Calvin J. Lensink

Danielle Jerr...

Preliminary Report

WATERFOWL POPULATIONS AND PRODUCTION WITHIN THE IMPOUNDMENT AREA OF THE PROPOSED DAM AT RAMPART ON THE YUKON RIVER, ALASKA IN 1961

By

Calvin J. Lensink

Section of Waterfowl Population Studies
Migratory Bird Population Station
Bureau of Sport Fisheries and Wildlife
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INTRODUCTION

Construction of the proposed dam in Rampart Canyon of the Yukon River will cause the innundation of the major waterfowl breeding area in interior Alaska. The primary objective of this project is to evaluate the ultimate effect upon the waterfowl population if the dam is constructed. This report is a summary of the results from the first season of a 4 year study.

Estimates of annual waterfowl production in arctic and subarctic habitats have depended primarily on aerial surveys of the breeding population. Such estimates are relatively imprecise because of errors caused by differences in observers, aircraft, habitat, and natural visibility factors, but furthermore are not suited to the present problem because they are designed to assess trends or changes in production rather than to estimate production in absolute numbers. Thus, to evaluate the effect of flooding the Rampart impoundment area upon waterfowl populations, it is first necessary to devise satisfactory techniques for censusing the population. Other fundamental problems also must be answered. We need to know something about the carrying capacity of the habitat, and the ecological factors affecting waterfowl production in the arctic and subarctic. Will ducks that are displaced from the Yukon Flats be able to move to other areas such as Minto or Tetlin Lakes and to nest there successfully? We also need information on the migration patterns, winter distribution, and harvest rates of waterfowl from the Rampart area, because the migration of the waterfowl population results in a continental distribution and interest.

General Description of the Area

The Yukon Flats cover approximately 10,000 square miles of typical lowland taiga or muskeg that is dotted by more than 20,000 lakes and ponds of diverse origin, size, and drainage. Most of these lakes and ponds were formed by the meandering of the Yukon River and several of its tributaries: from the north, the Black, Chandalar, Christian, and Porcupine rivers, which drain the southern slopes of Brooks Range; and from the south, Beaver and Birch Creeks, which drain the northern slopes of the White and Crazy Mountains. Of lesser importance are the lakes formed in natural reservoirs among the foothills of the mountains which surround the Flats.

The lakes vary greatly in size and general characteristics, but nearly all are relatively shallow or have extensive shallow areas which support a luxuriant growth of aquatic vegetation. The vegetation, although abundant, in most lakes is of a type which indicates only moderate fertility. Most waters are stained brown, and are slightly acid as a result of organic decomposition. However, the relative fertility of lakes may occasionally vary so markedly, that lake types can frequently be distinguish from the air.

Shorelines of many lakes and sloughs during periods of high water are bordered by willows or alder, but at normal or low levels most are surrounded by wide meadows of various grasses, sedges, and horsetails. The climax vegetation of the Yukon Flats is a spruce-birch forest, but numerous fires have reduced vast areas to a seral stage consisting primarily of aspen, balsam poplar, and willow.

The climate is continental with winters relatively long and cold, and summers short and hot. Fort Yukon, just north of the Arctic Circle and centrally located on the Flats, has recorded temperatures of -76° F. and 100° F.---the greatest range of temperature for any community in Alaska. The breakup of ice on the Yukon River has occurred as early as May 6 and as late as May 22 with a mean breakup date of May 14. Precipitation is low, averaging only 6.93 inches annually. July and August with average rainfall of only 1.00 and 1.23 inches respectively, are the two wettest months. Such scant precipitation would result in desert conditions in a more temporate climate, but in the subarctic is sufficient to maintain lakes at relatively stable levels, and droughts which result in serious loss of waterfowl habitat are unknown.

Previous Studies

Initial studies of waterfowl on the Yukon Flats were conducted by Calvin J. Lensink with an Indian assistant in 1953 and Eugene J. Rueter as assistant in 1954. Rueter and Kenneth Hughes continued the studies in 1955 and Hughes and George W. Cornwell in 1956. During this period, emphasis was on banding, but field seasons were begun sufficiently early to permit estimations of breeding population density, to make observations of nesting and early broods, and to follow the phenology of nesting and moult among adults and hatching and development of young. These studies were limited to transportation by riverboat and canoe, and thus sampled a relatively small portion of the Flats---all in the vicinity of Fort Yukon.

In 1960 Jay N. Eisenhart conducted similar studies on Beaver Creek. Also in 1960 Game Management Agent James G. King initiated a much enlarged banding program which was continued through 1961. Bandings since 1953 are summarized in Table 1. Hansen (Annual Waterfowl Report: Alaska, 1956) has summarized the results of the various studies, which are therefore not discussed in detail here.

In addition to the above studies, the Yukon Flats have been included in the annual spring aerial surveys of the breeding population since 1952. These surveys have been standardized since 1957 on 20 transect routes of 16 miles length. These provide a rough estimate of relative population size and trend.

Procedures

Field operations in this first year of study were designed to explore the relative efficiency of ground sampling procedures----particularly as such sampling is affected by isolation of sampling areas and the limitations of air transportation.

Sample areas for intensive study were selected by forming grids at four mile intervals within an area of 3,200 square miles for which aerial transects of past years had indicated an average population index ~~density~~ of 20-30 ducks per square mile. Twenty areas were then selected systematically from a random start. Actual sampling, however, was conducted on only eight areas which were selected by taking alternate areas from the original group; omitting those areas which fell immediately adjacent to an area already sampled.

All ground sampling relative to population density was conducted on square plots formed by the central four square miles of each area. Data were recorded by lake or other water body so that smaller sampling units could be selected from each plot.

Aerial transects were flown on four north-south lines located at one mile intervals on the sample areas. The area sampled by air transects was equal to that of the ground plots, but sampled only 25 percent of that area also sampled by ground surveys. All air surveys were conducted from a Cessna 180 in the same manner as standard aerial surveys of breeding populations in Alaska. Game Management Agent James G. King served as pilot on all transects and Calvin J. Lensink and Jay N. Eisenhart as observers. Ground observations were made by Lensink and Eisenhart.

