless of survey timing. A low LDI in conjunction with a detectable bird movement would suggest the survey was early. In contrast, a low LDI in conjunction with an unusually large number of post-breeding drake aggregations consisting of 4 or more birds would suggest the survey was late. Irregular weather patterns may complicate the interpretation. There are several species which do not exhibit synchronous nesting, regardless of the season; therefore, only certain species are used in deriving this index. Since the mallard, northern pintail, and canvasback normally begin to nest in early May and their numbers are comparatively high, the determination of the LDI is based on these species only. The method used to calculate lone drake indices is presented in Exhibit 18. Table 3 (Exhibit 3) of the survey unit report contains these data for the current and all previous years of record. These data are not tabulated for the bush units.

Flyway Biologists conducting surveys in Canada cooperatively analyze and interpret the field survey data with the Population Management Biologist, CWS, and

provide copies of all pertinent data before leaving Canada. The data are made available to the CWS as soon as possible after survey completion because of the importance of these data for the development of annual Canadian waterfowl regulations in early June.

E. Segment Data Form

The Waterfowl Breeding Population and Habitat Survey-Segment Data Form (Exhibit 19) is used to provide data for entry in the FWS primary computer. The form is completed following the tabulation of the data for each day's flight. Transcribing errors are greatly reduced by the observer and the pilot-observer auditing each other's work.

F. Survey Design

The survey design and the coverage of the current year's survey is presented in Table 7 (Exhibit 7). The first set of data presents the survey as it was designed by stratum including the area (mi^2) in each stratum, the area (mi^2) in the sample (both waterfowl and ponds), the number of linear miles in the sample, the number of transects in the sample, the number of segments in the sample, and the expansion factor. The second set of data is the current year's survey coverage. If the current survey is incomplete or has been modified, the second set of data will reflect these changes. The narrative section of the report explains the reasons for any omissions or changes.

G. Reports

1. Mid-May Habitat Conditions Report: During mid-survey, the Flyway Biologist in charge of each crew area contacts the Assistant Branch Chief-Surveys, by telephone, and provides a report regarding general habitat conditions including spring weather, and other events that "set the stage" for the survey since the previous summer (i.e. climatological, land-use changes), surface water abundance and relative water levels, soil moisture, timing of snow and ice disappearance, quality and timing of run-off, relative availability and quality of both upland and overwater nesting cover, phenology of vegetation, impact of agricultural practices, nesting chronology, overall production potential, and other pertinent information. This report is due on 15 May for prairie units and 25

May for bush units. A one-page report reflecting these observations is mailed at the time this information is called in. Attached to this is a roughed-out map of the survey unit including pertinent notes based on reconnaissance flights and survey observations made prior to the mid-survey reporting date. Express Mail is used for this purpose whenever possible.

2. Waterfowl Breeding Population and Habitat Survey Report: The Waterfowl Breeding Population and Habitat Survey Report is prepared using the following outline and suggested minimum text material.

COVER SHEET: The following statement is used--"The data presented in this report are preliminary and subject to further auditing. Final estimates will be available from the U.S. Fish and Wildlife Service, Migratory Bird Management Office, Patuxent Wildlife Research Center, Laurel, Maryland 20708."

TITLE: Waterfowl Breeding Population and Habitat Survey for (insert unit title)

STRATA SURVEYED: (insert strata numbers)

DATES: __-__ May 19__

DATA SUPPLIED BY: United States Fish and Wildlife Service and Canadian Wildlife Service (include CWS only for surveys conducted in southern Alberta, southern Saskatachewan, and southern Manitoba).

Air Crew
- Pilot-Observer (insert name, affiliation, and title)
- Observer (insert name, affiliation, and title)

Ground Crew
- Crew Leader (insert name, affiliation, and title)
- Assistants (insert names, affiliations, and titles)

ABSTRACT: A concise summary of weather and habitat conditions, the May pond estimates, lone drake indices, and breeding population estimates for the more numerous and important species is presented showing changes from the previous year, the previous 10-year mean, and the long-term mean. A brief statement is provided on the

overall waterfowl status in the reporting unit compared to previous years.

