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Progress Report

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

By

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November, 1962

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ABSTRACT

Investigations to determine the feasibility of a multi-purpose dam in Rampart Canyon of the Yukon River were authorized by Congress in 1959. Construction of the proposed dam will result in the inundation of the major waterfowl breeding area in interior Alaska. The primary objective of this part of the feasibility study is to evaluate the ultimate effect upon the waterfowl population if the dam is constructed. A preliminary report of April 1962 provided detailed information on studies conducted in 1961 and previously. The present report summarizes the results obtained during the 1962 season.

Censuses on 20 ground sampling units totaling 80 square miles, and on aerial transects totaling 1,872 square miles indicated that the breeding population consisted of approximately 500,000 ducks. However, a late spring and extensive flooding during critical periods resulted in an estimated production of only 350,000 young. The indicated ratio of .7 young per adult is much below the average production, and may be below that required to maintain the population. Previous studies of waterfowl and climatological records for the Yukon Flats indicate that conditions as deleterious to production as those experienced in 1962 are extremely rare, and we can reasonably anticipate that the average fall flight, adults and young, from the Yukon Flats will be much higher than in 1962. Scaup, widgeon, and pintail are the most important species comprising about 60 percent of the total, but canvasback, mallard, shoveler, and green-winged are also important segments of the population.

The distribution of 578 recoveries from ducks banded on the Yukon Flats suggests that more than half are taken by hunters in the Pacific Flyway, about 20 percent are taken in Canada, and the remainder are taken in other flyways. The recoveries may reflect the restrictive regulations in the eastern flyways, as rough calculations suggest that more than 40 percent of the ducks are available to hunters there.

It is probable that most of the waterfowl population of the Yukon Flats will be lost if this area is inundated by construction of the Rampart Dam. The poor production which resulted from local flooding of the Yukon Flats in 1962 despite the presence of unflooded areas, and the failure of prairie duck production in years of drought although habitat with adequate water is available northward, are two divergent examples of the failure of displaced ducks to breed. Furthermore, although much of Alaska is dotted with countless lakes, most are infertile and incapable of supporting any significant increase in waterfowl numbers.

INTRODUCTION

Investigations originated to determine the feasibility of a multipurpose dam on the Yukon River in Rampart Canyon were authorized by resolution in the Public Works Committee of the U. S. Senate on 24 April 1959. Construction of the proposed dam will result in the inundation of the major waterfowl breeding area in interior Alaska. The primary objective of this study is to evaluate the ultimate effect upon the waterfowl population if the dam is constructed.

A preliminary report of April 1962 provides a general description of the impoundment area and detailed information on studies conducted in 1961 and previously. The present report summarizes the results obtained during the 1962 season. It is anticipated that a final report will be submitted during the fall of 1963 which will cover all phases of the investigation in detail.

Personnel participating in one or more phases of the field studies in 1962 include: Calvin J. Lensink, Jay N. Eisenhart, Charles D. Evans, Jack W. Lentfer, Dale R. Evans, Garvan P. Bucaria, and Clifford Adams. Lensink and Eisenhart had conducted the preliminary studies in 1961 and were in charge of field crews conducting censuses from the ground. Charles D. Evans with Lentfer as observer conducted all aerial censuses, and Dale Evans, Bucaria, and Adams assisted in conducting ground censuses.

GENERAL CHARACTERISTICS OF THE SEASON

The spring of 1962 was abnormally late and a complete snow cover prevailed when the first migrant waterfowl were observed on May 3 - a

week later than the normal time of arrival (Tables 1 and 2). Large numbers of pintail and widgeon were present in the vicinity of Fort Yukon by May 6 where human activity resulted in an early melting of snow. The buildup of the waterfowl population in Fort Yukon continued despite considerable harassment by villagers, until by May 13 the population had reached at least 10,000 ducks. Concurrently, large flocks were concentrated at open leads in the Yukon River. On May 14 there was a marked reduction of the concentration of ducks in the vicinity of Fort Yukon, indicating the appearance of bare ground and/or open water at the edges of shallow lakes. By May 16 there were fewer than 100 ducks remaining in the vicinity of Fort Yukon.

Breakup of the Yukon River at Fort Yukon occurred on May 22, ten days later than normal. Local flooding accompanied breakup but was of short duration and not unusual. However, above normal rainfall (Table 3) combined with melting of snow in the mountains resulted in widespread flooding of the Yukon Flats between May 25 and June 10. On May 30 water levels which exceeded those at breakup prevailed at Fort Yukon, and lower portions of the village were flooded, parts of Beaver Village were flooded by May 31, and most of Stevens Village was inundated by June 4, resulting in its evacuation. Water levels at Stevens Village were reported by local residents to be higher than at anytime since 1937. On June 8 the Yukon was still at its crest at Stevens Village, but had dropped about a foot at Beaver, and between two and three feet at Fort Yukon. Most streams tributary to the Yukon were also above flood stage during this period.

During the several days that extreme flood conditions prevailed, water reached and flooded lakes many miles from the river. All of the Beaver and Nuntraget study areas, each about 75 square miles, were flooded. All lakes on 13 of the census plots were flooded, nearly half of the lakes on three plots were flooded, minor flooding occurred on one plot, and only two plots were not flooded. Probably habitat used by more than half of the waterfowl on the Yukon Flats was flooded. This caused nest destruction or delayed nesting for all species with the possible exception of scaup and scoter.

High water prevailed throughout the summer, and intermittent flooding occurred on lakes connected to the Yukon or its tributaries. Water in "closed basin" lakes which had been flooded frequently extended into bordering willows or shoreline forest. The wide meadows of grass and sedge, principally Calamagrostis and Carex, which previously surrounded most lakes, formed equally wide bands of emergent growth. Although the flooding may have contributed to a significantly lower production of broods this season than in normal years, the habitat was probably improved for subsequent seasons.

The late spring and flooding resulted in a prolonged nesting period and many late broods, but it is unlikely that any broods failed to fledge before freezeup of lakes and ponds which was complete by October 15.

PROCEDURES

Field operations in 1961, the first year of this study, were designed to explore the possibility of sampling waterfowl populations

from the ground in the sub-arctic habitats of the Yukon Flats where the lack of normal means of transportation prevent the use of sampling techniques used in more highly developed areas. Because the results of the 1961 studies seemed generally promising, similar procedures were used in the 1962 expanded program.

Twenty plots for intensive study, each of four square miles, were selected from a grid covering an area of 3,800 square miles. The first eight plots, retained from 1961, were chosen as a systematic sample from a random start; the 12 additional plots were selected by means of random numbers. The area from which these plots were selected (hereafter referred to as "Area A") is relatively uniform, and contains approximately 70 percent of the waterfowl population in the impoundment area (Fig. 1). All waterfowl censuses conducted from the ground were confined to these plots. The remaining 7,000 square miles of the impoundment area (designated as "Area B") contains much excellent waterfowl habitat, but is extremely variable. It is thus not suited to sampling from the ground, because the cost of a sufficient number of sampling units to reduce variance to a tolerable level would be excessive.

In addition to the aerial censuses conducted on the 20 plots, censuses were made on lines traversing the impoundment area from north to south at intervals of four miles. Data were recorded separately for each four mile segment of the transects. A total of 210 usable segments fell in Area A and 227 in Area B.

Censuses from the ground were conducted by walking or canoeing along the shorelines of all lakes and streams found on the plots.

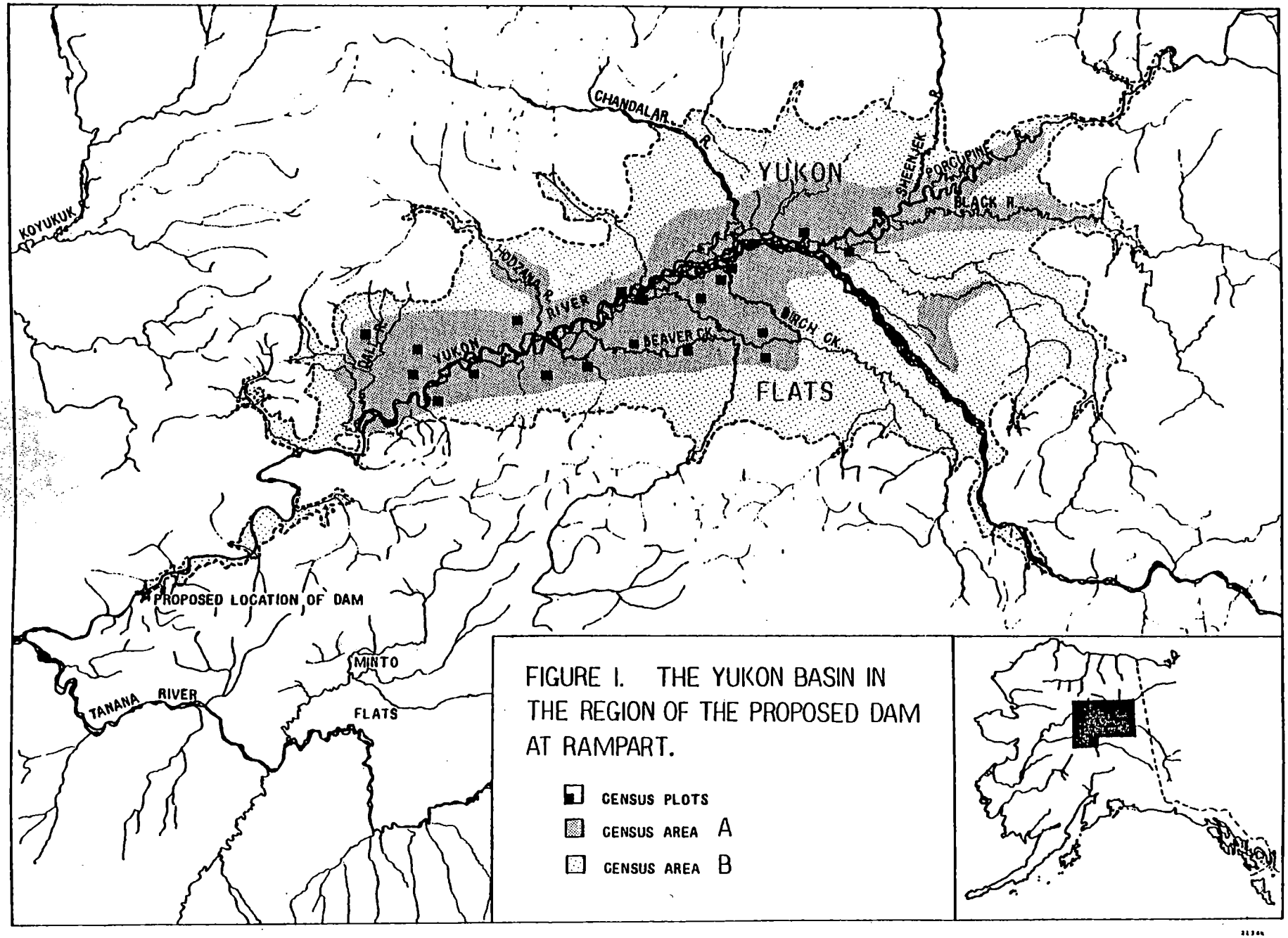

FIGURE I. THE YUKON BASIN IN THE REGION OF THE PROPOSED DAM AT RAMPART.

