Regional Copper-Nickel Study

Waterfowl Characterization Report

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Dick Huempfner
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1.0 INTRODUCTION

The drainage of wetlands in the United States, as elsewhere in the world, has been viewed as a necessary step in civilization's expansion. As a result, the total habitat available for waterfowl as well as numerous species of song birds, fur bearers, reptiles, amphibians, fish, ame mammals and aquatic plant communities has been seriously reduced. It is estimated that in the United States alone (Shaw and Frendine, 1971, p44 (19070)) "... that at least 45 million acres (18.2 million hectares) of the original 127 million acres (51.4 million hectares) of natural wetlands has been drained or otherwise destroyed."

Shaw and Frendine (1971, p17, Table 6 (19090)) have classified approximately 90 percent of the wetlands in the United States which are used or have potential for use by waterfowl. On their brood scale, Minnesota was ranked no. 4 of all the states in availability of wetlands with a total of 6.78 percent (5,044,900 acres (2,042,470 hectares) of a total of 74, 439, 300 acres (30, 137, 368 hectares)). However, it appears that less than 2 percent of Minnesota's wetlands according to this inventory (Appendix A, Figure 1) occurs within the boundaries of the Regional Copper-Nickel Study Area (Study Area) Figure 1. In addition, all of the wetlands present were classified as being of "lesser importance" to waterfowl.

The northern forested lake states (Minnesota, Wisconsin and Michigan) have generally received low priority by the Fish and Wildlife Service during establishment of census routes used to estimate the continental waterfowl population (March et al. 1973, p2, (13064)). This is due to the low waterfowl densities present relative to the prairie states and prairie provinces of Canada. There are currently no census programs in this forested region of the United States (Benning et al. 1973, p23, 36 (02033)), in the boreal forest region of Northwestern Ontario since 1960 (Henny et al. 1972, App Table E1 (08045)).

1.1 Justification for Studing Waterfowl in Low Density Forested Regions.

There are indications that the emphasis of waterfowl research is and will be changing to include forested regions in the future. Wisconsin's contribution to duck production in the Mississippi Flyway has recently been demonstrated by a state-sponsored 5 year population study (March et al. 1973 (13064)). Several researcher's working in Minnesota have also indicated the stability

potential future importance of these forested ecosystems to waterfowl. Mathison 1966, p24, 28, 29 (13047), working at the Chippewa National Forest in north central Minnesota suggested that "Drainage of prairie wetlands continues to remove production habitual from the waterfowl flyways. Periodic drought in the prairie region has had catastrophe effects on waterfowl populations. " ... It is evident that the Chippewa National Forest makes a substantial contribution to the Mississippi Flyway population. The future of waterfowl may well depend on the so called peripheral breeding zones such as the wooded region, where production is perhaps not spectacular, but it is relatively constant. Certainly, woodland areas deserve future study and evaluation." This indeed has been done in this forest by subsequent studies conducted during the breeding season (Gilman 1971 (07025), Riechmann 1976 (10030), brood rearing (kirby 1973 (11043), Ball 1973 (02042)), and fall movements hunting season response of waterfowl (Kirby 1976 (11028).

An earlier study by Marshall and Co-worker (1959, p125 (13049)) on Lake Itasca in north central Minnesota emphasized waterfowl habitual use on a lake surrounded predominantly with spruce-balsam fur and aspen forest, and possessing " ... a band of emergents almost entirely around the lake ..." This information indicates a relatively low production, chiefly of mallards, on a per mile of shoreline basin in eutrohic lakes surrounded by forest types. However, when one visualizes the large number of lakes of this type in the forested regions of Minnesota, it becomes apparent that there is a considerable production of waterfowl."

In addition to the low but relatively stable waterfowl populations currently using forested regions, future studies using sophisticated techniques such as radio telemetry (Gilmer 1971 (07025), Ball 1973 (02042), Kirby 1976 (11028)) may document shifts from the prairie to forest habitats by breeding ducks during drought periods, as has been documented for prairie nesters moving to the Artic regions during similar severe conditions (Hanson and McKnight 1964 (08028)).