Waterfowl observations were recorded in narrative form to permit the greatest flexibility in analysis. General information regarding water levels, source of water supply, character of the shoreline etc. were noted for each lake. Permanent bench marks were established on one or more lakes in each area.

Three complete censuses of waterfowl were conducted on each of the study plots: (1) census of the breeding population from May 24 to June 7, (2) census of broods from early nesting species from July 16 to 31, and (3) census of broods from late nesting species from August 9 to 21. New broods on the second census for species which were encountered on the first brood census were identified by classifying to age according to the method described by Gollop and Marshall (1954). Intervals between censuses were used to examine the study areas of previous years.

General Characteristics of the Season

Waterfowl arrived on the Yukon Flats on schedule with first pintail and mallard migrants in late April and all others before mid May.

The breakup period of the Yukon River was abnormally extended over several days with high water peaking on May 18, four days later than the average for 11 years.

First broods were only a few days later than in normal seasons, but the hatching period seemed prolonged and was perhaps indicative of unsuccessful early nesting.

Lakes which are subject to annual flooding from the Yukon or its tributaries remained unusually high long into the summer, but water levels in lakes and ponds dependent on spring runoff from their own basins continued to decline, and many which contained water in 1952 and 1953 are now dry. Both of the two areas studied intensively in previous seasons had fewer ducks than before because of changed water levels----the Nuntraget area because of drought and the Beaver Creek area because of flooding. Habitat conditions were generally satisfactory, however, and local losses in numbers of ducks such as on Nuntraget or Beaver Creek are the result of redistribution on the Flats rather than a general decrease in the population.

Results of Surveys

Breeding Population Surveys. All waterfowl destined to breed on the Yukon Flats were believed to be present when surveys were begun on May 24, although snow geese and old squaw ducks, which are not residents, continued to pass through in small numbers until at least that time. Because passage birds of resident species can not be identified from residents, it is not certain whether initial surveys are biased by their presence. However, with the possible exception of the lesser scaup, it is believed that the breeding population was stabilized.

Results of the breeding population ground survey on the eight sample plots are summarized in Table 2. A total of 2964 ducks was tallied; this number including 755 pairs, 100 females, not accompanied by males, 1215 unpaired males and 139 with sex not identified. The estimated total of males in the population was 2064. The number of males on sample plots varied from 139 to 359 with a mean density of 258.0 males per plot or 64.5 per square mile with a standard error of 12.7 percent of the mean (Table 3).

Results of the experimental air surveys are summarized in Table 4. A total of 704 ducks was counted with the number of drakes in the sample areas varying from 3 to 67 with a mean area density of 50.8 and a standard error 14.7 percent of the mean (Table 5). The relationship between air and ground surveys was generally poor in respect to both density and species composition.

Brood Surveys. Results of brood surveys are summarized in tables 6 and 7. A total of 371 broods was observed on the first survey conducted between July 16 and 31, and 176 on the second survey conducted between August 12 and 21, when many of the early broods were already fledged. The estimated total of different broods observed was 430 of which 86.3 percent were observed on the first survey. The mean density of broods per plot was 53.8 or an average of 13.45 per square mile with a standard error of 16.4 percent of the mean. Average brood size (Class I and II young with all species combined) was 6.04 for a total of 545 broods. Following discussions of brood sizes, development etc., also include observations of broods from areas other than the survey plots. The over-all total of broods observed was 787 of which 728 were classified to age and 545 by number of young.

Species Composition

Breeding Population. The most reliable estimate of species composition in the breeding population is based on ground counts of adult drakes, because there is no time at which pairs or females of all species are equally available for observation. Drake counts indicated that pintail, scaup, and widgeon were the most important species in the order named (Table 2). The proportion of pintail and scaup was not appreciably different than the proportion observed in 1954, but a decrease of 11.7 percent for widgeon may indicate a significant change in composition. The species of lesser importance such as canvasback, mallard, shoveler, and green-winged teal appear to have increased slightly in relation to the three dominant species (Table 8). Although the sampling techniques used in 1954 were different and less reliable than those of 1961, the differences in composition are in some cases relatively large and may be significant. They are probably the result of population increases rather than a marked decrease in any species. A possible cause for the changes in composition could be in the influx of displaced prairie ducks which from Saskatchewan and Alberta would largely be composed of species other than widgeon.

Broods. Species composition of broods was quite different from that of drakes with widgeon, scaup, green-winged teal and pintail dominant in the order named----the reverse to drake composition for these species (Table 8). The differences may be caused partly by variation in the accuracy that broods of different species can be censused, but are considered to be primarily the result of differences between species in the sex ratio of the breeding population and in reproductive success. Thus, widgeon, scaup, and green-winged teal broods are censused more accurately than pintail which would tend to cause under estimation of pintail broods, but data of Bellrose et al. (1961:415) indicate that spring sex ratios of pintail are much disturbed in favor of males (59.4 percent) as compared to widgeon (52.6 percent), (See also Table 9 in this report). This characteristic in itself could result in the lower proportion of pintail broods than drakes in the population. However, the change in composition between drakes and broods can also be a reflection of relative differences in reproductive success between species. The late spring of 1961 could be expected to affect pintails more adversely than most other species because of the pintails early nesting habits. A similar situation was indicated by composition estimates of 1954, another late spring, but not nearly so strongly by composition figures of 1953 which was an early spring.

Sex Ratios

Sex ratios of adults are given by five day intervals for the period of May 22 to June 25 in Table 9. In all species, for which an adequate sample was obtained, there was a significant imbalance in favor of males. For scaup, canvasback, scoters, shovelers, green-winged teal, and perhaps widgeon, our observations were sufficiently early to eliminate most bias resulting from the absence of nesting females in the counts, but not for pintails and mallards, which were nesting before surveys were begun.