Observations were recorded by lake or other water body so that smaller sampling units could be selected from each plot or distribution of waterfowl could be further analysed on the basis of habitat type. Aerial censuses were flown according to standards established for routine breeding ground surveys.

THE BREEDING POPULATION

Censuses

Census of Sample Plots from the Ground. A census of the breeding population on the sample plots was started on May 26 and was completed on June 13 (Table 4). Observations are summarized by species and sex in Table 5. The total of 5,476 observations includes only 332 ducks for which the sex was undetermined and 16 for which the species was not determined. The total number of drakes (ducks with sex not identified prorated on the basis of observed sex ratios) was 3,752. The number of drakes per plot varied from 44 to 453 with a mean of 187.55 and a standard error of 23.79 (Table 6.).

The mean for plots 1-8 (the only plots censused in 1961) was 215.4 drakes with a standard error of 23.3 as compared to the mean of 258 drakes per plot in 1961. The overall loss of about 16 percent is not statistically significant ($p < .5$). However, a breakdown of observations by species (table 7) indicates that the number of diving ducks observed remained unchanged, and that a lower count of dabbling ducks in 1962 accounted for all of the observed decrease.

This difference might be considered significant ($p \approx .05$), but, as indicated previously, the considerable change in census conditions would probably result in low counts of dabbling ducks, thus causing the apparent difference in population. Therefore, it seems likely that the population did not differ from 1961.

A rather large difference (21.5 percent) also exists between the mean plot density for plots 1-8 and the mean (169.1) for the remaining 12 plots. The difference is due to normal sampling error. Because evidence from aerial censuses (to be discussed later) suggests that all of the 20 plots sampled provide an estimate which is probably near the true mean, they also suggest that 1961 population estimates are slightly high.

Census of Sample Plots from the Air. Aerial censuses of sample plots were conducted during the same period that censuses were conducted from the ground. Because the number of aerial censuses varied from plot to plot, and because air census covered the equivalent of only half a plot (Fig.2), the average for each plot times a factor of two is used as a basis for the following discussion. This weighting makes aerial observations directly comparable to those from the ground. Counts of both observers were combined as they did not differ significantly either in total count or in identification of species. The weighted total number of drakes counted on plots was 1,977. Plot totals ranged from 21 to 189 with a mean of 98.85 per plot and a standard error of 10.79 (table 8). The mean for plots 1-8 was 97.25, almost identical with the mean for the remaining 12 plots, but almost double the mean of 50.9 obtained in 1961. The difference is attributed to a difference in observers on aerial censuses,

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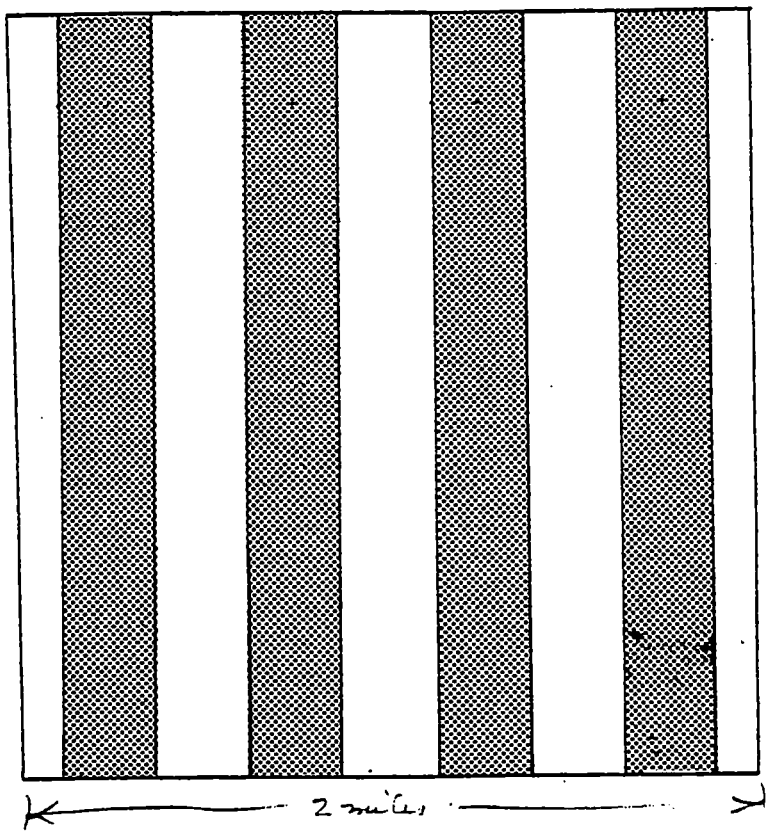

Figure 2. Area covered by aerial transects on census plots (shaded). The entire area was censused from the ground.

Aerial Censuses in Areas A and B. Aerial censuses in Areas A and B were conducted between May 28 and June 11, the censuses being concurrent with each other and with those on sample plots. The total number of drakes counted on the 210 segments in Area A was 5,270 with a mean of 25.0 per segment and a standard error of 1.7 (Table 9). The mean per segment in Area A is almost identical with the mean of 24.7 for an equal area (1 square mile) obtained in aerial censuses of sample plots, all of which were also in Area A. The similarity of these means suggests that the distribution of sample plots is truly representative of Area A. Conversely, if we assume that the plots are representative of Area A, the similarity in the means suggests that aerial counts in samples of this size are consistent. If we accept both conclusions, the results suggest further that much of the variability in repeated aerial censuses of small areas is due to factors other than census technique -- the most probable being that caused by movements of birds to and from the census area.

The total number of drakes counted on the 227 segments in Area B was 2,140 (Table 10). The mean per segment was 9.8 with a standard error of 1.1. As expected, the coefficient of variation is considerably higher for the segments in the more variable habitat of Area B than that for Area A. The frequency distributions (Tables 9 and 10) show that the range in the number of ducks per segment is quite similar between Areas A and B, and that the primary difference is the number of segments with less than five observations. These results confirmed the general observation that the primary difference between Areas A and B is the number, rather than the quality, of lakes and ponds.

Breeding Population Survey. Twenty transects from routine breeding population surveys conducted by Henry A. Hansen fall within the boundaries of the impoundment area. These transects are 1/8 by 16 miles (only Hansen's observations are used) and in 1962 were flown on May 22. The number counted in 1962 was 738 as compared to 949 in 1961, an indicated decrease in population of about 22 percent. However, the difference is not statistically significant ($p \cong .2$). Furthermore, the decrease was mostly of scoters which changed in species composition from 23 percent in 1961 to 5 percent in 1962. As all experimental censuses indicate a higher proportion of scoters than Hansen observed, and as no scoters were observed near Fort Yukon until May 27, it seems likely that many scoters had not arrived when Hansen's surveys were made.

Species Composition on Aerial Censuses. A comparison of species composition indicated by the various aerial surveys (table 12) provides another means of determining if results are consistent. The differences which are present are no greater than might be caused by the observation of a single large flock, a not uncommon occurrence, and are no larger between censuses in Areas A and B than they are for the censuses in Area A. The similarity in composition estimates suggests again, as in the previous section, that aerial censuses were reasonably consistent, and that ducks in Areas A and B are essentially one population.

Comparison of Census from the Air and from the Ground. Aerial counts were consistently lower than ground counts on the sample plots in a ratio of $.527 \pm .122:1$. Although the correlation coefficient of .570 seems rather low, it is significant ($p < .01$). The regression line, with a regression coefficient of 1.256, and a Y intercept of 63.39

(Figure 3), would appear to provide estimates of Y which become too low as X, the value of aerial counts, increases.

The ratio of air to ground counts varied widely between species (table 13). The lowest for any of the diving ducks (.222 for old squaw) was higher than that for any of the dabbling ducks. The higher ratios for divers appear to be caused by both coloration and their propensity for using open water areas. Thus, we can account for the difference in ratios for canvasback (.673) and scaup (.397) which have similar habits on the basis of coloration, but the high ratio for scoters (1.030) is probably due to the fact that most are observed in large flocks in open water. The ratio in which puddle ducks were observed (.094) is perhaps lower than would be anticipated for most years, because of their extensive use of the flooded margins of lakes. Such habitat has not been available in previous years.

Sex Ratios

The sex of all adult waterfowl observed was recorded during the period of April 27 to June 25 and the ratios obtained arranged by intervals of 5 days (table 14). During the pre-incubation period, when the sexes should have been equally visible, sex ratios indicated a significant imbalance in favor of males in all species for which a realistic sample was obtained (table 15). The average proportion of males for all species with weighting proportional to percent frequency of occurrence was 61.9 percent.