1.2 Purpose of the Aerial Waterfowl Census

The main source of field data was an erial waterfowl census conducted in April and May of 1977. The purpose of the census was to; 1) ennumerate migrating waterfowl in the area and 2) to identify lakes, rivers and creeks

that receive the predominant use, ranking them and the watersheds they occur in by their relative importance to migrate.

In this way, the threat of water pollution, the use of water for mining operations, the physical location of tailings ponds, and other related technical problems of copper-nickel mining in this region relative to waters use and feeding areas of a migratory species may be evaluated on an individual lake, river or watershed basis.

Direct aerial census of the breeding populations was not conducted due to the financial and manpower requirements of such a study. However, estimates of the probable breeding density have been calculated using density estimates for the ' low density' forested region of Wisconsin obtained during a five year aerial census in that state (March et al. 1973 (13064)).

2.0 METHODS

2.1 Census Route Establishment and Proportion of Water Areas Censused

The route flown for the aerial waterfowl census (Fig. 1) was designed to cover the majority of shoreline or surface area of most lakes and rivers, along with several of the larger creeks, originating on or traversing the study area. In all, 58 different lakes and ponds, 8 different creeks and 6 different rivers were censused in 9 different watersheds. A total of 96.2 miles (153.6 km) of rivers and creeks (measured by a map wheel down the center of the channel) and 12564.3 acres (5019.3 hectars) of lakes and ponds were censused. This is judged to be 70-80 percent of the surface area of all lakes in the Study Area, 70-80 percent of all river mileage, and 10-15 percent of the total length of various creek systems.

The route shown in Figure 1 was plotted on more detailed township maps prepared by the United States Forest Service (USFS , _____, 2" = 1 mi. (1cm = .32km)) and included as Appendix B of this report. These maps were used in the aircraft for orientation and navigation, and allowed recording of waterfowl concentrations (espically along river systems) to a mile of shoreline by recording the section number.

2.2 Qualifications of Pilot and Observers

Mr. Don Glazer, Warden-Pilot for the Minnesota Department of Natural Resources flew each of the census flight. Mr. Glazer is an experienced pilot, and has flown many low level census on a variety of wildlife species.

The same two observers were used on each flight, thus reducing observer bais which can greatly affect the count from one period to another.

Observers' were; Dick Huempfner and Lee Pfannmuller both biologists from the MDNR assigned to the Copper-Nickel Study. Although both observers are experienced in waterfowl identification from the ground, neither had previous experience at waterfowl identification from an aircraft. Since this 'art' requires a great deal of prior experience, the aerial census is strictly an ennumeration of the individual waterfowl observed on a particular lake, creek or river, with no breakdown by species. After the initial flight, the observers felt confident that common merganson goldeneyes, mole mallards probable scaup could be accurately identified, the lack of corroboration from ground checks forced in to use all duck observations as simply the number of individuals present. This number was later converted to ducks per acre-hectars of lakes searched per mile-km of river or creek flown. The number of great blue heron, gulls (primarily herring gulls), canadian geese and loons were for the most part, readily identifiable and recorded by species.

2.3 Census Schedule

A preliminary non-census flight was made on 6 April to familarize the pilot and the observers with the route and to determine what changes , if any, would use air-time more efficently. Ice was present and partially or entirely covered some lakes, although most fast flowing rivers were open. The first of three census flights were on 22 April (approximately 7-12 days after'ice-out'on most lakes), 27 April and 6 May 1977. Since dabbler species usually return to breeding areas 1-2 weeks before divers (Dzubin 1967, p187 (04020)), with the interval for optimum census of all breeding ducks ranges from April 24 - June 6 (depending on whether they are early, mid or late nesters). The two week interval during which this census was conducted was probably adequate to ennumerate the relative numbers of both groups during migration. Additional evidence for the adequacy of these techniques is the similarity of the first two counts (n = 801 and 810). The third census showed sharp reduction on 6 May

to only 442 ducks (Table 1). This reduction probably caused in part by the early initiation of nesting by some species (Dzubin, 1967; p198 (04020), Moyle (Ed) 1964; p22 (13063)) but probably also represented a movement of many migrants further north to their breeding grounds.