METHODS: A statement similar to the following begins this section of the report: "The procedures followed in conducting this survey are contained in the Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys in North America, Section III, revised 1987." Any deviation from these procedures or changes in aerial or ground coverage is explained in detail.

WEATHER AND HABITAT CONDITIONS: This section of the report expands on the Mid-May Habitat Conditions Report and updates these comments. Reference is made to Table 6 (Exhibit 6) which contains weather data from representative weather stations within the reporting unit from the previous summer through the survey period. The results of the adjusted pond counts compared to the previous year, the previous 10-year mean, and the long-term mean as presented in Table 4 (Exhibit 4) are also discussed in this section of the prairie unit reports.

BREEDING POPULATION ESTIMATES: Waterfowl breeding population status based upon the estimates contained in Tables 1 and 2 (Exhibits 1 and 2) is discussed in detail, and comparisons are made between the current year and the previous year, the previous 10-year mean, and the long-term mean estimates. Suspected reasons for any changes are discussed.

LONE DRAKE INDEX: The current year's figures, as well as all previous years of record, are presented in Table 3 (Exhibit 3) and their implications in interpreting the nesting season chronology and survey timing are discussed in the prairie unit reports.

CONCLUSIONS: Based on weather, habitat conditions, breeding population estimates, and other available information, the anticipated recruitment within the reporting unit is discussed.

TABLES: The following titles are used for the tables included in each survey unit report. The bush unit reports do not include tables on the lone-drake index, May ponds, and air-ground visibility rates.

1. Table 1. Long-term trend in waterfowl breeding population estimates by species in (reporting unit), 19__-__. (Exhibit 1)

2. Table 2. Status of waterfowl breeding population estimates by species and stratum in (reporting unit), comparing 19__ with 19__ , the 19__-19__ previous 10-year mean, and the 19__-19__ long-term mean. (Exhibit 2)

3. Table 3. Lone drake index: long-term trend expressed as a percentage of total drakes in (reporting unit), 19__-19__. (Exhibit 3)

4. Table 4. Long-term trend in May pond estimates by stratum in (reporting unit), comparing 19__ with 19__, the 19__-19__ previous 10-year mean, and the 19__-19__ long-term mean.(Exhibit 4)

5. Table 5. Air-ground visibility rate calculation for ducks, coots, and ponds for (reporting unit) in strata __-__, May 19__. (Exhibit 5)

6. Table 6. Precipitation summaries for selected reporting stations in (reporting unit), September 19__ through May 19__. (Exhibit 6)

7. Table 7. Survey design for (reporting unit), May 19__. (Exhibit 7)

One copy of the Waterfowl Breeding Population and Habitat Survey - Stratum Summary Form (Exhibit 17) for each stratum becomes a part of the survey unit report and will follow Table 7.

The Segment Data Forms and originals of all supporting Field Data Forms, Field Data Form (stratum summaries), Ground Crew Field Data Forms and Air-Ground Comparison Segment--Ground Crew Summary Forms are submitted directly to the Assistant Branch Chief-Surveys, immediately upon return of the Flyway Biologist to the field station after the survey is completed. Express Mail is used for this purpose whenever possible. Reference is made to the appendix for report addressees and distribution. This report and all supporting data are due on 10 June for prairie units and 20 June for bush units.