Sex ratios obtained after the initiation of incubation suggest that there were more non-nesting or deserter females among scaup, pintails, and mallards than among widgeon, shovelers, and teal for which males exceeded 90 percent of total observations for some periods. Reproductive success for the species listed above followed the same rank as the predominance of male observations except for mallard (high) and shoveler (low) for which the sample for the sex ratio was very small. However, sex ratios must be obtained both earlier and later in the season, and for a much larger sample if we are to attach much significance to changes in sex ratios as indicators of reproductive success.

Reproductive Success

The two measures of reproductive success available with present survey techniques are the ratio of broods to drakes or breeding pairs, and the average size of broods. Because estimates of the number of breeding pairs are subject to considerably greater error and bias than estimates of total males the ratio of broods to drakes in the breeding population is favored. Both ratios are provided in the estimates of reproductive success in Table 10, but for the present data, little confidence should be placed on estimates of breeding pairs.

Green-winged teal, widgeon, and mallard in the order named were the most successful species. Nesting success of shovelers and canvasback, for which sex ratios were much in favor of males, seemed low when estimated from the number of drakes, as compared to scaup for which the observed sex ratio was not as extreme. Success of pintails at only 10.2 percent of drakes and 16.9 percent of pairs was lowest of any species except scoters. The difficulty in censusing pintail broods has been mentioned previously, but as the indicated success was less than a third of 1953 and only slightly more than half that of 1954 there seems little doubt that the majority of pintail nesting attempts met with failure. This failure of pintail nesting may have been caused by the late spring, and possibly by the presence of displaced birds from the Prairie Provinces. The displaced birds would be expected to consist of a high proportion of pintails, which also had the poorest reproductive success, and it seems not unreasonable to assume that birds shifted from their normal range to more severe habitat with phenological events much delayed, would tend to exhibit poor reproductive success, as a result of the disturbance in their reproductive cycle.

Variation of brood sizes between species followed the general pattern of previous years with shoveler, green-winged teal, scaup, and widgeon tending to have larger broods than canvasback and pintail (Table 10). The sizes of broods for all species combined averaged slightly less than the mean size for the years 1953 to 1956 and 1960 with 217 Class I broods having a mean size of 6.72 and Class II broods having a mean size of 6.04.

Table 9 compares average brood sizes for all species combined and for pintail, widgeon, and scaup which are early, middle, and late nesting species respectively, with the date of the breakup of the Yukon River at Fort Yukon for a period of 6 years. The breakup date of the Yukon River appears to represent a fair summation of spring phenological conditions as breakup is affected not only by spring temperatures, but by winter temperatures and snowfall. During the three years with early breakup (1953, 1956, and 1960) broods averaged .9 ducklings larger than in the years with late breakup (1954, 1955, and 1961). The differences for scaup and pintail are significant ($p = .05$) but not for widgeon. For all species combined the probability that the difference between early and late seasons could be due to chance was less than .01. As indicated previously, the ratio of broods to drakes suggests also that fewer broods are produced in years with late springs. Although a late spring seems to affect pintails, which are an early nesting species, most severely, even late nesting species appear to produce fewer broods.

Population Estimates

Population estimates for the Yukon Flats are summarized separately for the two major density strata (III and IV) which cover nearly all of the important waterfowl habitat. Population estimates for Stratum IV with a total area of 3,200 square miles were made by extrapolation of the mean densities of the eight experimental census plots. Drake counts were doubled to provide an estimate for hens which are missed on surveys during the nesting season. Total broods were converted to total young by multiplying by the mean number of young in Class II broods. Mortality of young beyond this age was assumed to be negligible. Population estimates for Stratum III are based on six random transects totaling 12 square miles flown in this stratum by Hansen during standard breeding pair surveys. The totals of these transects were corrected to ground density with a factor derived from the ratio of air to ground densities on the experimental ground surveys and 14 aerial transects flown by Hansen in Stratum IV during standard breeding pair surveys. Species composition and reproductive success were assumed to be the same in Stratum III as Stratum IV. With the small sample and rather poor estimate of the correction factor for air surveys, the estimate for Stratum III can not be considered much more than a slightly educated guess.

Reasonably adequate confidence limits can be placed on estimates for Stratum IV (error in estimates of average brood size are assumed negligible), but crude limits which consider only the variance of the aerial transects are given for Stratum III. Despite the lack of precision of the confidence limits, it is probably safe to assume that the true population is somewhat above the lower limits, perhaps near the actual estimates, because counts of both adults and broods, but particularly broods, are biased so that estimates would tend to be too low. Thus, with conditions as outlined above, 90 percent limits for the population estimates given in Tables 12 and 13 are summarized below.

	Estimate	Upper and Lower Limits
Adults		
Stratum III	246,000	59,000 - 433,000
Stratum IV	413,000	307,000 - 508,000
	659,000	366,000 - 941,000
Young		
Stratum III	156,000	53,000 - 259,000
Stratum IV	260,000	179,000 - 340,000
	416,000	232,000 - 599,000
Total Fall Population	1,075,000	598,000 -1,540,000

Perhaps the greatest source of error in the above estimates is in the assumption of an even sex ratio in the breeding population. The estimate for the number of adults in the population is reduced by approximately 20 percent if the number of females in the population is assumed to be that indicated by prenesting sex ratios. This would suggest a fall population of approximately 943,000 ducks.

Winter Distribution

The distribution of 186 band returns from 2292 ducks banded prior to 1956 suggests that about 81 percent of the ducks from the Yukon Flats migrate to States of the Pacific Flyway, 16 percent to the Central and Mississippi Flyways, and 3 percent to the Atlantic Flyway. The results of banding in 1960 and 1961 will be largely available before completion of this study and will provide more precise information on the migration and winter distribution of the population.