2.3a Sampling Philosophy and Techniques

The objectives of the current study were to ennumerate migrating waterfowl on the major reivers and lakes in the study area. The route could not be randomly determined initially as is done during many flights conducted by the US Fish and Wildlife Service (USFWS) (US Bureau of Sport Fishery and Wildlife, 1969 (21008)) to determine spring breeding indexes each year. Although many of the techniques recommended in this paper were adapted, our attempt to census most permanent water areas was more in line with fall census studies conducted by Kirby (1976, p158 (11028)) at Chippewa National Forest in northcentral Minnesota. Details of the mechanics of the present census are as follows: 1) the same aircraft (Cessna 180), pilot and observers were used to conduct all three census to reduce bias (Caughley 1974 (03024)); 2) the route was flown at 100-200 ft. (30-60m) about the ground at an average air speed of 85mph; 3) all census were started between 30-60 minutes after sunrise, the entire route being covered in 2.5-3.0 hours. Morning census programs produced the most accurate waterfowl estimates during the breeding season (Smith 1956 (19066); Rogers 1964 (18029); Dzubin 1967 (04020); Diem and Lu 1960 (04021)). There is no evidence to suggest that this pattern would be different during migration. Early morning periods also provide better light conditions for observation (less surface glare) and more stable flight conditions; 4) all waterfowl were recorded, regardless of their proximity to shorelines. The exception was Birch Lake where all ducks were counted within one-quarter mile of shore. However, due to the low density of ducks on this lake, enough time was spent observing the center protion of the lake to give us confidence that few, if any, groups of divers using this area were mined. The census on the remaining lakes was completed for the entire water surface area, recognizing the inherant visibility bias for all aerial census techniques (discussed further (p__). Since the census occured in advance of leaf-out, this was not a complicating factor when censusing rivers or creeks; 5) all flights, especially over lakes, were made along a course which to allowed the best possible use of available light, and reduced surface glare. If large duck concentrations could not be counted accurately on the first pass,

another pass was made and the maximum number counted as recorded. All ducks whether on shore, in the water or flying were recorded. 6) During each census, one observer sat in the seat next to the pilot to assist with navigation, record data and observe as much as possible. Data were recorded by section number on a previously prepared checklist. The second observer, sitting in the rear seat, was free to move from one side of the plane to the other to maximize observation time. When rivers and creeks were being censused, a course was flown to allow both observers to census and maximum observations were recorded.

The three census flights, each lasted about three hours and covered 250 air miles and required 18 hours of observation time (9 hours per observer), excluding the pilots time.

2.4 Limitations and Biases of all Aerial Census

Dzubin (1967 (040203)), in a comprehensive and often referenced paper, presents comparisons between ground counts on two different study areas in Manitoba and Sashatchewon. His recommendations on waterfowl behavior census techniques and timing, data intermetation, and the problems with all census, including aerial census, were used for this study. Dzubin (1967) states that "Spring and summer duck population estimates, whether based on direct air or ground counts, remain relatively inexact. Even more inexact is the accurate assessment of absolute seasonal populations of pairs attempting to breed in a stratum, alon a transect, or on a sample block." Some of the problems affecting these "breeding season" estimates (and most surely affect the distributions in time and spare of migrants) include " ... weather, breeding phenology, asynchronous nesting periods, vegetative growth, species present and their daily activity, previous field experience of personnel, plus others ..."