During the period of incubation and before drakes entered the moult, the observed ratio of drakes to hens increased. The proportion

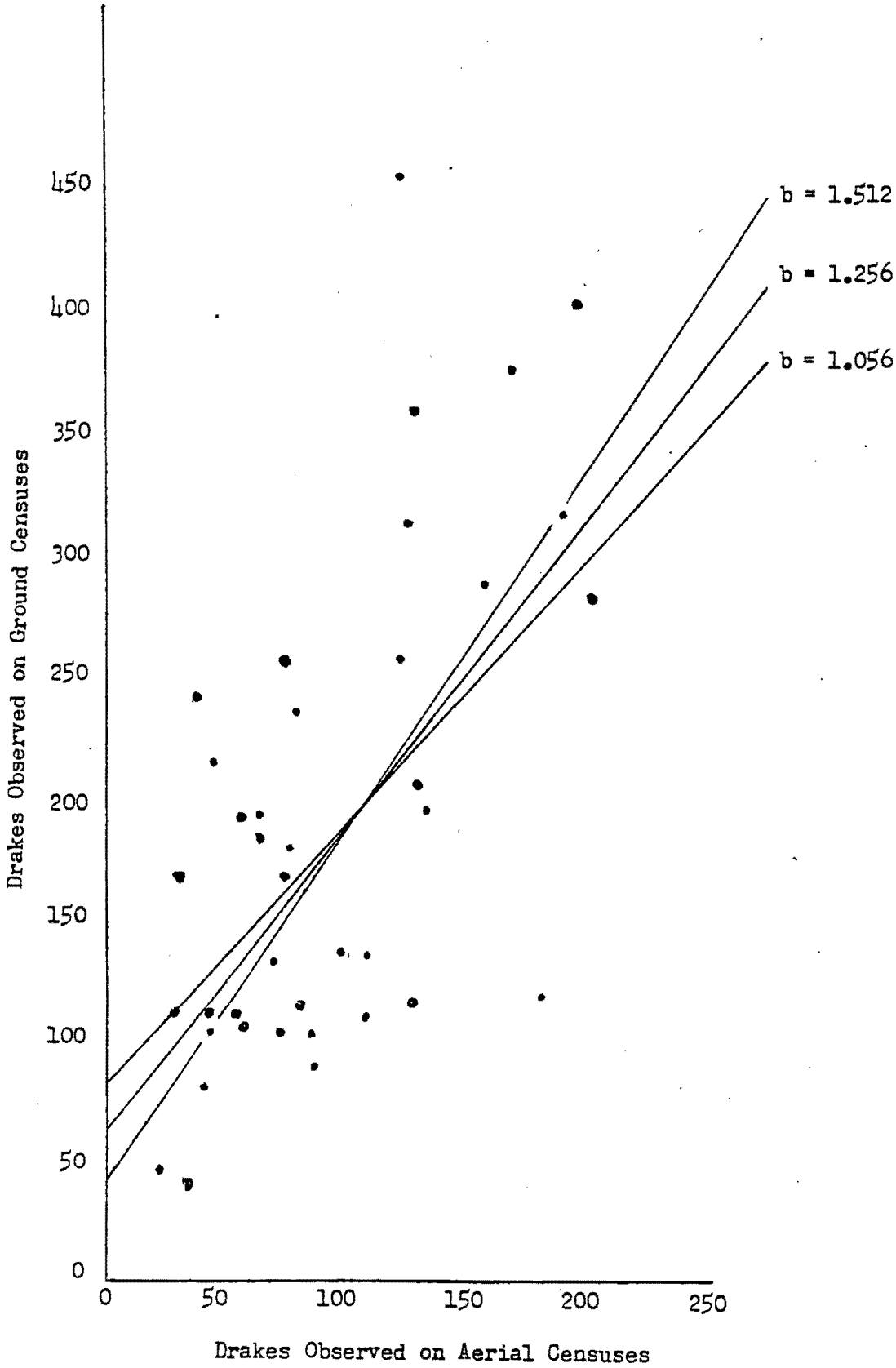

Figure 3. Regression Comparison of the Number of Drakes Observed on Aerial and Ground Census.

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of males exceeded 80 percent for canvasback, pintail, and mallard, and exceeded 90 percent only for widgeon. However, in 1961, the proportion of males exceeded 80 percent for scaup, canvasback, and pintail, and exceeded 90 percent for widgeon, shoveler, and green-winged teal. The difference suggests that there may have been more non-nesting or deserter females in 1962. Although quantitative data are lacking, observations of females without broods seemed to be more common in 1962 than in 1961 as anticipated by the sex ratios.

BROODS

The Brood Season

The first brood observed was of widgeon on June 28. From that date all broods observed were classified by species, age, and number of young. Observations of broods by age class are summarized for periods of five days in table 16. Hatching dates were estimated from ages as suggested by Gollop and Marshall (1954), but with each age class abbreviated by one day (tables 2 and 17). The indicated hatching periods extended from 30 days for bufflehead to 45 days for widgeon, shoveler, and scaup, and 50 days for pintail. Estimates of hatching dates derived from aged broods suggest that before the first brood was observed (for each species) at least 9 percent of widgeon, 82 percent of pintail, 61 percent of shoveler, 56 percent of canvasback, etc., were hatched. It is unlikely that so many early broods would be missed and it seems probable that age intervals of Gollop and Marshal, even as abbreviated, are too long, and that growth rates on which age intervals are based, must be considerably

accelerated in the sub-arctic.

The last newly hatched brood observed was that of a lesser scaup on August 10, approximately 10 days later than in 1961. Last hatching dates for other species were similarly delayed. The extended hatching period is probably a consequence of both the late spring and flooding.

Brood Censuses

Two brood surveys were conducted, the first from July 6 to 27, and the second from July 28 to August 19. A total of 366 broods was observed on the first census and 512 on the second, of which 314 broods were considered to be different from those observed on the first survey, resulting in an estimated total of 680 broods (table 18). The number of broods observed on plots ranged from 2 to 95, with a mean of 34 and a standard error of 5.48.

The large number of new broods observed on the second survey, about 46 percent of the total, differed from observations in 1961 when only 14 percent were considered to be new broods. The large number of late broods encountered on the second survey is a reflection of the delayed nesting or renesting caused by the late spring and flooding.

Widgeon with 197 broods and scaup with 167 broods accounted for more than half of the broods produced (table 19). No other species exceeded 10 percent of the total broods.

Nesting Success

Estimates of nesting success are based on the ratio of broods to females in the breeding population (table 20), and on the average size

of Class I and II broods (table 21). The average proportion of females with broods was 29.5 percent, a decrease of about 4.4 percent from 1961. The most successful species was widgeon for which 61.7 of the females produced broods. Early nesting ducks, mallard and pintail, had notably poorer success, 14.6 and 14.7 percent respectively, than later nesting species. Nesting success was of similar magnitude to 1961 for most species, but for widgeon was higher, and for mallard and teal was lower.

The combined production rate for all species was .7 young per adult. This rate is much below the overall rate of 1.25 or the rate for forested habitats of 1.10 young per adult which Crissey (1957,1956) suggested was necessary to maintain a stable population.

Average sizes of Class I broods was slightly smaller and Class II broods larger than in 1961 (table 21). Average size for Classes I and II combined was 6.43 in 1962 as compared to 6.34 in 1961, an increase of less than 2 percent which is not considered significant.

POPULATION ESTIMATES

To derive population estimates for the entire impoundment area we have the following sources of information:

1. Ground censuses of the breeding population and of broods on sample plots.
2. Aerial censuses of sample plots to provide a ratio of aerial observations to those obtained from the ground.
3. Intensive aerial census which sampled the entire impoundment area.
4. Estimates of pre-nesting sex ratios based on observation of over 6,000 ducks.

Estimates for the fall population of 20 census plots in Area A are given in table 22. These are extrapolated to provide estimates for all of Area A as indicated in table 23. The estimates for Area B (table 23) are based on aerial transects which censused a total of 227 square miles. Aerial counts were corrected by the ratio of air to ground counts in Area B. Confidence limits provided in table 23 are those for the mean total per plot on ground census in Area A, and on the ratio of air to ground counts on sample plots for Area B. Estimates of average brood sizes, of the sex ratio of adults, and of broods per adult are based on such large samples that error resulting from their use is assumed to be negligible.

The estimate for the total population of 832,000 ducks is probably somewhat low. Confidence limits take into account only the characteristics of our sample and do not account for error in actual counts of the population. Flooding and the existence of unmapped water areas during censuses of breeding population and rank growth of emergent vegetation during the brood season may have resulted in failure to observe some adults and young. Birds missed would probably consist primarily of dabbling ducks. A decrease in percentage composition for these species from 1961, when the adverse censusing conditions did not exist, supports this conclusion. Although we can not provide a precise estimate for ducks that we failed to observe, it seems unlikely that the fall population would much exceed one million ducks.

Aerial censuses in Area A covering 210 square miles which were not used in calculating estimates in table 23 provide a check on the other estimates. The estimate for the total population in Area A

derived from the results of the aerial census is 501,000 ducks. This is within 2.5 percent of the estimate based on ground censuses.

Most important species in the fall population are lesser scaup which form about 25 percent of population, widgeon 20 percent, pintail 15 percent, and white-winged scoter 13 percent (table 24). No other species exceeded 10 percent of the total population.

DISTRIBUTION OF HARVEST

Recoveries from 578 ducks banded on the Yukon Flats (table 25) provide a means for estimating the distribution of harvest for birds from the impoundment area. The distribution of returns weighted for species composition and rate of recovery (table 26) suggests that more than half of the ducks shot are taken by hunters in the States of the Pacific Flyway, 20 percent in Canada, and about 16 percent by hunters of other Flyways.

The distribution of harvest reflects recent regulations which provide generous limits in the Pacific Flyway but which are highly restrictive in other Flyways, and with closures on some species. It is likely that more liberal regulations in eastern Flyways will result in greater dispersal of recoveries, as rough calculations suggest that more than 40 percent of the ducks are available to hunters there.

GEESE

Canada and white-fronted geese, not heretofore considered, are an important segment of the resident waterfowl population on the Yukon Flats. In addition many thousands of snow geese pass through the Flats on their spring migration, and occasionally small flocks of black brant are observed.

Techniques used for sampling duck populations do not provide a satisfactory means of estimating numbers of geese which have a contagious distribution, usually associated with river channels. Thus, although a total of 86 Canada geese were observed on census plots, providing a mean of 4.2 geese per plot (table 26), no geese were observed on 10 plots and 1 plot had 45. Confidence limits on such variable observations are unrealistic. Extrapolation of ground census data to all of Area A suggests a total population of 4,000 Canada geese. A total of 77 Canada geese were observed during aerial censuses of Area A, and 33 in Area B, suggesting population totals of 1,400 and 1,000, respectively, for the two areas.

Three white-fronted geese were observed on aerial censuses, and only one was observed on sample plots during ground censuses. General observations throughout the impoundment area indicate that geese are considerably more common than the censuses suggest, and estimates of at least 8,000 Canada geese and 2,000 white-fronted geese are not unreasonable.

OTHER BIRDS

The waterfowl censuses also provided information on the abundance of other species. Those species obviously adapted to our sampling design include cranes, loons, and grebes. A check list of birds was maintained and all observations of nesting were recorded.

Little Brown Crane

A total of 57 cranes were observed on census plots during breeding population surveys (table 27). This total if extrapolated

to all of Area A provides an estimate of approximately 2,700 cranes in the breeding population. Fifteen cranes were observed on 210 air census segments in Area A, and 8 in 227 segments in Area B. Observations in Area A suggest a ratio of aerial observations to ground observations of 10.0:1. Application of this ratio to observations in Area B provides an estimate of 2,500 cranes, or a total of 5,200 cranes for both areas. Observation of cranes on census plots surveyed in 1961 suggest that the total number of cranes was about twice that indicated by present data. The inundation of the grass or sedge meadows surrounding lakes such as occurred in 1962 caused a movement to other upland or unflooded meadow areas. No attempt was made to examine such alternate habitat. Despite the rather limited number of observations and the discrepancies between observations in 1961 and 1962, it seems probable that there are at least 10,000 cranes in the breeding population.