Evaluation of Survey Methods

The Mechanics of Ground Surveys. Ground surveys of waterfowl populations have been conducted on many previous occasions, and the concensus of observers is that the results of ground surveys provide reasonably accurate estimate of actual populations. It was therefore assumed that surveys providing comparable results could be conducted in the Yukon Flats. The chief problem, thus became one of determining the feasibility of air transportation for reaching randomly selected plots. Our experience in conducting the present survey suggest that air transport is usually feasible and that nearly all plots could be reached with relatively little difficulty. However, if ground surveys were extended to areas where lakes are less numerous or were unevenly distributed (as in Stratum III) it is likely that many plots could be reached only with major effort. Under such conditions, where we might also expect increased variability in samples, ground surveys, if limited to air transportation, would probably not be feasible.

A Cessna 180 equipped with floats was used in all 1961 operations. This aircraft generally proved adequate, although the survey could probably be more efficiently conducted with Super Cubs which have better performance under marginal landing and take-off situations, and have lower operating cost. Use of Super Cubs, however, would be feasible only if one of the ground survey crew of two men, could also serve as pilot.

The chief difficulty encountered with use of air transportation was that of adequately covering ground plots when a boat or canoe could not be transported to the plot. Thus, plots with rivers or creeks which could not be easily forded, and lakes with floating or brushy shorelines, required relatively more effort to census than plots without such characteristics. In such situations, however, the census results were perhaps not seriously affected. Emergent vegetation is relatively scant on the Yukon Flats and when present is usually restricted to a narrow shoreline zone. For this reason, counts of adult waterfowl were considered to have been seriously reduced by the presence of emergent vegetation on only one of the 135 lakes which existed on the eight study plots. The proportion of broods missed in emergent vegetation was probably somewhat higher than that of adults.

Precision of Surveys. The standard errors computed for the surveys of eight experimental plots were 12.7 percent of the mean for ground census of the breeding population, 14.7 percent for aerial census of the breeding population and 16.4 percent for the census of broods. Estimates for the number of aerial transects or ground survey plots required to provide population estimates that fall within ± 20 percent of the mean at a probability level of 95 percent are given in Table 14. Estimates for ground survey plots of smaller size than used in 1961 are also provided. It may be observed that the precision of air and ground surveys does not differ seriously, but that the number of plots required for a given degree of precision increases rapidly as the size of plots decreases. Because of the large increase in precision of plots of four square miles over those of one to three square miles, and the comparatively slight decrease in cost for surveying the smaller plots, the relative efficiency is highest for the larger plots. Plots of larger size than four square miles would probably further reduce the variance, but too few could be examined to adequately sample the various types of habitats extant on the Yukon Flats.

Table 15 compares the standard errors of aerial surveys in Stratum IV for a five year period and for one and two observers (in effect, sample areas with a ratio of 1:2). The results of the comparison suggest that the precision of survey has tended to increase as the population increased and that increasing the area covered by a transect also results in increased precision. In all surveys since 1957 observer No. 1, H. A. Hansen, has been constant. The second observer, however, has varied each year, thus introducing an uncertain bias. In evaluating the results from a limited series of transects it may at times be preferable to ignore the bias from the second observer in favor of higher precision so obtained. However, if observers vary widely, bias may be considerable and should not be ignored. Thus, in Table 16 in which annual difference in populations from 1957-1961 are compared. The results for observer No. 1 indicate a significant increase in the population from 1957 to 1958, but if data from observer No. 2 is included, the results suggest a small population decrease. The conflicting results appear to be caused entirely from bias resulting from differences in effectiveness of the second observers. Thus, if possible, results from various observers should be weighted for calculation of population estimates. In as much as observers are consistent in their counts, and appropriate weights are applied to them, the magnitude of estimates should not be seriously affected.

Comparison of Ground and Air Surveys

The ratio of air to ground counts, all species combined, obtained during the experimentals surveys was .197 with a standard error of 31 percent. The correlation coefficient (r) of air on ground surveys was only .522 which is not significant. The imprecision of the ratio estimate and the low correlation coefficient suggest a poorly defined relationship between air and ground counts. However, the poor correlation is probably caused primarily by inadequate sampling techniques and the true relationship may be much better than the data indicate. The sampling techniques used to obtain present data resulted in air and ground counts which did not sample the same parts of the population because (1) air and ground survey areas overlapped by only 25 percent, and (2) the high mobility of waterfowl results in shifting of populations, and thus, a change of unknown magnitude of the population surveyed by the two methods. Although the above factors decrease the precision of estimates, it is not likely that they cause serious bias.

The mechanical limitations of sampling waterfowl populations with existing conditions precludes revision of techniques to completely define the population. However, some improvement in precision can be obtained by: (1) increasing sample size, (2) increasing size of sampled areas, (3) revision of aerial transects to increase overlap of areas censused from the ground and air, and (4) replicate sampling to obtain a measure of population shifting caused by mobility of waterfowl. Of these possibilities, those which will provide greatest gain per unit of effort appear to be increasing the sample size, revision of air transects, and replication of aerial surveys. Estimates of sample size required for satisfactory limits on ratio estimates fall within the range of those cited previously (Table 14) for population estimates. Aerial transects may be revised with replication for relatively small increase in cost, but increasing the size of areas censused on the ground or extensive replication of ground censuses, would probably not result in as much gain in precision or other useful data as increasing the sample size.

Comments relative to variance or sample size cited above apply only to total counts and do not reflect differences between species. In general, much larger samples would be required to obtain a given precision if species are considered individually, than if they are combined. Thus, for ratio estimates of the proportion of the population seen from the air (Table 17), only widgeon and mallard estimates had lower standard errors than the ratio for all species combined. Observations of several species which are relatively scarce, or of others with low visibility from the air, were to few to determine satisfactory ratio estimates. The differences in a species tendency to form flocks and the mobility of these flocks, seems also to be reflected in the relative magnitude of the variance for ratio estimates.

Other Species

The various censuses of waterfowl populations permitted extensive observation of other birds, and several mammals. For most species observations were too few or recording of observations too incomplete to permit precise estimates of populations. Estimates for populations of cranes and moose are provided in Tables 18 and 19. Totals given in both cases include observations from the three ground surveys with elimination of all observations for which duplicate counts of an individual could have occurred.