Although all of these factors enter into the final interpretation, the single most important problem is the differences between the 'actual' number of ducks present based on ground census and the number reported when the same area is aerial censused. Martinson et al. (1967, p1 (13050)) stated, "The purpose of the "air ground comparison study" was to evaluate factors affecting the aerial "visibility" of waterfowl and to develop a method to correct or adjust aerial waterfowl breeding population indexes for "visibility bias". Air: ground ratios are also affected by the species

composition on the area at the time of the census. Martinson et al. (1967, p4 (13050)), in summarizing USF and WS data concluced that " ... about a third of all ducks present are recorded from the air in Canadian areas while less than one-fourth are recorded in the Tristate Area (north and south Dakota and Minnesota). This disparity is due mainly to the preponderance of blue-winged teal in the Tristate area which contribute to the low air: ground ratios." Census data for Minnesota is from the western-northwestern portion of the state and comes from MDNR studies.

Air:ground ratios for the Tristate area for all species and for a four year period were 0.246 (1963), 0.225 (1964), 0.223 (1965) and 0.213 (1966), averaging 0.227 for this four year period (Martinson et al. 1967, p1 (13050)). A five year average in Wisconsin (March et al. 1973, Table 3, p9 (13064)) for all species was 0.199 (420/2112). This later ratio is probably more representative of the Study Area because a large portion of the area censused each year was in forested regions. Sample sizes were too small to compute separate air:ground ratios for the largely open SE/central region vs the primarily forested low density regions (p4, p8).

All data presented on tables, figures or in the text of this paper will indicate whether data has been corrected or remains uncorrected for a "visibility bias".

This provides data that is a relative, rather than an absolute, measure of duck abundance. The same technique was used by Kirby (1976, p127 (11028)) during a similar aerial census of the entire permanent water areas on a portion of the Chippewa National Forest in Minnesota.

2.5 Determinations of Area-Distances Censused

The distance alon rivers and creeks censused during each flight was determined by using a map wheel down the center of each channel on 2" = 1mile (1cm = .6km) maps (Appendix B, Map 1, p1-17).

All lakes (except Birch Lake) were censused entirely. Surface areas were determined using existing data, when available, from the current study (Lakes Nutrient Analysis; Work Outline), or by using a 'dot grid'. This method involves counting the number of dots (printed on a piece of accetate)

and miluplying by a constant depending on the map scale. Area censused on Birch Lake was calculated by using a mpa wheel aong the shore line censused, assuming a one-quarter mile strip was searched. Thus, for every mile of shore line, 160 acres (64 hectares) was covered. All distance and area statistics for river, creeks and lakes are provided in Appendix B, Table 1.

3.0 RESULTS

3.1 Duck Census Data

A summary of the duck census data is present in several tables and figures, each designed to fulfill the present and future needs of specific groups of people. Appendix B, Table 1 contains the names, technical discription and area or distances censused. This table, and the detailed route maps provided in Appendix B (map 1, p1-17), are provided for more detailed discussing of specific areas on lakes and portions of rivers receiving heavy use by ducks. Use of Appendix B would allow for a repetition of the census in the future.

For the majority of this presentation, the summaries provided in the text, figures and tables (especially Table 1) of this paper will adequately portray the aerial survey findings.

3.2 Migrating Duck Concentrations-By Lakes

In general there was a low density of waterfowl over most of the study area. A small number of lakes contained the majority of the duck observations.

3.2a Stone Lake

Based on our observations Stone Lake, located in the St. Louis watershed, is the most heavily used lake in the study area (Table 1). This lake also had some of the highest density estimates (ducks/acre-hectares). The lake is 264 acres (105.6 hectares), or about 2.1 percent (264/1256, Appendix B, Table 1) of the total surface area of all lakes censused. However, 18.6 percent (280/1507) of all ducks observed using lakes during the three flights were recorded on Stone Lake (Table 1). The lake is shallow, the majority being less than 2m deep. Scattered emergent vegetation was present around the entire

shoreline. Ducks were scattered over the entire surface, propably indicating adequate water depth and food resources over most of the lake.

3.2b Long Lake

Long Lake was the second most heavily used lake based on total observations (Table 1, 270 ducks of 1507, 17.9 percent of observations on lakes). However, it is 442 acres (176.8 hectares, 1.6 times larger than Stone Lake), and the density of ducks was lower than in Stone Lake (Table 1).