Table 1. Long-term trend in waterfowl breeding population estimates by species in Southern Duckland, 1955-85 (estimates in thousands)[a]

Species	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Ducks											
Dabblers											
Mallard	2,443.1	3,026.5	2,866.8	1,911.4	2,237.2	2,138.8	1,504.6	1,944.4	1,713.7	1,412.1	1,232.9
Am. black duck	1.1	.0	.0	.0	.7	.0	.0	.0	.0	.0	.0
Gadwall	753.5	721.9	600.8	532.9	695.5	474.5	409.5	619.7	573.2	460.4	588.4
Am. wigeon	817.5	664.6	460.6	641.5	812.8	610.4	332.2	594.5	675.0	366.7	453.4
Green-winged teal	311.0	321.9	222.3	302.1	463.7	276.6	185.3	269.8	255.8	131.4	237.4
Blue-winged teal	2,622.7	1,799.6	1,631.3	902.4	1,482.8	1,307.2	1,110.1	818.2	963.2	874.9	1,327.3
N. shoveler	730.3	823.0	422.7	426.6	692.4	494.8	333.8	699.1	792.8	352.7	670.9
N. pintail	2,050.3	2,549.5	672.5	961.7	1,580.0	897.5	526.2	1,222.1	1,029.3	542.1	520.6
Subtotal	9,729.5	9,907.0	6,877.0	5,678.6	7,965.1	6,199.8	4,401.7	6,167.8	6,003.0	4,140.3	5,030.9
Divers											
Redhead	288.6	270.5	227.6	184.1	227.9	323.0	213.3	123.9	233.4	306.9	326.8
Canvasback	305.7	283.3	253.5	128.9	280.9	221.0	111.1	181.1	212.7	166.6	118.8
Scaups	622.0	495.0	702.2	526.1	796.5	629.0	277.1	498.2	844.8	549.2	328.2
Ring-necked duck	62.1	49.1	45.0	51.8	54.0	63.9	47.2	80.5	25.1	48.0	24.7
Goldeneyes	18.4	18.0	73.1	15.8	40.2	33.1	22.8	23.4	18.3	17.1	30.5
Bufflehead	62.0	33.5	52.5	58.1	61.8	34.8	40.0	33.5	52.2	38.5	36.9
Ruddy duck	114.8	97.3	122.7	68.1	134.5	77.1	76.6	301.2	149.9	88.5	163.7
Subtotal	1,473.6	1,246.7	1,476.6	1,032.9	1,595.8	1,381.9	788.1	1,241.8	1,536.4	1,214.8	1,029.6
Miscellaneous											
Oldsquaw	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Eiders	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Scoters	8.6	1.3	5.1	3.2	15.1	2.1	.6	4.0	3.0	3.7	3.2
Mergansers	4.7	3.4	2.1	4.1	8.2	4.3	9.2	2.2	3.7	11.2	1.2
Subtotal	13.3	4.7	7.2	7.3	23.3	6.4	9.8	6.2	6.7	14.9	4.4
Total ducks	11,216.4	11,158.4	8,360.8	6,718.8	9,584.2	7,588.1	5,199.6	7,415.8	7,546.1	5,370.0	6,064.9
Canada goose	8.7	12.9	9.3	12.6	15.3	15.9	21.5	22.6	30.7	33.0	32.7
Am. coot	1,177.4	1,513.0	440.0	433.6	1,309.1	634.3	395.1	282.8	673.4	566.7	662.8

[a]Adjusted for visibility bias.

Table 1 (continued). Long-term trend in waterfowl breeding population estimates by species in Southern Duckland, 1955-85 (estimates in thousands)[a]