Probably most cranes on the study plots were observed during the three surveys as counts on given plots were generally similar on repeated censusing. The total population indicated by ground surveys was about 4,900 cranes. This compares to estimated populations of only 500 using counts on the experimental air surveys and of 250 on the standard air surveys conducted by Hansen in 1961. This suggests that population estimates based on air surveys must be corrected by a multiplication factor of 10 to 15.

Estimates of the moose population are undoubtedly ultra conservative, as it is not likely that more than a small fraction of the moose present were observed. The observed sex ratio of 12 animals yearling or older was

50:50 although the sex ratio varied widely on different plots. Correction of the population estimate in Table 19 for an even sex on each plot would suggest a population of about 1,800 moose.

Moose sign (trails, droppings, browse utilization) indicated relatively low densities on plots, 18 and 26, both in the vicinity of Fort Yukon, a moderate density on plot 33 and a high density in all other areas.

Observations of arctic, common, and red-throated loons, and of beavers or beaver cuttings suggest that reasonably accurate population estimates for these species can also be obtained in conjunction with the waterfowl surveys. Census of these species, however, was not attempted in 1961.

SUMMARY

The construction of a dam on the Yukon River at Rampart Canyon will cause the innundation of the major waterfowl breeding area in interior Alaska. The primary objective of this project is to evaluate the ultimate effect upon the waterfowl population if the proposed dam is constructed. The foregoing report is a summary of results from the first season of a four year study.

A total of eight plots, each of four square miles, was censused from the ground and from the air to provide estimates of the size of the breeding population and the number of broods produced.

The adult population was estimated to be approximately 659,000 and the number of young to be 416,000 for a total fall population of more than 1,000,000 waterfowl.

A late spring resulted in an average brood size that was one duckling smaller than for broods in years with early springs. Nesting success seemed also to be adversely affected, and the total loss to production attributed to the late spring was 15 to 25 percent.

Habitat conditions on the Yukon Flats are relatively stable as compared to prairie habitats, and significant losses to production because of drougth or other factors causing changes in the habitat are unknown.

Pintail, lesser scaup, and widgeon, in the order named, were the most important species in the breeding population, but production of broods was highest for widgeon, scaup, green-winged teal, and pintail. Other important species include mallard, shoveler, and canvasback.

Drougth in the Prairie Provinces of Canada has apparently caused a movement of ducks to northern areas. The influx of displaced waterfowl is most noticeable for blue-winged teal and redheads, which were not previously resident on the Flats, but was believed to include a significant number of ducks of other species. The nesting success of displaced waterfowl was not believed to be as high as among normal residents.

Sample areas of four square miles were demonstrated to be of more efficient than those smaller size. However, even for plots of four square miles, it will be necessary to survey at least 18 plots for breeding pairs and 29 plots for broods in order to provide population estimates of $\pm$ 20 percent at a probability level of .05. Ratio estimates for comparing air and surveys require approximately the same number of sample areas if all species are combined. A total of 25 sample plots is recommended for surveys of both breeding pairs and broods.

The waterfowl surveys have also yielded much information on other species including loons, cranes, beavers and moose. Survey totals indicate populations of at about 4,900 cranes and at least 1,300 moose in the 3,200 square mile area in Stratum IV.

Table 1. Waterfowl Banded on the Yukon Flats, 1953 - 1961.

Species	1953 Loc	1953 Ad	1954 Loc	1954 Ad	1955 Loc	1955 Ad	1956 Loc	1956 Ad	1960 Loc	1960 Ad	1961 Loc	1961 Ad	Totals
Lesser Scaup	138	7	115	15	3	1	2		62	1936	282	5446	8,007
Greater Scaup										9		31	40
Canvasback	23		11		8		4			23	49	262	380
Redhead										9	14	86	109
Scoter			37		2				49	19	131	116	354
Bufflehead			16		7				2	285	1	898	1,209
Goldeneye			4	1	1				7	1412	6	1350	2,781
Widgeon	166	7	151	20	105	1	50		39	887	218	1813	3,457
Pintail	58	5	47	7	22	1	16	1	5	186	40	394	782
Mallard	36	1	45	2	18		1	1	10	6	2	4	126
Shoveler	50		40		17		7	4	1	48	2	171	340
Green-winged Teal	10	2	24	3	22		6		1	3	7	18	96
Blue-winged Teal											2	72	74
Totals	481	22	490	48	205	3	86	6	176	4823	754	10661	17,755

Table 2. Sex and Species Composition of Ducks Observed During Ground Surveys of the Breeding Population.

Species	Pairs	Total Identified Females	Total Identified Males	Sex Unidentified	Estimated Total Males	Percent Composition
Lesser Scaup	281	284	421	60	453	22.1
Canvasback	37	47	129	0	129	6.1
Redhead	5	5	5	0	5	.4
Scoter	105	106	164	72	216	10.5
Bufflehead	15	18	24	0	24	1.2
Goldeneye	3	4	6	0	6	.3
Old Squaw	2	3	3	0	3	.1
Widgeon	98	100	303	0	303	14.8
Pintail	74	131	492	0	492	24.0
Mallard	52	67	143	0	145	7.0
Shoveler	51	54	168	7	175	8.5
Green-winged Teal	31	35	111	0	111	4.9
Blue-winged Teal	1	1	2	0	2	.1
Totals	755	855	1970	139	2064	100.0

Table 3. Observations of Drakes by Sample Plot During Ground Surveys of the Breeding Population.

	Drakes per Plot								
	18	26	33	60	67	96	103	131	Total
Lesser Scaup	57	62	49	32	51	62	125	15	453
Canvasback	38	20	1	15	1	34	16	4	129
Redhead	2	1	0	0	0	1	1	0	5
Scoter	17	20	47	11	48	41	28	4	216
Bufflehead	6	5	3	3	0	3	1	3	24
Goldeneye	4	2	0	0	0	0	0	0	6
Old Squaw	3	0	0	0	0	0	0	0	3
Widgeon	28	76	31	26	11	53	58	20	303
Pintail	56	63	19	169	11	52	71	51	492
Mallard	22	28	6	12	12	28	18	19	145
Shoveler	17	9	5	49	7	55	15	18	175
Green-winged Teal	19	21	7	15	5	13	27	4	111
Blue-winged Teal	1	0	0	0	0	1	0	0	2
	270	307	168	332	146	343	359	139	2064

Mean plot density - - - - - - 258.0
Standard error - - - - - - - - 32.8
Drakes per square mile ------ 64.5

For pre-nesting sex ratios of 1962
Total ♀♀ would be 1270

Table 4. Sex and Species Composition of Ducks Observed During Air Surveys of the Breeding Population.