This is also a shallow lake (mean depth 0.5m, Cu-Ni "Lakes Nutrient Analysis: Work Outline". Little emergent vegetation was present during the census period.

3.2c Birch Lake

Birch Lake, the largest lake in the study area, was not censused completely. Although this lake accounted for the third largest number of observations, the duck density was 15-64 times lower than on Stone or Long Lake. With a mean depth of about 4m (Cu-Ni report, "Lakes Nutrient Analysis: Work Outline"), rocky shorelines and very limited to no emergent vegetation, the lake was not nearly as attractive to migrating ducks.

3.2d Other Lakes Heavily Used by Migrating Ducks

In addition to the three most heavily used lakes presented above, an addition of eight of the total 58 censused sustained relatively significant use by ducks. These 11 lakes produced 81.0 percent (1221/1507) of all observations made on lakes.

A common method for showing preference and amount of proportional use of a resource (exa., food, habitat) is to divide the frequency of use by frequency of occurrance of the resource, both being expressed or percentages. This is often called an "Important Value" (I.V.), and from this the "rank" of the resource can be calculated (Table 2). Avalue of 1.0 indicates use of a lake was proportional to its surface area relative to all other lakes. Values greater than 1.0 indicates preferential use, with values less than 1.0 suggesting avoidence compared to other lakes. Since any ranking system has its advantages and disadvantages, interpretation of table 2 and others like it that follow will depend on the questions being considered. It is obvious, for example, that low ranked lakes such as Birch (rank 10) and Seven Beaver

(rank no. 7) are very important when the percentage of total observations are considered, even if they have low duck densities/acre-hectare (Table 2).

Lakes ranked by I.V. are compared by their relative density/acre-hectare. The number 1 and 2 ranked unnamed lakes are adjacent to Bonga Lake (ranked no. 4, Appendix B, map 1, p13) in a forested bog cotaining slow growing, generally stunded tomarach and black spruce. These three lakes, and others in this general region, are bog lakes with sedge (probably floating) shorelines.

Although one researcher has found bog lakes avoided by mallards and wood ducks broods (Ball 1973, p42 (02042), Marshall 1959, p125 (13049) and Stoudt 1938, p88 (19052)) have indicated important use of bog lakes by broods (especially by ring-necked ducks) in north-central Minnesota. However, the bog lakes Stoudt censused were much larger (100-200 acres, 40-80 hectares) than either unnamed lake ranked no. 1 or no. 2 (3.5 acres-1.4 hectares and 11.4 acres-4.6 hectares, respectively). Since ring-necked ducks apparently do not move from forest pothole-to-pothole until the flight stage (Marshall, 1959; p125 (13049)), these small bog lakes may be too small to support a brood(s). However, Bonga and Lobo Lakes (also bog lakes) may provide brood habitat in this region due to their greater size (125 acres-50 hectares and 145 acres-58 hectars, respectively).

3.3 Migrating Duck Concentrations Along Creeks

Segments of 8 different creeks were censused totaling 20,5 miles (32.8km, Appendix B, Table 1). Four creeks contained very few waterfowl while no ducks were seen on the remaining four (Table 1). In general, creeks contained only 20-30 percent of the duck density/mile-km compared to rivers they may be used by breeding ducks. Creek data will be included in the following section on watersheds (p__) and will not be further discussed here.

3.4 Migrating Duck Concentration Along Rivers

Portions of 6 different rivers were flown during the census for a total of 75.7mi (121.1km, Appendix B, Table 1). Of the 2053 total duck observations made on the three flights, 515 (25.1 percent) occured on rivers.

3.4a St. Louis River

Although second ranked by the I.V., the St. Louis River provides the longest river system of favorable hatitat in the study area, with over half of all the duck observations recorded along rivers (Table 3). The largest concentrations were recorded in the 2 mile (3.2km) portion just south of Norway Point Picnic Area (Appendix B, Map, p9, sec 8 & 9). This same area in summer is 50-75 percent covered with pond lillies (per. obs. summer 1976-77). The shoreline is sedge and grass covered, unlike much of the portion immediately to the east which is rocky, with forest extending to the banks. Additional, smaller concentrations occured alon the four mile (6.4km) portion from Seven Beaver Lake to the southwest (Appendix B, Map 1, p11). The river at this point also flows through grass, sedge and shrub communities and provides favorable waterfowl habitat.