Species	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Ducks										
Dabblers										
Mallard	1,104.1	1,965.6	2,015.8	2,119.9	2,164.1	2,938.3	3,401.5	2,670.9	2,367.0	2,079.5
Am. black duck	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0
Gadwall	506.6	677.9	469.2	689.7	556.9	524.4	637.1	572.9	334.0	626.9
Am. wigeon	774.8	845.1	690.1	584.4	787.1	812.1	914.3	673.1	1,050.6	751.2
Green-winged teal	126.6	273.0	373.6	215.7	521.0	439.2	390.0	243.8	313.0	303.7
Blue-winged teal	1,070.0	1,496.7	1,395.7	862.4	1,034.0	2,160.5	1,917.8	1,819.7	1,842.8	1,520.9
N. shoveler	308.1	843.6	793.6	485.9	750.4	760.8	907.7	922.0	538.4	705.2
N. pintail	716.6	1,595.4	1,671.0	774.4	1,956.1	2,417.2	2,222.1	2,261.6	1,006.3	2,186.1
Subtotal	4,606.8	7,697.3	7,409.0	5,732.4	7,769.6	10,052.5	10,391.2	9,164.0	7,452.1	8,173.5
Divers										
Redhead	90.5	149.5	213.1	69.2	210.6	189.3	279.6	138.1	179.2	179.0
Canvasback	111.3	112.9	148.7	91.0	197.0	255.4	191.8	137.7	229.0	181.7
Scaups	155.2	185.6	316.4	189.4	306.5	323.0	221.7	239.2	223.0	377.9
Ring-necked duck	26.7	18.5	12.0	1.7	7.5	16.1	8.3	9.8	9.6	49.1
Goldeneyes	9.9	11.8	16.2	25.4	9.8	17.5	16.0	5.1	23.3	15.7
Bufflehead	33.3	20.0	25.9	43.7	56.1	28.9	18.4	48.1	25.3	26.9
Ruddy duck	48.4	83.3	77.7	87.2	58.6	52.1	76.0	97.8	153.5	131.1
Subtotal	475.3	581.6	810.0	507.6	846.1	882.3	811.8	675.8	842.9	961.4
Miscellaneous										
Oldsquaw	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Eiders	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Scoters	10.0	3.1	2.4	7.5	4.4	.6	6.2	3.0	5.7	2.7
Mergansers	3.3	.0	.0	.6	.9	5.5	.8	.0	1.4	.3
Subtotal	13.3	3.1	2.4	8.1	5.3	6.1	7.0	3.0	7.1	3.0
Total ducks	5,095.4	8,282.0	8,221.4	6,248.1	8,621.0	10,940.9	11,210.0	9,842.8	8,302.1	9,137.9
Canada goose	2.5	3.2	1.6	1.0	5.3	4.1	8.8	10.0	6.5	8.7
Am. coot	254.4	333.3	357.9	450.7	407.5	900.7	963.1	569.7	931.9	1,088.6

[a]Adjusted for visibility bias.

Table 1 (continued). Long-term trend in waterfowl breeding population estimates by species in Southern Duckland, 1955-85 (estimates in thousands)[a]