Species	Pairs	Females	Males	Sex Unknown	Total Males	Percent Composition
Lesser Scaup	117	117	156	10	162	39.8
Canvasback	6	6	11	0	11	2.7
Redhead	0	0	0	0	0	0
Scoter	21	21	21	65	55	13.5
Bufflehead	2	2	4	0	4	.9
Goldeneye	0	0	1	0	1	.2
Old Squaw	0	0	0	0	0	0
Widgeon	19	19	25	7	30	7.3
Pintail	19	19	30	0	30	7.3
Mallard	12	12	30	0	30	7.3
Shoveler	3	3	8	0	8	1.9
Green-winged Teal	1	1	1	3	4	.9
Blue-winged Teal	0	0	0	0	0	0
Unidentified	9	9	10	113	72	17.6
Totals	209	209	297	198	407	99.4

Table 5. Observations of Drakes by Sample Area During Air Surveys of the Breeding Population.

	Drakes per Sample Area								Totals	
	18	26	33	60	67	96	103	131		
Lesser Scaup	29	24	22	20	18	20	28	1	162	+ 34
Canvasback	6	0	0	2	3	0	0	0	11	+ 2
Redhead	0	0	0	0	0	0	0	0	0	
Scoter	4	20	1	11	7	6	6	0	55	+ 12
Bufflehead	0	0	3	1	0	0	0	0	4	+ 1
Goldeneye	0	1	0	0	0	0	0	0	1	
Old Squaw	0	0	0	0	0	0	0	0	0	
Widgeon	3	4	5	3	5	4	5	1	30	+ 6
Pintail	4	1	2	5	13	4	0	1	30	+ 6
Mallard	2	6	6	6	1	5	4	0	30	+ 6
Shoveler	3	1	0	2	1	0	1	0	8	+ 2
Green-winged Teal	1	0	0	1	1	1	0	0	4	+ 1
Blue-winged Teal	0	0	0	0	0	0	0	0	0	
Undentified	9	10	4	8	16	9	16	0	72	
Totals	61	67	43	59	65	49	60	3	407	

Mean plot density - - - - - - - - - 50.875
Standard error - - - - - - - - - - 7.40
Drakes per square mile - - - - - 12.7

Table 6. Brood Observations by Sample Plots

Species	1	2	3	4	5	6	7	8	Total	Percent Composition
	Broods per Plot									
	18	26	33	60	67	96	103	131		
Lesser Scaup	5	8	10	13	9	15	22	1	83	19.3
Canvasback	3	0	0	3	1	4	7	0	18	4.2
Redhead	0	0	0	0	0	0	0	0	0	0
Scoter	0	1	3	0	5	7	5	3	24	5.6
Bufflehead	2	2	2	0	1	0	0	1	8	1.9
Goldeneye	2	2	0	1	0	0	0	0	5	1.2
Old Squaw	0	0	0	0	0	0	0	0	0	0
Widgeon	11	35	6	7	5	22	13	4	103	24.0
Pintail	12	14	3	6	3	2	5	5	50	11.6
Mallard	3	8	4	7	4	5	2	2	35	8.1
Shoveler	4	7	3	5	0	8	5	1	33	7.8
Green-winged Teal	13	17	4	12	2	11	7	2	68	15.8
Blue-winged Teal	0	0	0	0	0	0	0	0	0	0
Unidentified	0	0	0	0	3	0	0	0	3	.7
Total	55	94	35	54	33	74	66	19	430	100.2

Mean plot density - - - - - - - - - 53.8
Standard error - - - - - - - - - - 8.76
Mean density per square mile - - 13.45

Table 7. Average Brood Sizes, Yukon Flats, 1961.

Species	Class I		Class II		Class III	
	No.	Av. Size	No.	Av. Size	No.	Ave. Size
Lesser Scaup	76	6.80	41	6.20	-	-
Canvasback	18	6.33	15	5.33	2	4.50
Scoter	14	7.21	22	5.27	-	-
Bufflehead	5	7.40	14	5.29	1	5.00
Goldeneye	1	11.00	5	6.00	2	7.00
Widgeon	62	6.71	84	6.18	9	5.89
Pintail	10	6.00	14	5.50	19	5.26
Mallard	10	6.30	21	5.95	4	5.50
Shoveler	6	6.67	28	6.79	7	6.29
Green-winged Teal	15	6.60	29	6.34	11	6.82
All Species	217	6.72	273	6.04	55	5.85

Table 8. Comparison of Species Composition Estimates of the Breeding Population and of Broods in 1954 and 1961.

	Percent Composition 1/			
	Drakes		Broods	
Species	1954	1961	1954	1961
Lesser Scaup	25.5	22.1	20.0	19.3
Canvasback	3.0	6.1	2.9	4.2
Redhead	0	.4	0	0
Scoter	0	10.5	1.1	5.6
Bufflehead	1.8	1.2	1.4	1.9
Goldeneye	1.1	.3	2.0	1.2
Old Squaw	0	.1	0	0
Widgeon	26.5	14.8	32.5	24.0
Pintail	28.5	24.0	18.2	11.6
Mallard	7.2	7.0	8.5	8.1
Shoveler	4.4	8.5	5.9	7.8
Green-winged Teal	1.6	4.9	7.5	15.8
Blue-winged Teal	0	.1	0	0
Totals	99.6	100.0	100.0	99.5

1/ Estimates based on total of 1084 drakes and 490 broods in 1954, and 2064 drakes and 430 broods in 1961.