Two nests, two broods and one broody pair were observed on census plots. As the young are secretive, and no effort was made to locate nests, the observations may suggest a minimum production of 500 to 1,000 young. The total fall population of cranes in the entire impoundment area is probably not lower than 6,000 (1962 data) and may not exceed 11,000 (1961 data).

Loons

Arctic, common and red-throated loons are common on the Yukon Flats, although arctic loons are considerably more abundant than other species. Thus, 208 arctic loons were observed on census plots

but only 11 common and 3 red-thoated loons. Observations of adult and young arctic loons are summarized in table 28. In addition 60 loons were observed in Area A and 18 in Area B during aerial censuses. These were not identified as to species, but were undoubtedly nearly all arctics. Calculations similar to those used for cranes results in an estimate of about 15,000 arctic loons in the breeding population which produce approximately 1,700 young for a total fall population of 17,000.

Arctic loons are usually most abundant on bog type lakes although they are not restricted to them. Common loons occupy habitat similar to that used by arctic loons. So few red-throated loons have been observed that we are uncertain of their choice of habitat, but they seem most prevalent in lakes which fluctuate with the river to which they are connected, i. e., Mud Lakes, near the mouth of Beaver Creek. Fish are particularly abundant in such waters, and perhaps the red-throated loon is more dependent on such a food supply than are other loons.

Grebes

Horned and red-necked grebes are numerous on the Yukon Flats. The distribution of grebes is similar to that of ducks in that they are most abundant on shallow or fertile lakes. Observations of grebes on census plots are summarized in table 29. Extrapolation of these observations to all of Area A provides estimates of approximately 8,300 adult horned grebes and 3,800 young for a total population of 12,100. Red-necked grebes number approximately 6,600 adults and 3,800 young for a total population of 10,400. These estimates have a confidence interval of about ± 30 percent at a significance level of 95 percent.

Only 31 grebes were observed during aerial censuses, 24 in Area A and 7 in Area B. None were identified by species. The aerial observations are too few to provide reliable estimates of the total population in Area B, but as observations follow a similar pattern between the two areas as other species, we can probably assume that the indicated estimates of approximately 3,200 horned grebes and 2,800 red-necked grebes are reasonable. Total fall populations for the Yukon Flats based on the above estimates would probably exceed 15,000 horned grebes and 13,200 red-necked grebes. As grebes are shy, particularly the young, and escape observation by prolonged submergence or use of emergent cover, our estimates are probably conservative.

Miscellaneous Birds

Check lists of birds observed on the Yukon Flats were kept by Lensink for the summers of 1953, 1954, 1961, and 1962, and by Eisenhart for the entire period of June 1961 to date. Few of our observations have been validated by collections, but all have been checked against known distribution records. A check list of all species which have been identified is included as table 30. Furthermore, most identifications are based on repeated observation, and are not likely to be in error. However, a few species which occur in limited numbers, or which might on casual observation be confused with more familiar species, may not be listed. The total of 121 species that are listed included 11 permanent residents, 1 winter resident, 74 summer residents, 17 migrants, and 5 visitors or strays. The 12 species which are listed with "status unknown"

are those for which identification was uncertain, or which are placed on the list on the basis of distributions indicated in published reports on adjacent regions.

AQUATIC VEGETATION

Collection of aquatic plants was initiated in 1961 and continued in 1962 in an effort to relate vegetation type and abundance to waterfowl distribution and production. Species of plants collected through 1962 are listed in table 31. Identifications are tentative with nomenclature after Hulten (1941-50).

Lakes on the Yukon Flats can be classified in three broad catagories: (1) Bog lakes, (2) lakes subject to annual flooding from the Yukon or its tributaries, and (3) closed basin lakes which are seldom flooded. Although there is a complete gradation within and between the various types of lakes, they frequently vary sharply in the amount and kind of aquatic plants they support, in their shoreline vegetation, and in their value as waterfowl habitat.

Bog lakes appear to develop in situations where water levels remain relatively constant and where absence of fire has allowed plant succession in adjacent areas to reach a stage consisting primarily of a moss-heath association which may or may not support stands of black spruce, *Picea mariana*. The existence of the deep moss cover causes an upward movement of permafrost which frequently results in poor drainage, saturation of surface layers, and the development of acid conditions. Run-off from such areas is relatively deficient in nutrients required for plant growth. Lakes in such

areas (as in Plot 8) are infertile, the dominant plants usually being Nuphar polysepalum, Nymphaea tetragona, Sparganium angustifolium, Potamogeton natans, and Utricularia macrorhiza. A floating mat develops along the shoreline, usually with Menyanthes trifoliata, and Caltha palustris on margins adjacent to the water. Depth of the water adjacent to the floating mat varies from 2 to 4 feet.

Utilization of bog lakes by waterfowl is low, with only occasional use by scoters, scaup, green-winged teal, pintail, and mallard in order of abundance as listed. However, the bog lakes support larger populations of loons and beavers than other types of lakes. Occasionally fertility of bog lakes appears to have been increased as a result of fire in the surrounding watershed (as in Plot 12). The variety and density of aquatic plants, and utilization by waterfowl is correspondingly increased.

Lakes which are subject to annual flooding vary widely in character, depending primarily on the degree to which they are flooded or drained. Most are usually of higher fertility than bog types, although if outlets are blocked at a relatively high level they may approach a bog type. Higher portions of the margins which are only briefly flooded are usually covered by Carex spp. and/or Equisetum spp., Polygonum amphibium, and Sagittaria cuneata are frequently present in areas flooded for longer periods, the former frequently in dense stands. Potamogeton perfoliatus, Potamogeton vaginatus and other pondweeds are common in continuously submerged areas.

Utilization of lakes which are subject to annual flooding varies, but in general they appear to be more important as foraging areas for

adults or fledged young than for broods. In late summer and fall large flocks of pintail, wedgeon or other dabbling ducks, and Canada geese may gather on such areas prior to migration.

The most fertile lakes and those also of most importance for waterfowl production are closed basin lakes which are rarely flooded (as in Plot 4) although because of limited watersheds, occasional flooding may be necessary for their maintenance. Surrounding areas have been kept in early successional stages by fire, and vast areas may be dominated by willow, Salix spp., aspen, Populus tremuloides, and occasional stands of white spruce, Picea glauca. Bare ground may frequently be exposed, and grassy meadows are common. Run-off from such watersheds may be expected to contain more nutrients than that from the moss mats surrounding bog lakes. Furthermore, prolonged drawdown by evaporation of lakes in such areas results in further concentration of nutrients. The drawdown also prevents the formation of floating mats and permits the establishment of grasses, Calamagrostis canadensis, Glyceria grandis, Hordeum jubatum, and other species. These grasses frequently form broad meadows around lakes. In moist situations Carex aquatilis and C.rostrata are common. Within the lakes pondweeds, Potamogeton vaginatus, P. perfoliatus, P. praelongus and other species of Potamogeton as well as Myriophyllum spicatum, may form dense beds. Polygonum amphibium may be common near shore. In addition to the abundance of aquatic vegetation, populations of aquatic invertebrates are large.

Utilization of these fertile lakes is heavy by all species of waterfowl found on the Yukon Flats, and during all seasons. Species

composition, however, may vary with size, depth, or other characteristics of particular lakes.

EXPECTED EFFECTS FROM THE RAMPART DAM

The building of Rampart Dam will result in the complete destruction of waterfowl habitat on the Yukon Flats. Furthermore, margins of the impoundment will be steep, and will provide only a negligible amount of new habitat. In essence then, we must consider the displacement of the entire population, and the possibility of its addition to production in other areas. Such prospects are dim, and evidence from a variety of sources indicates that the major portion of the population will be lost.

To examine the results of destruction of waterfowl habitats we have examples on varied scales: 1. The gradual decline in continental populations resulting from drainage of marshes and potholes in the United States and Canada; 2. the disastrous decline of waterfowl populations following years of drought on the prairie States and Provinces despite the existence of an abundance of lakes to the north and the undisputable evidence that at least some prairie ducks move to them; and 3. losses to production on the Yukon Flats caused by late springs or by flooding, although delay in nesting may be no more than a few days and other habitat that was not flooded was available.

In the previous discussion of aquatic vegetation it was shown that various lakes differed in the type and quantity of vegetation depending on the basic fertility of the lake. Waterfowl distribution and abundance corresponded to water fertility as indicated by vegetational types, the infertile lakes receiving relatively

little use by waterfowl. Aerial recconnaissance of waterfowl habitats in interior Alaska during September 1962 indicated that the majority of lakes are of this infertile type, and that the low waterfowl numbers found on them are representative of the lakes' capacity for production rather than an indication of vacant habitat which could absorb the Rampart population. Fertile areas such as Tetlin Lakes are already highly productive of waterfowl and are so small compared to the Yukon Flats that the number of additional ducks they might support is negligible. Other areas, such as Minto Lakes, are subject to catastrophic flooding and sharply reduced production. The advantage that might be gained by increasing the size of the breeding population on such areas could only be temporary.

Two East areas in need of investigation are the Mackenzie. Although very few displaced birds nested successfully in 1957, the first year they were displaced, there is some evidence in age ratios that the displaced birds may have produced in the last 2 or 3 years. Also, going back to the 1950's, Bob Smith was recording very large numbers of birds along the Mackenzie and fall flights were good; better in fact than I would have expected considering the condition of the [illegible] habitat [illegible]

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Table 1. Phenological Events Affecting Waterfowl Production.

Phenological Event	Date			
	1960	1961	1962	Average 1/
Spring				
Ground partially bare of snow 2/	Before 5/9	Before 5/10	5/15	
Edges of lakes opening	Before 5/9	Before 5/10	5/15	
Last ice observed on lakes	5/17	5/25	6/29	
Extensive openings present on Yukon River		5/11	5/16	
Breakup of Yukon River	5/7	5/18	5/22	5/12
Fall				
First ice on lakes		9/29	9/29	
Freezing of lakes complete			10/15	
First ice in Yukon River		10/8	10/15	
Freezing of Yukon River complete	10/21	10/18		10/24

1/ Averages are those listed by the U. S. Weather Bureau.

2/ Exclusive of prematurely bared areas in the vicinity of villages.

Table 2. Phenology of the Nesting and Brood Seasons.