Species	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Ducks										
Dabblers										
Mallard	3,948.4	5,339.8	4,518.6	5,066.4	2,192.1	3,287.7	1,650.4	1,133.6	1,552.5	1,379.1
Am. black duck	.8	.0	1.9	.0	.0	.0	.0	.0	.0	.0
Gadwall	366.8	436.9	390.9	144.6	185.0	237.1	717.8	632.0	307.5	408.7
Am. wigeon	997.7	1,460.4	859.4	1,113.4	571.9	598.2	453.8	760.0	505.9	488.2
Green-winged teal	430.1	574.4	316.3	238.1	142.4	245.6	412.1	199.2	207.7	201.8
Blue-winged teal	2,758.2	3,428.6	2,528.0	1,891.7	1,247.8	1,337.3	1,223.1	674.6	459.9	1,022.1
N. shoveler	809.2	1,037.3	757.4	396.9	302.2	720.6	482.5	426.8	199.2	375.3
N. pintail	4,113.3	5,105.7	2,700.5	1,556.9	645.2	1,418.7	846.6	596.7	835.2	853.4
Subtotal	13,424.4	17,383.1	12,073.0	10,408.0	5,286.6	7,845.2	5,786.3	4,422.9	4,067.9	4,728.6
Divers										
Redhead	225.8	470.8	280.2	150.9	115.1	140.3	57.2	157.6	36.3	84.5
Canvasback	240.7	362.1	330.5	234.2	76.0	107.7	99.9	166.9	87.2	121.6
Scaups	723.9	1,074.1	757.0	440.0	577.3	409.1	673.2	324.3	153.6	133.5
Ring-necked duck	31.4	19.4	12.6	13.4	31.8	15.9	9.6	.0	24.0	11.2
Goldeneyes	13.3	23.9	19.9	11.0	15.0	24.1	11.9	8.7	4.4	2.9
Bufflehead	11.1	13.4	22.2	10.1	13.7	19.4	12.4	2.9	17.4	19.3
Ruddy duck	155.8	330.2	158.1	72.4	269.4	133.1	80.9	67.3	40.3	37.6
Subtotal	1,402.0	2,293.9	1,580.5	932.0	1,098.3	849.6	945.1	727.7	363.2	410.6
Miscellaneous										
Oldsquaw	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Elders	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Scoters	6.5	16.2	1.0	12.0	5.8	6.6	3.1	.0	4.6	7.1
Mergansers	.3	.0	.0	.0	.3	7.2	1.7	.0	6.0	1.5
Subtotal	6.8	16.2	1.0	12.0	6.1	13.8	4.8	.0	10.6	8.6
Total ducks	14,833.3	19,693.2	13,654.5	11,352.0	6,391.0	8,708.6	6,736.2	5,150.6	4,441.7	5,147.8
Canada goose	-	-	-	-	1.8	2.6	2.5	2.5	3.6	3.2
Am. coot	1,265.3	2,104.6	1,503.3	448.2	489.4	383.5	211.0	252.5	109.4	202.0

[a]Adjusted for visibility bias.

Table 2. Status of waterfowl breeding population estimates by species and stratum in Southern Duckland, comparing 1985 with 1984, the 1975-1984 previous 10-year mean, and the 1955-1984 long-term mean (estimates in thousands).[a]

Species	Stratum (1985)						1985 Total	1984 Total	10-Year Mean	Long-Term Mean	Percent Change from		
	30	31	32	33	34	35					1984	10-Year Mean	Long-Term Mean
Ducks													
Dabblers													
Mallard													
Am. black duck													
Gadwall													
Am. wigeon													
Green-winged teal													
Blue-winged teal													
N. shoveler													
N. pintail													
Subtotal													
Divers													
Redhead													
Canvasback													
Scaups													
Ring-necked duck													
Goldeneyes													
Bufflehead													
Ruddy duck													
Subtotal													
Miscellaneous													
Oldsquaw													
Eiders													
Scoters													
Mergansers													
Subtotal													
Total ducks													
Canada goose													
Am. coot													

(NOTE: This table provided for format only. Data will be supplied at a later date.)

[a] Adjusted for visibility bias.

Table 3. Lone drake index: long-term trend expressed as a percentage of total drakes in Southern Duckland, 1956-1985.[a]

Year	Mallard	Pintail	Canvasback	Total
1956	76.44	82.68	63.21	78.46
1957	83.49	85.97	75.44	83.83
1958	79.38	81.33	73.68	79.55
1959	74.58	69.44	46.39	72.96
1960	85.92	82.47	71.57	84.65
1961	73.90	69.94	44.97	71.90
1962	51.66	36.35	39.83	47.32
1963	82.81	82.92	77.77	82.59
1964	85.21	82.32	65.64	83.47
1965	82.11	83.69	68.02	81.77
1966	81.75	82.66	77.57	82.98
1967	86.80	82.13	56.50	83.80
1968	80.24	75.50	47.65	77.88
1969	88.37	85.10	64.14	85.92
1970	82.10	78.28	65.35	79.60
1971	79.33	76.58	64.68	77.62
1972	81.14	78.24	60.52	79.12
1973	78.85	74.25	42.26	75.02
1974	85.75	79.60	76.59	82.42
1975	83.06	74.88	72.78	79.08
1976	78.52	78.68	74.02	78.23
1977	69.62	62.99	41.93	65.54
1978	83.78	79.50	61.05	80.91
1979	81.30	77.87	63.50	78.85
1980	77.46	75.73	57.12	75.64
1981	75.68	71.78	46.04	73.37
1982	82.18	75.04	49.94	78.25
1983	75.04	73.80	65.77	73.97
1984	76.63	77.43	60.21	75.30
1985	78.04	73.44	78.30	77.03
10-year mean (1975-84)	78.33	74.77	59.24	75.91
Long-term mean (1956-84)	79.37	76.35	61.75	77.57