Table 9. Sex Ratios in Breeding Population by Five Day Periods.

	5/22-26	5/27-31	6/1-5	6/6-10	6/11-15	6/16-20 2/	6/21-25	6/26-30
Scaup								
No. ♂♂:♀♀	119:89	178:138	234:149	71:38#	148:61	31:7*	13:3	
% ♂♂	57.2	56.3	61.1	65.1	70.8	81.6	81.2	
Canvasback								
No. ♂♂:♀♀	65:29#	59:26	55:23*	1:1	37:10	17:2	-	
% ♂♂	69.1	69.4	70.5	-	78.7	89.5	-	
Redhead								
No. ♂♂:♀♀	2:2	1:1	2:2	-	-	-	-	
% ♂♂	-	-	-	-	-	-	-	
Scoter								
No. ♂♂:♀♀	34:22	124:93	51:23	49:39	76:63#	10:10	-*	
% ♂♂	64.7	57.1	68.9	55.7	54.7	50.0	-	
Bufflehead								
No. ♂♂:♀♀	14:7	10:10	12:7	10:8	32:11	1:2	-	
% ♂♂	66.7	50.0	63.2	55.6	74.4	-	-	
Goldeneye								
No. ♂♂:♀♀	8:6	3:0	2:2	0:1	1:6	-	-	
% ♂♂	57.1	-	-	-	-	-	-	
Old Squaw								
No. ♂♂:♀♀	23:19	-	-	-	-	-	-	
% ♂♂	54.7	-	-	-	-	-	-	
Widgeon								
No. ♂♂:♀♀	84:63	146:80*	180:45	73:36 1/	159:34	106:9	41:17	
% ♂♂	57.1	64.6	80.0	67.0	82.4	92.2	70.7	

The same decrease occurred in 1942.

Table 9. (cont"d)

	5/22-26	5/27-31	6/1-5	6/6-10	6/11-15	6/16-20 2/	6/21-25	6/26-30
Pintail								
No. ♂♂:♀♀	147:41	307:88	364:82	19:6	88:26	149:48	-	
% ♂♂	78.2	77.7	81.6	76.0	77.2	79.7	-	
Mallard								
No. ♂♂:♀♀	80:33*	84:39	77:28	7:8	33:9	59:19	-	
% ♂♂	70.8	68.3	73.3	46.7	78.6	75.6	-	
Shoveler								
No. ♂♂:♀♀	37:30#	126:51	84:22*	6:3	37:7	21:2	-	
% ♂♂	55.2	71.2	79.2	-	84.1	91.3	-	
Green-winged Teal								
No. ♂♂:♀♀	37:22#	62:31	67:15*	7:3	39:7	12:1	-	
% ♂♂	62.7	66.7	81.7	70.0	84.8	92.3	-	
Blue-winged Teal								
No. ♂♂:♀♀	-	2:1	1:1	-	3:2	-	-	
% ♂♂	-	-	-	-	-	-	-	

Approximate start of nesting (#) and start of incubation (*).

1/ Widgeon % ♂ low for this date because of bias of count on Beaver Creek where pairs are frequent but not flocks of drakes which are in lakes.

2/ Observations for 6/16-20 may be biased by failure to list some large flocks of moulters which would be mostly males.

Table 10. Estimates of Reproductive Success

Species	Broods	Broods/ Drakes	Broods/ Pairs	Average Size 1/ Class I & II Broods
Scaup	83	.183	.275	6.20
Canvasback	18	.140	.346	5.33
Scoter	24	.111	.160	5.27
Bufflehead	8	.333	.500	5.84
Goldeneye	5	.833	1.250	6.83
Widgeon	103	.340	.446	6.18
Pintail	50	.102	.169	5.50
Mallard	35	.241	.402	5.95
Shoveler	33	.188	.351	6.79
Green-winged Teal	68	.613	1.015	6.34
Totals	430	.2083	.3302	6.34

1/ Brood sizes were calculated from a total of 217 Class I broods with average brood size of 6,72 and 273 Class II brood with average size of 6.04.

= ,778 young/adult using 1962 pre-[illegible] estimates

Class I & II broods

Table 11. Comparison of Brood Sizes in Early and Late Years as Indicated by the Date of Breakup of the Yukon River at Fort Yukon.

Year	Breakup Date	All Species No.	All Species Av.	Scaup No.	Scaup Av.	Widgeon No.	Widgeon Av.	Pintail No.	Pintail Av.
		No. of Broods Observed & Average Brood Size							
1953	May 11	146	7.3	24	8.1	51	7.2	31	6.6
1954	" 18	377	5.9	108	6.4	130	6.1	89	5.3
1955	" 19	344	6.3	49	6.4	40	6.3	38	6.2
1956	" 9		6.9	8	7.0	63	7.0	26	7.8
1960	" 6		7.0	62	7.5	75	6.4	15	6.8
1961	" 18		6.3	117	6.6	146	6.4	24	5.7
Mean of all years			6.62		7.0		6.57		6.40
Mean of 3 early years			7.07		7.53		6.9		7.07
Mean of 3 late years			6.17		6.47		6.3		5.73

Table 12. Waterfowl Production and Fall Population Estimates, Yukon Flats Stratum IV, 1961.

Species	Total Adults	Total Broods	Total Young	Total Fall Pop.
Scaup	90,600	8,300	51,460	142,060 21,27
Canvasback	25,000	1,800	9,594	34,594
Scoter	43,200	2,400	12,648	55,848
Widgeon	60,600	10,300	63,654	124,254
Pintail	98,400	5,000	27,500	125,900
Mallard	28,600	3,500	20,825	49,425
Shoveler	35,000	3,300	22,407	57,407
Green-winged Teal	18,400	6,800	43,112	61,512
Other	8,000	1,600	8,752	16,752
Totals	412,800	43,000	259,952	667,752

Table 13. Waterfowl Production and Population Estimates, Yukon Flats Stratum III, 1961.