Species	First Spring Migrants	Earliest Nesting	First Broods Hatched	Peak of 1/ Hatching	Last Broods Hatched
Lesser Scaup	May 15	May 27-31	June 26-30	July 11-August 4	August 10-14
Canvasback	May 10	May 22-26	June 21-25	June 21-July 15	July 21-25
White-winged Scoter	May 27	June 6-10	July 6-10	July 11-August 4	August 5-9
Bufflehead	May 21	May 22-26	June 21-25	July 1-July 15	July 16-20
Goldeneye	May 21	May 22-26	June 21-25	July 1-July 20	July 31-August 4
Widgeon	May 3	May 17-21	June 16-20	June 21-July 25	July 31-August 4
Pintail	April 29	May 7-11	June 6-10	June 11-July 10	July 26-30
Mallard	May 3	May 17-21	June 16-20	June 26-July 10	July 11-15
Shoveler	May 3	May 12-16	June 11-15	June 21-July 25	July 26-30
Green-winged Teal	May 8	May 22-26	June 21-25	June 21-July 20	July 26-30

1/ Approximately 90 percent of broods hatched during this period.

Table 3. Precipitation in the Upper Yukon Basin, October 1961 - June 1962.

	October	November	December	January	February	March	April	May	June	Total
Fort Yukon										
Total	.64	.27	.40	.52	.22	.33	.39	.90	.72	4.39
Departure	.07	-.20	.02	.06	-.13	.01	.21	.58	.08	.70
Fairbanks										
Total	1.17	.47	.59	.69	1.26	.66	.38	.62	2.22	7.76
Departure	.25	-.16	.09	-.20	.74	.26	.13	-.09	.83	1.85
Northway										
Total	.45	.27	.50	.45	.37	.17	.29	1.64	3.07	7.21
Departure	-.04	-.09	.13	-.16	.03	-.05	.06	.92	1.07	1.87
Dawson										
Total	1.30	1.00	.80	.80	--	.20	1.50	.60	2.10	8.30
Departure	.20	.00	-.20	-.10	--	-.40	1.10	-.50	.90	1.00
Total	3.11	2.01	2.29	2.46	1.85	1.36	2.56	3.76	8.11	27.51
Departure	.48	-.45	.04	-.40	.64	-.18	1.50	.91	2.88	5.42

Table 4. Itinerary of Censuses on Sample Plots. 1/

Plot	Aerial Censuses of Breeding Population	Censuses from the Ground		
		Breeding Population	First Brood Census	Second Brood Census
1	5/29, 6/1, 3, 4, 10, 11	6/10-12	7/12-13	8/3-4
2	5/30, 6/3, 4, 10, 11	5/26, 27, 29 & 6/11	7/6, 7, 9	7/31 & 8/2
3	5/30, 6/1, 3	5/29	7/14	8/1
4	6/3, 7	6/1	7/6	8/1
5	6/3, 3	5/31	7/15	8/9
6	5/30, 6/1, 3, 6	6/1	7/25	8/19
7	6/8, 10	6/4	7/16	8/2
8	6/8, 9	6/6	7/22	8/18
9	5/30, 6/1, 3, 5, 6	5/31	7/17	8/3
10	6/3, 4, 6	6/2	7/10	7/28
11	5/29, 6/3, 6	6/8	7/21	7/14
12	6/8, 10	6/6-7	7/7-8	8/11-12
13	5/28, 29, 30, 6/3	5/27	7/20	8/8
14	5/30, 6/1, 3, 5	5/30	7/23	8/16
15	6/3, 6	6/4	7/22	8/15
16	6/1, 7	6/5	7/14	8/12
17	6/1, 3, 4, 5	6/2	7/26	8/19
18	6/3, 9	6/5	7/20	8/19
19	5/30, 6/4, 10, 11	6/12-13	7/16	8/6
20	6/8, 9	6/7	7/26-27	8/16-17

1/ Separate dates for aerial census indicate replications, whereas those under ground surveys indicate days required for one complete census.

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Table 5. Ducks Observed During Census of the Breeding Population from the Ground.

Species	Pairs	Total Identified Females	Total Identified Males	Sex Unidentified	Estimated Total Males
Lesser Scaup	490	620	938	0	938
Canvasback	61	107	199	0	199
Redhead	1	1	1	0	1
White-winged Scoter	142	204	346	324	622
Surf Scoter	14	14	7	3	23
Bufflehead	22	36	50	0	50
Barrows Goldeneye	2	3	11	0	11
American Goldeneye	9	10	22	0	22
Goldeneye	3	10	14	0	14
Old Squaw	9	12	18	0	18
Widgeon	160	183	475	0	475
Pintail	130	193	802	0	802
Mallard	76	98	199	0	199
Shoveler	95	108	184	0	184
Green-winged Teal	48	61	181	0	181
Blue-winged Teal	3	3	4	0	4
Unidentified	5	5	5	6	9
Totals	1,270	1,668	3,456	332	3,752

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Table 6. Drakes Observed on Sample Plots During Census from the Ground.

Plot	Number of Drakes																		
	Scaup	Canvasback	Redhead	White-winged Scoter	Surf Scoter	Bufflehead	American Goldeneye	Barrows Goldeneye	G (?)	Old Squaw	RM	Widgeon	Pintail	Mallard	Shoveler	Green-winged Teal	Blue-winged Teal	Unidentified	Total
1	43	14		21	1	3						38	74	5	23	12			234
2	51	11		4		4	6					56	36	22	5	19			214
3	62	26		19	1		1	4		9		10	24	11	3	4	1	5	180
4	19	11		9								25	73	7	31	19			194
5	105	9		106						3		24	42	5	11	8		3	316
6	75	37		50	9	1						28	61	5	12	9			287
7	78	14		39					2			15	33	10	1	3			195
8	17	3		3	4	4						7	47	5	7	6			103
9	13			50	1	2						5	7	5		6			89
10	11	2										26	51	5	31	6			132
11	41	4		17	3			1	6			23	15	14	2	6	3		135
12	114	6		104	1	4				2		42	43	24	17	17			374
13	23	2		1	1	1	3					26	48	6	18	6		1	136
14	86	6		81	1	8	10	1		4		30	15	4	1	9			256
15	2	2				1			6			12	11	3		7			44
16	13	9		33	1			2				25	21	6		8			118
17	20	3		36		2						21	5	8	1	6			102
18	15			5		3			F			9	27	14	1	7			81
19	133	30	1	25		9			F		F	38	151	34	17	15			453
20	17	10		19		8	2	3				15	18	6	3	8			109
Total	938	199	1	622	23	50	22	11	14	18	T.	475	802	199	184	181	4	9	3,752
Percent Species Composition	25.0	5.3	T	16.6	.6	1.3	.6	.3	.4	.5	T	12.7	21.4	5.3	4.9	4.8	.1	.2	100.0

Mean/plot 187.55
Standard Error 23.79

Table 7. Comparison of Species Composition of Drakes Observed on Census Plots 1-8, 1961 and 1962.

Species	Number 1961	Number 1962	Percent 1961	Percent 1962
Diving Ducks				
Lesser Scaup	453	450	22.1	26.1
Canvasback	129	125	6.1	7.3
Redhead	5	0	.4	0
Scoters	216	266	10.5	15.4
Bufflehead	24	12	1.2	.7
Goldeneye	6	13	.3	.8
Old Squaw	3	12	.1	.7
Sub-total	836	878	40.7	51.0
Dabbling Ducks				
Widgeon	303	203	14.8	11.8
Pintail	492	390	24.0	22.6
Mallard	145	70	7.0	4.1
Shoveler	175	93	8.5	5.4
Green-winged Teal	111	80	4.9	4.6
Blue-winged Teal	2	1	.1	.1
Sub-total	1,228	837	59.3	48.6
Unidentified Ducks	0	8	0	.5
Total	2,064	1,723	100.0	100.1
Mean per plot	258.0	215.4		
Standard Error	32.8	23.3		

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Table 8. Drakes Observed on Census Plots During Aerial Censuses. 1/

Plot	Number of Drakes												
	Scaup	Canvasback	Scoter	Bufflehead	Goldeneye	Old Squaw	Widgeon	Pintail	Mallard	Shoveler	Green-winged Teal	Unidentified	Total
1	8	11	16	2	1		4	4	3	1	1	26	77
2	7	11	1	2	1		1	4	1			14	42
3	14	1	21	3			3	1	3	1	1	27	75
4	16		9	2			3	6		2		30	68
5	25	2	125				2	9	1	8		17	189
6	19	1	60				5	6				65	156
7	35	25	14				1	3				54	132
8	6	4	2	2				3		2		20	39
9	7		61	1	2		1	1	1			12	86
10	2	2	1				4	7	1	4		47	68
11	24	19	13		1	1	2	7	2	1		38	108
12	33	4	73	4			6	3	1		1	42	167
13	23	10	24		1	1	1	2	1	2	2	30	97
14	40	3	32	2	2	1		2	2	1		36	121
15	7	1		1				2	1			9	21
16	21	1	138				2	3	2	1		10	178
17	12	4	36	1		1	1	1				28	84
18	4	2		4				1	2	1	2	24	40
19	25	16	17	2			6	6	2	1	1	46	122
20	44	17	20	2			3	3	1		1	16	107
Total	372	134	663	28	8	4	45	74	24	25	9	591	1,977
Percent Species Composition	18.8	6.8	33.5	1.4	.4	.2	2.3	3.7	1.3	1.3	.5	29.9	100.1

1/ Numbers for individual species are the average of all censuses times a factor of 2. Totals are averaged separately. True unweighted total is 3,025 drakes.

Mean/plot 98.85
Standard Error 10.79

Table 9. Distribution of Drakes per Segment in Area A.