3.4b North River

The meandering sedge-grass lined shoreline of the North River contained relatively high migrating duck concentrations, especially near the confluence with Seven beaver Lake (Appendix B, Map 1, p11,12). Although third in total observations, the North River was ranked no. 1 based on duck density per mile (km) searched (Table 1) and represented as I.V. (Table 3).

3.4c South Kawishiwi River

The portion of the South Kawishiwi River from the Birch Lake Dam to White Iron Lake produced the major portion of observations (69/87, 79.3 percent) on the length of this river censused (Appendix B, Map 1, p2). Although ducks were scattered alon this section of river, the major concentrations were recorded within 100m from the dam and were predominately golden eye.

Portions of this river remain open during the entire winter. A wintering population of golden eye have been observed in this area for a number of years (Fred Thunhorst, Area manager, MDMR, per. comn.). Frequent observations during the winter of 1976-77 were made by Lee Pfannmuller, with a maximum of 35 birds observed on 17 January, 1977 from the budger on Highway 1 adjacent to the dam. A more intensive search

of the river during the Christmas bird count recorded 50 golden eye (Minnesota Orthologial Union (M.O.U.) report, 3.44 other date rivers).

Portions of the remaining three rivers were used more seldom by migrating waterfowl (Table 3). Although both the Dunka and Partridge Rivers are meandering, with sedge-grass lined shorelines (Appendix B, Map 1, p5-9 incl), both had verylow duck densities (Table 1). The Stony River, with predominantly steep banks and rocky shorelines (Appendix B, Map 1, p14,15) had intermediate duck densities (Table 1).

4.0 MIGRATING DUCK USAGE-WATERSHED COMPARISONS

Lakes and rivers supporting the largest migrating duck concentrations have previously been noted and iscussed in this report (section 3.21-3.24 and 3.41-3.43). In this section, data from all areas censused (whether they contained none, low, medium or high concentrations) will be presented on a watershed basis. Since densities for lakes and ponds (ducks/acre-hectare) can not be directly compared to densities along rivers-creeks (ducks/mile-km), these two data catergories remain seperated.

4.1 Lakes and Ponds

Total duck observations made on all lakes and ponds during the three census flights were summarized from Table 1, as was total area searched from Appendix B, Table 1. Both values were changed to percentages to calculate I.V. and presented in Table 4.

Lakes and ponds on the St. Louis watershed stand far above the other eight watersheds sampled from both the total number of ducks observed and relative duck densities (Table 4). Migrating duck observations on lakes and ponds within these two watersheds accounted for 79.9 percent (1204/1507) of all observations, while covering only 34.5 percent of the total area censused. Apparently requirements of migrating (and presumarily breeding) ducks are met by lakes and ponds in these southern and east-central watersheds to a much greater degree on a unit-area basis than is true for the remainder of the study area.

When comparing the relative importance of watersheds based on density calculations (I.V., Table 4), the reader is again rem inded of the

various conclusions that may be drawn. The most evident example is the Birch Lake watershed. Although this watershed is ranked last based on its I.V., it is third in total duck observations (Table 4). A classification system for decision making based solely on density calculations may point out the relative unimportance of the Birch Lake watershed for migrating waterfowl. Yet, on a regional basis, habitat in this watershed may be extremely important based on nothing more than the extensive surface area of this one lake.

4.2 Rivers and Creeks

Of the 2053 total duck observations (3 census flights, Table 1), 546 (26.6 percent) were recorded on river and creek systems. The number, I.V. and rank of each watershed based on observations on these water areas within each watershed is presented in Table 5. Although 70-80 percent of all river routes were censused, lake present census sampled only 10-15 percent of creek systems and is probably a poor estimate of the importance of these water areas relative to use by migrating ducks (section 2.1).