[a]Unadjusted for visibility bias.

Table 4. Long-term trend in May pond estimates by stratum in Southern Duckland, comparing 1985 with 1984, the 1975-1984 previous 10-year mean, and the 1961-1984 long-term mean (estimates in thousands).[a]

Year	Stratum 30	31	32	33	34	35	Total
1955[b]	525.7	884.7	958.5	213.4	1,198.8	733.1	4,474.2
1956[b]	315.9	414.9	729.4	103.2	746.9	452.6	2,762.8
1957[b]	164.1	399.3	344.2	72.9	636.2	299.4	1,916.1
1958[b]	210.0	319.0	367.8	108.2	466.8	344.1	1,815.9
1959[b]	57.5	218.7	159.9	79.4	169.0	77.4	761.9
1960[b]	166.2	692.6	394.8	90.0	487.4	270.3	2,101.4
1961	142.2	219.4	252.2	80.3	67.5	48.0	809.6
1962	176.8	422.8	343.1	49.8	291.3	64.8	1,348.6
1963	144.7	198.1	268.4	43.2	230.9	125.3	1,010.6
1964	203.3	369.1	333.1	66.8	493.7	403.7	1,869.7
1965	327.9	439.9	610.1	112.2	442.1	337.6	2,269.8
1966	350.8	587.3	595.1	133.0	593.7	404.9	2,664.8
1967	282.3	642.1	688.8	194.9	545.1	299.0	2,652.2
1968	219.5	312.6	383.4	61.8	123.5	58.5	1,159.3
1969	383.2	465.5	774.7	138.7	267.1	179.6	2,208.8
1970	289.6	628.7	763.8	106.8	721.3	518.1	3,028.3
1971	302.5	418.3	509.2	123.8	608.6	391.7	2,354.1
1972	356.5	659.8	364.7	64.5	552.2	306.2	2,303.9
1973	259.3	453.5	317.6	83.3	227.6	117.0	2,458.3
1974	465.6	910.9	822.0	133.8	945.4	462.1	3,739.8
1975	395.2	806.1	785.2	192.8	821.4	401.3	3,402.0
1976	201.9	398.9	553.3	96.9	657.1	671.5	2,579.6
1977	176.0	254.7	265.5	44.6	338.7	170.3	1,249.8
1978	274.0	393.5	566.1	161.7	545.4	280.7	2,221.4
1979	433.3	697.4	660.0	130.2	667.7	481.1	3,069.7
1980	265.5	311.3	358.2	48.1	273.3	137.2	1,393.6
1981	145.9	160.4	126.1	28.5	97.3	52.6	610.8
1982	284.0	630.6	705.3	119.3	251.5	213.8	2,204.5
1983	384.9	715.5	712.0	96.0	464.6	323.4	2,696.4
1984	283.1	548.4	267.0	35.2	250.6	127.0	1,511.3
1985	622.9	737.8	723.6	108.1	558.5	207.1	2,958.0
10-year mean	284.4	491.7	499.9	95.3	436.8	285.9	2,094.0
Long-term mean	281.2	485.2	501.0	97.8	436.6	274.0	2,117.4
Percent Change							
1985 from 1984	+120	+ 35	+171	+207	+123	+ 63	+ 96
1985 from the 10-year mean	+119	+ 50	+ 45	+ 13	+ 28	- 28	+ 41
1985 from the long-term mean[c]	+122	+ 52	+ 44	+ 11	+ 28	- 24	+ 40

[a] Adjusted for visibility bias.
[b] 1955-1960 unadjusted for visibility bias.
[c] Long-term mean utilizes only the years of comparable data (adjusted for visibility bias).