No. of Drakes per Segment	Frequency													
	Scaup	Canvasback	Redhead	Scoter	Bufflehead	Goldeneye	Old Squaw	Widgeon	Pintail	Mallard	Shoveler	Green-winged Teal	Unidentified	Percent Total Males
0	49	139	208	99	164	206	203	137	97	159	167	183		5
1-5	96	55	2	56	46	4	6	73	105	50	42	27		35
6-10	24	8		15			1	1	6	1	1			33
11-15	14	6		14					1					24
16-20	17	2		9										17
21-25	3			4										18
26-30	3			5										13
31-35				1										15
36-40				2										10
41-45	2													5
46-50				2										5
51-55				3										8
56-60	1								1					5
61-65	1													3
66-70														1
71-75														3
76-80														1
81-85														1
86-90														1
91-95														4
96-100														
100-105														
106-110														1
111-115														
116-120														
121-125														
126-130														1
131-135														
136-140														
141-145														1
146-150														
Total Males	1,233	273	3	1,050	62	5	17	114	260	70	56	34	2,093	5,270
Percent	23.4	5.2	.1	19.9	1.2	.1	.3	2.16	4.9	1.3	1.1	.6	39.7	99.5

Total Segments - - - 210
Mean/Segment - - - - 25.095
Standard Error - - - 1.703

Table 10. Distribution of Drakes per Segment in Area B. 1/

No. of Drakes per Segment	Frequency													
	Scaup	Canvasback	Redhead	Scoter	Bufflehead	Goldeneye	Old Squaw	Widgeon	Pintail	Mallard	Shoveler	Green-winged Teal	Unidentified	Percent Total Males
0	143	198	225	179	214	221	223	183	140	208	198	215		34
1-5	65	26	2	29	13	6	4	44	81	19	29	12		91
6-10	16	2		6					6					47
11-15	1			5										19
16-20		1		1										8
21-25	1			1										10
26-30				2										5
31-35				1										2
36-40														2
41-45	1													3
46-50				1										
51-55														
56-60				1										
61-65				1										1
66-70														1
71-75														
76-80														
81-85														
86-90														
91-95														2
96-100														
101-105														1
106-110														
111-115														
116-120														
121-125														
126-130														
131-135														1
136-140														
141-145														
146-150														
Total Males	322	107	3	447	16	8	6	52	173	23	34	18	931	2,140
Percent	15.0	5.0	.1	20.9	.8	.4	.3	2.5	8.1	1.1	1.6	.8	43.5	100.1

Total Segments - - - 227
Mean/Segment - - - - 9.8
Standard Error - - - 1.098

Table 11. Drakes Observed on Breeding Population Survey Transects, 1961 and 1962.

Transect	Number of Drakes 1961	1962
1	58	20
2	65	39
3	49	52
4	84	31
5	73	9
6	71	64
7	26	40
8	137	53
9	15	43
10	33	48
11	9	28
12	45	29
13	43	36
14	61	42
15	33	61
16	14	39
17	10	24
18	30	28
19	85	41
20	8	10
Total	949	737
Mean	47.5	36.8
Standard Error	7.3	3.3

Table 12. Percent Frequency of Occurrence of Drakes Observed on Aerial Censuses. [1]

Species	Sample Plots Area A	Segments Area A	Segments Area B
Diving Ducks			
Scaup	26.8	38.8	26.6
Canvasback	9.7	8.6	8.9
Redhead	0	.1	.2
Scoter	47.8	33.1	37.0
Bufflehead	2.0	2.0	1.3
Goldeneye	.6	.2	.7
Old Squaw	.3	.5	.5
Sub-total	87.2	83.3	75.2
Dabbling Ducks			
Widgeon	3.2	3.6	4.3
Pintail	5.3	8.2	14.3
Mallard	1.7	2.2	1.9
Shoveler	1.8	1.8	2.8
Green-winged Teal	.7	1.1	1.5
Blue-winged Teal	0	0	0
Sub-total	12.7	16.9	24.8
Total	99.8	100.2	100.0
Total Observations	1,386	3,177	1,209

[1] Unidentified waterfowl are not included.

Table 13. Ratios of Air to Ground Counts of Drakes on Census Plots.

Species	Number Observed: Air Census		Number Observed: Ground Census		R 1/
Diving Ducks					
Scaup	372	159	938		.397
Canvasback	134	57	199		.673
Scoter	663	282	644		1.030
Bufflehead	30	13	50		.600
Goldeneye	11	5	47		.234
Old Squaw	4	2	18		.222
Sub-total	1,214		1,897		.640
Dabbling Ducks					
Widgeon	44	19	475		.093
Pintail	71	30	802		.089
Mallard	24	10	199		.121
Shoveler	25	11	184		.136
Green-winged Teal	9	4	181		.050
Sub-total	173		1,845		.094
Tot	1237				
Unidentified Ducks	591	522	9		65.667
Total	1,978		3,751		.527

1/ R = Number observed on air census/Number observed on ground censuses. Confidence limits on R for the total of observation and at a significance level of 95% are: .527 ± .122.

Table 14. Sex Ratios in Breeding Population by 5-day Intervals.

Species		4/27-5/1	5/2-6	5/7-11	5/12-16	5/17-21	5/22-26	5/27-31	6/1-5	6/6-10	6/11-15	6/16-20	6/21-25	4/26-7/3
Scaup	♂:♀				1:1	24:18	36:20	325:185	236:162	195:137	155:91	10:4	51:14	134:38
	%♂						64.2	63.7	63.5	58.8	63.0		78.5	
Canvasback	♂:♀			1:1	4:3	3:3	3:3	49:20	76:43	23:13	35:24		123:21	8:13
	%♂							71.0	63.9	64.0	59.4		85.4	
Redhead	♂:♀						1:1	1:1		1:1	1:1		6:0	
White-winged Scoter	♂:♀							259:108	79:47	133:118	10:8	10:9	23:29	68:39
	%♂							70.5	62.6	53	55.5		44.2	
Surf Scoter	♂:♀							2:2	10:4	6:6	1:0			2:2
Bufflehead	♂:♀	2:2				1:1	1:1	12:9	10:3	8:6	10:11	3:0	5:0	
Barrows Goldeneye	♂:♀							4:2		1:0				2:3
American Goldeneye	♂:♀					2:2	7:4	14:6					0:4	
Old Squaw	♂:♀							17:12		2:1				
Widgeon	♂:♀		10:8	80:55	173:115	18:11	18:12	130:60	205:62	86:23	63:20	63:13	382:24	39:15
	%♂			59.1	60.0			68.4	76.8	78.9	75.9	82.9	94.1	
Pintail	♂:♀	288:159	542:267	595:296	422:219	32:16	27:11	195:59	321:78	159:36	181:37	19:8	15:9	30:19
	%♂	64.5	67.0	66.8	65.8	66.6		76.7	80.4	81.5	83.0			
Mallard	♂:♀	6:6	1:1	43:33	41:33	4:4	5:5	33:21	62:25	46:18	36:17	8:4	38:5	18:5
				56.5	55.4			61.1	71.2	71.9	67.9		88:4	
Shoveler	♂:♀		2:2		3:2	12:7	16:8	41:29	79:51	39:18	27:9	4:1	5:1	3:3
								58.6	60.8	68.4				
Green-winged Teal	♂:♀	1:1		9:10	16:12	5:4		37:16	68:20	35:12	21:5	7:1	6:0	15:3
								69.8	77.3					
Blue-winged Teal	♂:♀							2:2		3:2				

Table 15. Pre-incubation Period Sex Ratios

Species	Start of Incubation 1/	No. of Males Observed	No. of Females Observed	Percent Males 2/
Lesser Scaup	June 17	972	614	61.2 ± 2.6
Canvasback	June 1	60	30	66.7 ± 10.4
Scoter	June 17	500	293	63.1 ± 3.6
Bufflehead	June 1	16	13	55.1
Goldeneye	June 1	24	16	60.0
Old Squaw	All observations	19	13	59.4
Widgeon	May 27	299	201	59.8 ± 4.4
Pintail	May 17	1,705	889	65.7 ± 1.9
Mallard	May 27	100	82	54.9 ± 7.7
Shoveler	May 22	17	11	60.7
Green-winged Teal	June 1	68	43	61.3 ± 9.6

1/Estimated by arbitrarily subtracting 20 days from period in which first broods were hatched.

2/Indicated confidence limits are at a significance level of 95 percent. The average proportion of males for all species with weighting proportional to percent frequency of occurrence, was 61.9 percent.

Table 16. Observations of Broods by Age Class in 5-day Intervals.

Species	June 26-30	July 1-5	6-10	11-15	16-20	21-25	26-30	August 31-4	5-9	10-14	15-19	Total
Widgeon												
Ia	1	3	11	1	1	1	1	1				20
b		1	19	3	3	5	1	5				37
c			11	9	5	6	7	3	1	1		43
IIa			2	6	5	3	4	7	7	3	1	38
b				1	3	13	5	21	15		6	64
c					1	2		9	8	4	9	33
III								2	6	9	7	24
F										1	4	5
Pintail												
Ia												
b			5	1			1	1				8
c			6				2					8
IIa			3	2	2	1	1	2				11
b			2		1	4	2	4	1			14
c			2		1			3				6
III					1	6	4	6	1	3		21
F								4	3	3		10
Mallard												
Ia			2									2
b			3									3
c			2	1	1	1						5
IIa						3						3
b					1			1				2
c										1		1
III										2	2	4
F								1			1	2
Shoveler												
Ia				1	1							2
b			6		1			2				9
c			1	1	1	2		5	1			11
IIa			1	1			1	4			1	8
b						2	2	2	1	1	1	9
c						1	1	2				4
III					(2)			6	5	6	1	20
F					have to headset				1		1	2

Table . 16. Observations of Broods by Age Class in 5-day Intervals. (continued)

Species	June	July						August				
	26-30	1-5	6-10	11-15	16-20	21-25	26-30	31-4	5-9	10-14	15-19	Total
Green-winged Teal												
Ia			5		1		1					7
b			7		1		1	2				11
c			6		4		2	1				13
IIa			2		6	1		2				11
b					3		2	1	1	1		8
c						1		3	1	1		6
III						4		3	3			10
F										2	2	4
Scaup												
Ia			2		1	2	1	5	1	2		14
b					7	1	3	19	7	8	1	46
c					1	1	1	17	15	14	5	54
IIa					1		2	5	13	20	3	44
b									1	9	12	22
c										1	2	3
III												
F												
Canvasback												
Ia			8			2						10
b			4	2	2	1		1				10
c			1	4	2			1				8
IIa						1		2	2			5
b							2	2	3	2	1	10
c									3	6	1	10
III										3	2	5
F												
Scoter												
Ia				2	1	3	1	5	2			14
b						3	1	3	4	2		13
c								2	7	11	1	21
IIa								1	2	10	3	16
b										1	5	6
c												
III												
F												

Table 16. Observations of Broods by Age Class in 5-day Intervals. (continued)

Species	June 26-30	July 1-5	6-10	11-15	16-20	21-25	26-30	August 31-4	5-9	10-14	15-19	Total
Bufflehead												
Ia												
b			1	1	1							3
c				1	2	1						4
IIa						1		1				2
b					1	1		2	1	1		6
c								1	1	1		3
III										3	3	6
F												
Goldeneye												
Ia								1				1
b			1			1						2
c												
IIa												
b						1	1		1			3
c						2		1	1	1		5
III										2	2	4
F												
Totals	1	4	113	37	64	77	50	172	119	135	77	849

Table 17 . Chronology of Hatching[1]

Species	June					July							August			Total
	6-10	11-15	16-20	21-25	26-30	1-5	6-10	11-15	16-20	21-25	26-30	31-4	5-9	10-14		
Widgeon																
#			6	25	54	41	60	39	21	16	3	1				266
%			2	9	20	15	23	15	8	6	1	t[2]				99
Pintail																
#	3	8	5	14	16	18	6	2	4	1	1					78
%	4	10	6	18	21	23	8	3	5	1	1					100
Mallard																
#			1	1	4	7	8	1								22
%			5	5	18	32	36	5								101
Shoveler																
#		2	2	8	11	15	6	9	2	6	1					62
%		3	3	13	18	24	10	15	3	10	2					101
Green-winged Teal																
#				6	10	16	18	5	9	3	3					70
%				9	14	23	26	7	13	4	4					100
Lesser Scaup																
#					? 1	1	5	15	43	52	37	17	9	3		183
%					1	1	3	8	24	28	20	9	5	2		101
Canvasback																
#				4	16	12	16	5	2	3						58
%				7	28	21	28	9	3	5						101
Scoter																
#							1	8	19	16	16	8	2			70
%							1	11	27	23	23	11	3			99
Bufflehead																
#				1	1	7	9	5	1							24
%				4	4	29	38	21	4							100
Goldeneye																
#				2	1	5	3	2	1			1				15
%				13	7	33	20	13	7			7				100
Total																
#	3	10	14	61	114	122	132	91	102	97	61	27	11	3		848
%	t[2]	1	2	7	13	14	16	11	12	11	7	3	1	t[2]		98

1/ Hatching dates were determined by estimating age of broods as described by Gallop and Marshal (1954) with each age class shortened one day to compensate for the accelerated growth occurring in arctic environments. Age classes for species with similar growth rates were used for species which were not described by these authors, i.e., blue-winged teal, canvasback, widgeon, and scaup for green-winged teal, scoter, bufflehead, and goldeneye respectively.