Species	Total Adults 1/	Total Broods	Total Young	Total Fall Pop.
Scaup	54,600	5,000	31,000	85,600
Canvasback	15,000	1,100	5,800	20,800
Scoter	26,100	1,500	7,900	34,000
Widgeon	36,700	6,200	38,200	74,900
Pintail	59,400	2,900	16,000	75,400
Mallard	17,200	2,100	12,500	29,700
Shoveler	21,200	2,000	13,600	34,800
Green-winged Teal	11,100	4,000	25,200	36,300
Other	4,900	1,000	5,500	10,400
Totals	246,000	25,000	156,000	402,000

1/ Total adults estimated by extrapolation of 6 aerial transects, each covering a 1/8 x 16 mile strip flown by Hansen and corrected on the bases of ground/air unit density ratio from experimental ground surveys and standard aerial surveys in Stratum IV (64.5 and 27.5 drakes per square mile respectively).

Table 14. Estimated Number of Aerial Transects or Ground Study Plots Required to Obtain Populations Estimates with Confidence Limits of 95 Percent that Fall Within ± 20 Percent of the Sample Mean.1/

Origin of Estimates	N
Aerial Surveys of the Breeding Population 2/	
Standard Surveys, 14 transects	20
Experimental Surveys, 8 transects	24
Ground Surveys of the Breeding Population 3/	
Plots of 4 square miles	18
" " 3 square miles	27
" " 2 square miles	63
" " 1 square mile	148
Ground Surveys of Broods	
Plots of 4 square miles	29
" " 3 square miles	36
" " 2 square miles	41
" " 1 square mile	51

1/ $N = t_{(\alpha=.05, n_b-1df)}^2 \; s^2/d^2$ where d is the required half interval.

2/ Each aerial transect covered an area of 4 square miles. Calculations for standard surveys were based on the estimate of total ducks, per transect in 1961 and from experimental surveys, of total drakes, per transect.

3/ A total of 8 plots were used for each set of calculations involving ground surveys. Estimates for the breeding population were based on total drakes.

Table 15. Comparison of Waterfowl Breeding Population Surveys, Yukon Flats Stratum IV, 1957 - 1961.1/

Characteristic	1957	1958	1959	1960	1961
Observer No. 1 2/					
Total	603	857	1,214	1,107	1,429
Mean	43.1	61.2	86.7	79.1	102.1
Variance	999	1,999	3,031	2,114	3,264
Standard Error	8.5	11.9	14.7	12.3	15.3
Relative Error 3/	19.6	19.5	16.9	15.5	14.9
Observers No. 1 + No. 2					
Total	1,702	1,000	2,015	1,946	2,415
Mean	121.6	114.3	143.9	139.0	172.5
Variance	4,484	1,701	6,217	3,914	5,179
Standard Error	17.9	11.0	21.1	16.7	19.2
Relative Error	14.7	9.6	14.6	12.0	11.1

1/ Fourteen aerial transects were flown over identical routes each year.

2/ Henry A. Hansen served as pilot-observer on all surveys. Observers included W. F. Crissey in 1957, Henzler in 1958, J. King in 1958, and M. Zahn in 1960 and 1961.

3/ Standard error expressed as percent of the mean.

Table 16. Changes in the Waterfowl Breeding Population Yukon Flats Stratum IV, 1957 - 1961.[1]

Parameters	1957-58	1958-59	1959-60	1960-61
Observer No. 1				
Total Difference	226	357	- 107	322
Mean Difference ♀	16.1	25.5	- 7.6	23.0
Percent Change	42.1	28.6	- 8.8	29.3
Variance	793	2,094	4,827	4,473
Standard Error	7.5	12.2	18.6	17.9
Probability difference is due to chance	.05	.04	.50	.21
Observers No. 1 + No. 2				
Total Difference	- 102	415	- 69	464
Mean Difference	- 7.3	29.6	- 4.9	24.1
Percent change	- 5.9	25.9	- 3.4	33.5
Variance	5,180	6,777	7,586	5,724
Standard Error	19.24	22.00	23.28	20.22
Probability Difference is due to chance	.50	.20	.50	.13

1/ Calculations are based on paired transects with probabilities determined by solving for $t = \bar{d} - \mu / S_{\bar{d}}$ where d is the difference between pairs.

Table 17. Comparison of Air and Ground Surveys.

Species	Number of Drakes: Ground Counts	Number of Drakes: Aerial Counts	R[1/]	S_R/R
Lesser Scaup	453	162	.358	.40
Canvasback	129	11	.085	.53
Redhead	5	0	.000	-
Scoter	216	55	.256	.41
Bufflehead	24	4	.167	-
Goldeneye	6	1	.167	-
Old Squaw	3	0	.000	-
Widgeon	303	30	.099	.21
Pintail	492	30	.060	.54
Mallard	145	30	.207	.28
Shoveler	175	8	.046	-
Green-winged Teal	111	4	.036	-
Blue-winged Teal	2	0	.000	-
Unidentified	0	72	-	-
Total	2,064	407	.197	.31

1/ R = x/y = AirCounts/Ground Counts.

$v(R) = \Sigma y_i^2 + \hat{R}^2 \Sigma x_i - 2\hat{R} \Sigma x_i y_i / n(n-1)\bar{x}^2$

$S_{\hat{R}} = \sqrt{v(\hat{R})}$

Table 18. Observations and Population Estimates for Cranes, Yukon Flats, 1961.

Area	Number Cranes
18	1
26	0
33	3
60	3
67	3
96	21
103	4
131	14
Total	49

Mean plot density : 6.1
Standard error : 2.84
Mean density per square mile 1.53
Estimated population on sampled area (Stratum IV = 3,200 square miles) : 4,900

3,800 5,800

Table 19. Observations and Population Estimates for Moose, Yukon Flats, 1961.

Area	Number Moose
18	1
26	0
33	1
60	0
67	0
96	7
103	0
131	4
Total	13

Mean plot density : 1.63
Standard error : 0.89
Mean density per square mile : .405
Estimate of population in sampled area
(Stratum IV = 3,200 square miles) : 1,300

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