Table 5. Air-ground visibility rate calculation for ducks, coots, and ponds for Southern Duckland in strata 30-33 May 1985

WATERFOWL BREEDING POPULATION AND HABITAT SURVEY--AIR-GROUND VISIBILITY RATE CALCULATION FORM

Province/State: S. Duckland | Strata: 30-33 | May 6-23, 1985 | Sheet 4 of 4

Segment	Kinistino		Ceylon		Goodwater		Dummer						30-33 Total		30-33 SOP	
Species	G/A	Rate	G/A	Rate	G/A	Rate	G/A	Rate	G/A	Rate	G/A	Rate	G/A	Rate	G/A	Rate
Mallard	76		22		22		50						772			
	42		4		20		24						414	1.8647		
Am. black duck																4.8000
Gadwall	14		32		6		56						344			
	6		2		2		16						90	3.8222		
Am. wigeon	18		14		2		16						228			
	2						4						38	6.0000		
G.W. teal	10		2										96			
	2												22	4.3636		
B.W. teal	56		14		10		34						768			
	14		4		4		6						142	6.4085		
N.shoveler	32		4		10		18						460			
	12		2				6						162	2.8395		
N.pintail	14		12		6		24						537			
	4		6		4		8						252	2.1310		
Redhead	13						28						175			
	1						12						23	7.6087		
Canvasback	8				4		18						89			
	6						10						70	1.2714		
Scaups	16		2		2		131						303			
	15						65						137	2.2117		
Ring-necked duck													8			
													2	4.0000		3.9363
Goldeneyes													0			
													0	--		5.5000
Bufflehead							2						16			
													2	8.0000		2.7000
Ruddy duck	1						17						102			
													19	5.3684		7.5382
Oldsquaw																6.5000
Eiders																6.0000
Scoters													0			
													0	--		1.3000
Mergansers													0			
													0	--		2.0000
TOTAL																
Am. coot	77				14		25						532			
	6				2		12						112	4.7500		
Ponds	214		44		50		67						2,168			
	200		44		48		62						2,098	1.0334		

Form 5

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Table 6. Precipitation summaries for selected reporting stations in Southern Duckland, September 1984 through May 1985.[a]

	9/1/84 to 10/31/84		11/1/84 to 3/31/85		4/1/85 to 5/22/85		9/1/84 to 5/22/85			
Station	Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Difference	Percent Change
N. Battleford	113.8	41.5	87.4	90.6	124.4	44.0	325.6	176.1	+149.5	+84.9
Saskatoon	116.8	49.1	65.8	87.9	113.6	45.1	296.2	182.1	+114.1	+62.7
Prince Albert	147.8	61.1	105.3	89.6	90.1	47.9	343.2	198.6	+144.6	+72.8
Hudson Bay	153.8	79.3	90.8	113.2	41.8	51.0	286.4	243.5	+ 42.9	+17.6
Wynyard	153.6	64.4	89.2	100.9	87.4	48.8	330.2	214.1	+116.1	+54.2
Kindersley	91.7	40.4	59.1	79.8	92.0	48.7	242.8	168.9	+ 73.9	+43.8
Swift Current	81.5	52.2	83.3	94.2	40.0	54.1	204.8	200.5	+ 4.3	+ 2.1
Moose Jaw	87.8	54.1	81.3	89.7	67.8	60.0	236.9	203.8	+ 33.1	+16.2
Yorkton	155.1	69.4	116.0	109.9	53.2	49.7	324.3	229.0	+ 95.3	+41.6
Regina	83.6	55.6	73.1	81.0	84.6	49.8	241.3	186.4	+ 54.9	+29.5
Broadview	146.0	75.5	80.9	76.8	43.2	66.5	270.1	218.8	+ 51.3	+23.4
Estevan	79.0	65.4	59.2	91.5	39.7	69.6	177.9	226.5	- 48.6	-21.5

[a]Data obtained from Environment Canada (all precipitation in millimeters).