2/ Less than .5 percent.

Table 18. Observations of Broods and Estimated Total of Different Broods on Census Plots.

Plot	No. Observed First Census	No. Observed Second Census	Estimated No. New Brood on Second Census	Total Broods
1	20	37	25	45
2	9	33	25	34
3	12	13	5	17
4	66	71	29	95
5	9	22	18	27
6	36	14	2	38
7	8	22	19	27
8	11	5	1	12
9	2	2	0	2
10	16	28	22	38
11	12	20	9	21
12	24	91	71	95
13	24	32	17	41
14	24	13	9	33
15	16	11	6	22
16	3	14	13	16
17	8	11	5	13
18	19	5	0	19
19	23	55	34	57
20	24	13	4	28
Total	366	512	314	680

Mean/plot 34.00
Standard Error 5.48

Table 19. Species Composition of Broods on Census Plots. 1/

Plot	Scaup	Canvasback	Redhead	White-winged Scoter	Surf Scoter	Bufflehead	Goldeneye	Widgeon	Pintail	Mallard	Shoveler	Green-winged Teal	Unidentified	Total
1	13	3		4		2	1	16	1	1	2	2		45
2	9	1		1		1	1	17	1		2	1		34
3	1	4		2				8	1				1	17
4	8	6	1					25	18	6	13	16	2	95
5	9			7				7	1	3				27
6	5	2		1				19	4	3	3	1		38
7	13			5	1			4			2	2		27
8	3			2	1				1	1		4		12
9	2													2
10	4	1						14	11		4	4		38
11	7	3					2	7			1		1	21
12	48	6		12		1		9	5	3	6	5		95
13	11	3		3	1			10	2	3	4	4		41
14	8			3		2		9	7			4		33
15		1				4	4	4	2	2	1	4		22
16	4	1		6				3	1	1				16
17	2	2		5			1	1	1	1				13
18	5	1				1	1	1	2		2	6		19
19	13	4		1		2	1	29	3		2	2		57
20	2	3		2				14			3	4		28
Total	167	41	1	54	3	13	11	197	61	24	45	59	4	680
Percent	24.55	6.03	.15	7.94	.44	1.91	1.62	28.97	8.97	3.53	6.62	8.68	.59	100.00

1/ Figures delete observations which were possibly duplicate.

Table 20. Nesting Success.

Species	No. of Females	No. of Broods	Percent Females With Broods
Lesser Scaup	594	167	28.1
Canvasback	99	41	41.4
Redhead	1	1	100.0
White-winged Scoter	364	54	14.8
Surf Scoter	13	3	23.1
Bufflehead	22	13	59.1
Goldeneye	31	11	35.5
Old Squaw	12	0	0
Widgeon	319	197	61.7
Pintail	419	61	14.6
Mallard	163	24	14.7
Shoveler	119	45	37.8
Green-winged Teal	143	59	41.2
Blue-winged Teal	2	0	0
Unidentified	6	4	67.3
Totals	2,307	680	29.5

Table 21. Average Brood Sizes. 1/

Species	Total Broods	Total Young	Young Per Brood
Scaup			
I	73	519	7.11
II	52	339	6.52
III	0	---	----
Canvasback			
I	18	91	5.06
II	19	99	5.21
III	0	--	----
Scoter			
I	28	197	7.04
II	9	60	6.67
III	0	--	----
Bufflehead			
I	5	30	6.00
II	7	35	5.00
III	1	5	5.00
Goldeneye			
I	1	13	13.00
II	3	20	6.67
III	3	18	6.00
Widgeon			
I	42	272	6.48
II	55	350	6.36
III	4	31	7.75
Pintail			
I	4	16	4.00
II	11	60	5.45
III	10	56	5.60
Mallard			
I	3	19	6.33
II	4	22	5.50
III	2	15	7.50
Shoveler			
I	6	32	5.71
II	11	76	6.91
III	8	59	7.38
Green-winged Teal			
I	15	99	6.60
II	13	83	6.38
III	4	21	5.25
Totals			
I	196	1,296	6.61
II	185	1,153	6.23
III	31	196	6.32

1/=Includes only observations by Lensink and Eisenhart.

Table 22. Estimates of Total Adults and Young on Census Plots.

Plot	Males	Females	Total Adults	Broods	Total Young	Total Population
1	234	144	378	45	280	658
2	214	132	346	34	212	558
3	179	110	289	17	106	395
4	194	119	313	95	592	905
5	316	194	510	27	168	678
6	287	177	464	38	237	701
7	195	120	315	27	168	483
8	103	64	167	12	75	242
9	89	55	144	2	12	156
10	132	81	213	38	237	450
11	135	83	217	21	131	349
12	374	230	604	95	592	1,196
13	136	83	219	41	255	474
14	256	158	414	33	206	620
15	44	27	71	22	137	208
16	118	73	191	16	100	291
17	102	63	165	13	81	246
18	81	50	131	19	118	249
19	453	279	732	57	355	1,087
20	109	67	176	28	174	350
Total	3,752	2,309	6,061	680	4,236	10,297
Mean	187.55	115.45	303.05	37.00	211.8	514.85
Standard Error	23.79	13.86	38.38	5.48	34.1	64.95

Table 23. Estimate of the Fall Population.

Area	Source of Estimate	Adults	Young	Total	Confidence Limits 1/
A	Mean/unit expansion of ground censuses (Table 22)	288,000	201,000	489,000	± 26.4%
B	Aerial censuses corrected by ratio of air to ground censuses on sample plots (Table 13)	202,000	141,000	343,000	± 23.1%
Total		490 484,000	342 ~~345~~,000	832,000	± 25.0%

1/ Confidence limits are calculated for a significance level of 95%.

Table 24. Species Composition of the Fall Population.

Species	Percent
Lesser Scaup	25.5
Canvasback	5.0
Redhead	.1
White-winged Scoter	13.1
Surf Scoter	.5
Bufflehead	1.6
Goldeneye	1.4
Widgeon	19.9
Pintail	15.1
Mallard	5.0
Shoveler	6.0
Green-winged Teal	6.5
Others 1/	.5
Total	100.2

1/Blue-winged Teal, red-breasted mergansers, and old squaw.

Table 25. Location of R ecoveries from Waterfowl Banded on the Yukon Flats.

Species	Number Banded	Number Returns	Location of Recovery						
			Alaska	Canada	Pacific Flyway	Central Flyway	Mississippi Flyway	Atlantic Flyway	Mexico
Scaup	8,383	156	5	13	23	31	65	14	5
Canvasback	644	18		6	11			1	
White-winged scoter	464	2	1				1		
Bufflehead	1,234	2	1	1					
Barrow's Goldeneye	2,737	25	24	1					
Widgeon	3,455	276	13	41	201	6	11	1	3
Pintail	799	35		14	16	3	1	1	
Mallard	152	19	4	9	6				
Shoveler	334	39		1	37	1			
Green-winged teal	99	4			2	1	1		
Canada goose	5	2			2				
Total	18,326	578	48	86	297	42	79	17	8

Table 26. Distribution of Harvest of Ducks from the Yukon Flats. 1/

Location	Percent
Alaska	5.8
Canada	20.0
United States	
Pacific Flyway	57.6
Central Flyway	6.0
Mississippi Flyway	8.3
Atlantic Flyway	1.9
Mexico, Dominican Republic, and Panama	.5
Total	100.1

1/ Calculated from band recoveries listed in Table 25, with weighting proportional to species composition and recovery rate.

Winter Distribution of Ducks from the Yukon Flats as Indicated by Band Returns [1]

Species [2]	Pacific Flyway	Central Flyway	Miss. Flyway	Atlantic Flyway	Mexico	Total
Lesser scaup	44,000	57,000	122,000	26,000	10,000	260,000
Canvasback	46,000			4,000		50,000
Widgeon	180,000	6,000	10,000	1,000	3,000	200,000
Pintail	114,000	21,000	7,500	7,500		150,000
Mallard	50,000					50,000
Shoveler	58,000	2,000				60,000
Green-winged teal	33,000	16,000	16,000			65,000

[1] Populations are based on a fall flight of a million ducks from the Yukon Flats, and on band returns which are not weighted for differences in shooting pressure or reporting rates. Thus, for example, the indicated canvasback population for the Atlantic Flyway may be too small because seasons were closed there, but were open in the Pacific in some years.

[2] Species not included in tabulation include scoter, bufflehead, goldeneye, and merganser; in aggregate these number about 170,000.

Table 27. Canada Geese Observed on Sample Plots.

Plot	Lone Adults	Pairs	Flocks	Total
1				0
2				0
3	1			1
4		3	7	13
5		1		2
6				0
7				0
8		15	15	45
9				0
10				0
11	1	1		3
12		2		4
13		1		2
14				0
15	1	4		9
16				0
17	1	2		5
18				0
19				0
20		1		2
Totals	4	29	22	86

Mean/plot - - - - -4.30
Standard Error- - -2.27

Table 28. Cranes Observed on Census Plots.