As shown for lakes and popals (Table 4, Section 4.1) the highest duck despities and maximum numbers were recorded for the St. Louis watershed (Table 5). The second and third ranks (Kawishiwi and Stony watersheds) are severed from that of lakes and ponds (Table 4). The remaining watersheds are ranked in the same order of importance for both types of habitat (Table 4 and 5), with the exception of the Birch Lake watershed which is ranked midway in usage for seven-creeks, rather than last in the case of lakes-ponds.

The high ranking of the St. Louis watershed is a result of high relative densities observed alon both the St. Louis/north rivers on a combined census distance of 31.7 miles (5.7km). This route was 33.0 percent of the total distance of rivers-creeks censused, but produced 65.2 percent (356/546) of all observations (Table 1).

5.0 OCCURRANCE OF GEESE, LOONS, GREAT BLUE HERON AND GULLS RECORDED DURING 1977 SPRING AERIAL CENSUS

The prime objective of the aerial census was ennumerate duck concentrations,

but numbers and locations of geese, great blue heron, loon and gulls were also recorded. The frequency of the first three species were recorded on each flight, with gulls tallied on only the last census.

5.1 Great Blue Heron

Only 12 heron were observed, 8 (66.6 percent) on the St. Louis Watershed (Table 6). These observations are surely underestimates of the actual population using the study area. Heron flying during the census pass were doubtfully missed, but birds paired motionless alon shorelines narrow portions of rivers and creeks) were surely missed.

5.2 Geese

The only species of geese observed during the census was the Canadian goose. Aerial recognition and visibility of these birds was excellent, resulting in possibly a complete ennumeration of the areas censused. The only qualification may be that the three birds observed on 6 May were actually two pairs, with the female of the pair on Labo-Lake possibly nesting and not observed (Table 6).

A total of 21 observations of geese were recorded, 16 (76.2 percent) of which were on 16 different birds on 22 April (Table 6). All 16 birds were using waters on the St. Louis watershed, with the largest concentration (n=10) on the St. Louis River near Long Lake (Appendix B, Map 1, p11, sec. 32). The census indicated that all but three (possibly four) had left the area or moved to water areas no censused by 6 May.

Blue geese are known to use the area, but actual field data during this study were restricted to a single reported instance in the fall when 25 birds were seen on Nip Creek on 14 October, 1976 (T60n, R11w, Sec 22), Cu-Ni Fisheries Crew, reported by Paul Diedrich).

5.3 Loons

Eight of the 21 loon observations (38.1 percent) were from the St. Louis, 5 (23.8 percent) from the Birch Lake and 4 (20.0 percent) from Stony River watersheds (Table 3).

Under certain conditions (but mainly the approach of the aircraft to allow a profile view of the birds), loons were readily discernable from the air. However, there may have been a number of instances where loons were recorded as ducks, especially on lakes and rivers where birds were especially numerous. No references are available which indicate what the air:ground ratio (section 2.4) for the "visual bias" of loons might be. Since only 20-25 percent of large ducks (such as mallards) are recorded compared to the number counted from the ground (March et al. 1973; p9 (13064)), it seems likely that between 50-75 percent were no counted. For these reasons, the maximum number of 10 different birds (all recorded as pairs) recorded on 6 May, 1977, should definately be considered the minimal number using the area censused.

5.4 Gulls

Gulls, recorded only on 6 May, were judged to be primarily herring gulls. However, a small percentage of ring-billed gulls may have baen present and counted. Herring gulls are known to breed in the area, ring billed gulls do not (Green and Janssen 1975, p__ (07030)). Due to the contrasting color, size and behavior (loofing on exposed shorelines, slow flight, ect), we beleive that the 51 birds observed are indicative of the number of gulls present during this census (Table 6).