Table 7. Survey design for Southern Duckland, May 1985.

	Stratum						
	30	31	32	33	34	35	Total
Survey design							
Square miles in stratum	18,570	21,086	37,911	11,345	13,164	9,044	111,120
Square miles in sample-waterfowl	162	144	571.5	90	175.5	126	1,269
Square miles in sample-ponds	81	72	285.75	45	87.75	63	634.5
Linear miles in sample	648	576	2,286	360	702	504	5,076
Number of transects in sample	4	5	14	6	5	6	40
Number of segments in sample	36	32	127	20	39	28	282
Expansion factor	114.630	146.431	66.336	126.056	75.009	71.778	87.565
Current year coverage							
Square miles in sample-waterfowl	162	144	571.5	90	175.5	126	1,269
Square miles in sample-ponds	81	72	285.75	45	87.75	63	634.5
Linear miles in sample	648	576	2,286	360	702	504	5,076
Number of transects in sample	4	5	14	6	5	6	40
Number of segments in sample	36	32	127	20	39	28	282
Expansion factor	114.630	146.431	66.336	126.056	75.009	71.778	87.565

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EXHIBIT 8

III-34

WATERFOWL BREEDING POPULATION AND HABITAT SURVEY, THE PRAIRIES--AERIAL CREW FIELD DATA FORM

Province/State: S. Duckland | Stratum: 31 | Transect: 17 | Pilot-Observer: J. Mallard | Observer: M. Pintail | Sheet 1 of 1

May 20, 1985 | Wind: SE | Speed: 10 | Sky: ⊕

Notes	Time & Segment	Mal	Blk	Gad	Wig	GWT	BWT	Shr	Pin	Red	Can	Scp	Rng	Gld	Buf	Rud	Old	Edr	Scr	Mer		TOTAL		Coot		CG	Water Nat	Water Art
49°F shot-Tail last enemy light	1308	14|2|5		1	1	4|3	4|2	1				1			3|						26	10				85	4
	3	PP [5]		P	P	PPP	PP					P										5						
S-15	1320	24|9|5		2		1|1	1|2	6|2	7|3	4|	3|3	4									48	27	PII (9)		III 5|	130	8
	4	PPPPPPPPP [5]		PP		P	PP	PP	PPP	P	PP	PPPP										5						
⊕	1332	8|7		2			1|1	5|1|5	3|2	1|2	4|6	3|5			1|4						31	21	IPHH (8)		II 2|1	125	2
	5	PPPPPP		PP			P	P [5]	PP	PP	[6]	PPPP			P							11			P			
SE-15	1344	4|4		1	1		3|1	2|2	4												14	8	I (1)			75	1
	6	PPPP		P	P		P	PP																				
	1354	12|6					2|3	3|3	4|1	1	1|5	1|5	1								22	20	IPIIII (7)		I 1|2	124	2
	7	PPPPPP					PPP	PPP	P	P	[5]	PPPPP	P									5				PP		
SE-10	1408	6|7		3|4	1|1		1|6	2|2	5	1	5|2	8|5			2|2						44	29	IIP5P GII (19)			166	1
	9 1420	PPPPPP		PPPP	P		PPPPP	PP	P	P	PP	PPPP				PP												
		80|35|10		3|10	2|2	5|4	12|15	19|10|5	27|6	6|4	12|5|11	12|20	1		3|1	4|2					185	115	44		6|3	705	18
	Total																						26						

Form 1

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