Plot	Single	Pair	Flock	Total
1		1		2
2				0
3	1	2		5
4		2		4
5	1	3		7
6			5	5
7		1		2
8	2	7		16
9				0
10				0
11		1		2
12	3	3		9
13		1		2
14				0
15				0
16				0
17	1			1
18				0
19				0
20		1		2
Totals	8	22	5	57

Mean/plot----------2.85
Standard Error---------- .90

Table 29. Arctic Loons Observed on Census Plots 1962

Plot	Adults			Broods			
	Flocks or Singles	Pairs	Total Adults	One Young	Two Young	Total Young	Total
1	2	1	4		1	2	6
2	4	3	10	1		1	11
3		2	4			0	4
4	1	1	3			0	3
5	1	1	3			0	3
6		5	10			0	10
7	5	8	21	1	1	3	24
8	7	18	43	4	3	10	53
9	1	1	3			0	3
10		1	2			0	2
11	1	4	9			0	9
12	4	17	38	1	2	5	43
13	3	3	9	1		1	10
14	2	6	14			0	14
15			0			0	0
16	2	3	8			0	8
17		2	4			0	4
18	1	5	11	2		2	13
19	1		1			0	1
20	4	4	12	1		1	13
Totals	39	85	209	11	7	25	234
Mean			10.45			1.25	11.70
Standard Error			2.57			.55	3.08

Table 30. Grebes Observed on Census Plots.

Plot	Horned Grebes			Red-necked Grebes		
	Adult	Young	Total	Adult	Young	Total
1	4	2	6	6	1	7
2	2	5	7	9	7	16
3	5	3	8	15	5	20
4	11	7	18	1	2	3
5	23	11	34	18	11	29
6	12	2	14	2	0	2
7	9	3	12	2	2	4
8	2	0	2	1	0	1
9	2	0	2	6	0	6
10	22	8	30	6	8	14
11	16	0	16	0	0	0
12	25	14	39	18	11	29
13	14	9	23	8	5	13
14	6	0	6	16	2	18
15	0	0	0	0	0	0
16	0	0	0	8	2	10
17	6	2	8	9	1	10
18	4	3	7	2	4	6
19	8	8	16	4	16	20
20	5	3	8	8	4	12
Total	176	80	256	139	81	220
Mean	8.80	4.00	12.80	6.95	4.05	11.00
Standard Error	1.70	.93	2.50	1.31	.89	1.99

Table 31. Check List of Birds Observed on the Yukon Flats.

Species	Status	
Common Loon	Common summer resident	*1/
Artic Loon	Common summer resident	*
Red-throated Loon	Common summer resident	
Red-necked Grebe	Common summer resident	*
Horned Grebe	Common summer resident	*
(Trumpeter) Swan	Occasional summer resident	*
Canada Goose	Common summer resident	*
Black Brant	Occasional migrant	
White-fronted Goose	Common summer resident	*
Snow Goose	Common spring migrant	
Pintail	Common summer resident	*
Green-winged Teal	Common summer resident	*
Blue-winged Teal	Occasional summer resident	*
Widgeon	Common summer resident	*
Shoveler	Common summer resident	*
Redhead	Occasional summer resident.	*
Ring-necked Duck	Rare visitor	
Canvasback	Common summer resident	*
Greater Scaup	Occasional visitor	
Lesser Scaup	Common summer resident	*
American Goldeneye	Common summer resident	? 2/
Barrow's Goldeneye	Common summer resident	?
Bufflehead	Common summer resident	*
Old Squaw	Common migrant	
White-winged Scoter	Common summer resident	*
Surf Scoter	Common summer resident	*
King Eider	Two killed & identified by Eskimoes in Beaver	
Red-breasted Merganser	Occasional summer resident	*
Goshawk	Occasional summer resident	
Sharp-shinned Hawk	Status unknown	
Red-tailed Hawk	Common summer resident	*
Harlan's Hawk	Status unknown	
Rough-legged Hawk	Status unknown	

Table 31. Check List of Birds Observed on the Yukon Flats. (continued)

Species	Status	
Bald Eagle	Occasional summer resident	*
Short-eared Owl	Common summer resident	
Boreal Owl	Status unknown	
Kingfisher	Occasional summer resident	
Red-shafted Flicker	A single observation by C. F. Yokum	
Northern Flicker	Common (permanent) resident	*
Hairy Woodpecker	Common (permanent) resident	
Downy Woodpecker	Common (permanent) Resident	
Black-backed Three-toed Woodpecker	Status unknown	
Northern Three-toed Woodpecker	Status unknown	
Northern Say's Phoebe	Common summer resident	
Alder Flycatcher	Common summer resident	
Wood Pewee	Status unknown	
Olive-sided Flycatcher	Common summer resident	
Pallid Horned Lark	Common migrant	
Violet-green Swallow	Common summer resident	*
Tree Swallow	Common summer resident	*
Bank Swallow	Common summer resident	*
Cliff Swallow	Common summer resident	*
Alaska Gray Jay	Common (permanent) resident	
Northern Raven	Common (permanent) resident	
Yukon Black-capped Chickadee	Common (permanent) resident	
Alaska Gray-headed Chickadee	Common (permanent) resident	
Robin	Common summer resident	*
Varied Thrush	Common summer resident	
Hermit Thrush	Common summer resident	
Olive-backed Thrush	Common summer resident	
Gray Cheeked Thrush	Common summer resident	
Wheatear	Occassional migrant	
Water Pipit	Common migrant	
Bohemian Waxwing	Common summer resident	

Table 31. Check List of Birds Observed on the Yukon Flats. (continued)

Species	Status	
Northwestern Shrike	Occasional summer resident	
Yellow Warbler	Common summer resident	*
Myrtle Warbler	Common summer resident	
Blackpoll Warbler	Common summer resident	
Northern Waterthrush	Common summer resident	
Rusty Blackbird	Common summer resident	*
Pine Grosbeak	Common summer resident	
Marsh Hawk	Common summer resident	
Osprey	Common summer resident	*
Peregrine Falcon	Occasional migrant, possibly a summer resident	
Pidgeon Hawk	Occasional migrant, possibly a summer resident	
Sparrow Hawk	Common summer resident	
Spruce Grouse	Common (permanent) resident	*
Ruffed Grouse	Common (permanent) resident	*
Willow Ptarmigan	Common winter resident	
Sharp-tailed Grouse	Common (permanent) resident	*
Coot	Rare visitor	
Little Brown Crane	Common summer resident	*
Semipalmated Plover	Common summer resident	*
Golden Plover	Common migrant	
Black-bellied Plover	Common migrant	
Wilson's Snipe	Common summer resident	*
Upland Plover	Common migrant	
Hudsonian Whimbrel	Occasional migrant	
Spotted Sandpiper	Common summer resident	*
Solitary Sandpiper	Common summer resident	
Lesser Yellowlegs	Common summer resident	*
Pectoral Sandpiper	Common migrant	
Western Sandpiper	Common migrant	
Least Sandpiper	Status unknown	
Red-backed Sandpiper	Status unknown	
Long-billed Dowitcher	Common migrant	
Semipalmated Sandpiper	Status unknown	

Table 31. Check List of Birds Observed on the Yukon Flats. (continued)

Species	Status	
Sanderling	Occasional migrant	
Northern Phalarope	Common summer resident	*
Long-tailed Jaeger	A single observation by Lensink	
Glaucous Gull	Common migrant	
Herring Gull	Common summer resident	*
Short-billed Gull	Common summer resident	*
Bonaparte's Gull	Common summer resident	*
Artic Tern	Common summer resident	*
Great Horned Owl	Common (permanent) resident	*
Snowy Owl	Occasional winter visitor	
Hawk Owl	Common summer resident	*
Great Grey Owl	Rare summer resident	
Gray-crowned Rosey Finch	~~Status unknown~~ Early spring migrants	
Hoary Redpoll	Status unknown	
Mealy Redpoll	Common summer resident	
White-winged Crossbill	Common summer resident	
Savannah Sparrow	Common summer resident	*
Slate-colored Junco	Common summer resident	*
Tree Sparrow	Common summer resident	*
White-crowned Sparrow	Common summer resident	*
Fox Sparrow	Common summer resident	
Lincoln's Sparrow	Common summer resident	
Alaska Longspur	Common migrant	
Snow Bunting	Common migrant	

1/ Nesting records were obtained for species marked with an asterisk.

2/ Goldeneye broods or nesting females have not been identified to species but adults of both species are common.

Table 32. List of Aquatic and Marsh Plants of the Yukon Flats.

Species	Occurrence 1/	
	Bog Lakes	Other Lakes
Andromeda polifolia L.	C	
Beckmannia syzigachne (Steud.) Fern.		O
Bidens cernua L.		C
Calamagrostis canadensis (Michx) Beauv.		C
Calla palustris L.	O	
Callitriche autumnalis L.		O
Caltha natans Pallas	C	
Carex aquatilis Wahlenb.		C
C. rostrata Stokes		C
Ceratophyllum demersum L.		O
Chamaedaphene calyculata (L.) Moench	C	
Chara spp.		O
Equisetum arvense L.		C
E. limosum L.		C
Eriophorum spp.	C	
Glyceria spp.		C
Hippuris vulgaris L.		C
Hordeum jubatum L.		C
Iris setosa Pall. ex Link.		O
Juncus spp.		C
Ledum palustre L. ssp. *decumbens* (Ait.) Hult.	C	
L. palustre L. ssp. *groenlandicum* (Oeder) Hult.	C	
Lemna minor L.		C
L. trisulca L.		C

Table 32. List of Aquatic and Marsh Plants of the Yukon Flats (continued)

Species	Occurrence 1/	
	Bog Lakes	Other Lakes
Menyanthes trifoliata L.	C	
Myriophyllum alterniflorum D. C.		R
M. spicatum L. ssp. exalbescens (Fern.) Hult		C
Nuphar polysepalum Engelm.	C	
Nymphaea tetragona Georgi ssp. Leibergii (Morong) Pors.	C	
Parnassia palustris L. ssp. neogaea (Fern.) Hult.		C
Polygonum amphibium L. ssp. laevimarginatum Hult.		C
Potamogeton filiformis Pers.		O
P. gramineus L.		C
P. interior Rydb.		O
P. natans L.	C	
P. pectinatus L.		C
P. perfoliatus L. ssp. Richardsonii (Benn.) Hult.		C
P. porsildorum Fern		C
P. praelongus Wulf		C
P. pusillus L.		C
P. vaginatus Turcz		C
P. zosteriformis Fern.		C
Potentilla palustris (L.) Scop		C
Ranunculus gmelini DC.		C
R. trichophyllus Chaix in Villars (=aquatilis in Anderson)		C
Ricciocarpus natans (L.) Corda		C
Rumex fenestratus Greene		C
Sagittaria cuneata Sheldon		C

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