6.0 SPECIES AND RELATIVE FREQUENCY OF DUCKS PRESENT BASED ON GROUND OBSERVATIONS

6.1 During Migration

Observations of ducks from the 1976 and 1977 field seasons are presented in Table 7. Approximately one-half of these observations were obtained by the Fisheries Staff of the Study while conducting stream, river and lake surveys during the spring-fall period of both field seasons. The remainder were obtained by incidental observations by other members of the terrestrial biology staff during routine field duties.

Table 7 has number of observations and percentages calculated for the April and May period which coincides with the aerial census. We interpret these frequences as the 'probable' distribution of ducks present, by species, during the migration period. It appears that seven species of ducks (the

top 7 listed in Table 7), making up _____ percent of all duck observations, form the predominant majority of migrants using the area. The table indicates that mallards are the most common duck present, with nearly equal numbers of golden eye and common mergansers. Ring necked ducks are moderately numerous, followed by relatively low numbers of wood ducks, blue-wing teal and black ducks. All of these species are also known to breed in the region (Green and Janssen 1975 (07030)). Observations of blue bills (lesser seoup), green wing teal and hooded mergansers and buffle head were uncommon, with none of these species breeding in the immediate region (op. c.). American widgeon (Lake County breeding record) and shovelers (Cook County breeding record) were not observed, but may have been present in very low numbers or in more remote areas where observation records would be unlikely. Likewise, no observations were made of godwall, pintail, redhead or canvas back ducks (none breed in the immediate region), the later two species have and are receiving protection through limited harvest and/or closed hunting seasons due to generally low continental populations in the last 20-30 years.

6.2 During the Breeding Season

The preponderance of divers in the study area is due to the nature of the predominant waterfowl habitat in the region, namely forested lakes, ponds, and rivers, rocky shorelines and the absence of dense cottail, grass and bullruck marshes. Although observations were limited during the principal breeding and brood rearing months of June, July and August, at least one brood observation was made of the seven most common species present during migration (with the exception of the black duck).

Our results indicate that the 'probable' species distribution during the breeding season may be similar to the frequencies observed during the migration (Table 7), with the following qualifications. It is possible that percentages of the common golden eye and common mergansers would be somewhat reduced in a study of breeding populations. The numbers seen during migration tend to high because peek movements through the state tend to occur in late March and early April for both of these species. The large numbers observed in mid April with fewer subsequent observations in May may represent a flush of migrants through the region in 1977, with reduced numbers remaining to breed (Table 7).

Three other studies in forested regions of Minnesota during the breeding season also suggests that the ranking of species in Table 7 may be a good estimate of the breeding populations. A five year brood observation study (1954-58) on Lake Itasca (north central Minnesota, Marshall 1959, p123 (13049)) found the following species and percentages of broods present; mallards (66.2 percent), wood duck (14.9 percent), hooder mergansers (9.5 percent), blue wing teal (8.1 percent) and ring neck ducks (1.4 percent).

Breeding duck frequencies by species for the Chippewa National Forest (Stoudt 1938, p88 (19052)) ranked mallards, blue winged teal, golden eye and ring necked ducks (in that order). These four species made up 87 percent of all observations (32,22,20 and 13 percent, respectively). A more recent study on the same National Forest (Mathisen 1966, p26 (13047)) produced essentially the same results. Mathison found that that "The six major species encountered on the Chippewa are the mallard, blue winged teal, common golden eye, American widgeon, ring necked cudk and wood duck. These species comprise over 90 percent of the breeding population".

7.0 DISTRIBUTION OF WETLANDS AND THEIR RELATIVE VALUES TO WATERFOWL IN THE STUDY AREA AND THE STATE

A wetlands inventory on an estimated 90 percent of the wetlands used by waterfowl, has been published for the United States by the USF and WS (Shaw and Fredine 1971 (19070)). Data and maps from this survey were used to evaluate the relative importance of wetlands in the study region as compared to those existing in the remainder of Minnesota.

The above study and findings are subject to several interpretive biasis. The first, and probably most important, is the evaluation of wetlands was conducted by using maps and charts from a number of state and federal agencies (op. cit. , p14). Although this procedure is valid, the inventory was completed in 1954 but published in 1971, with no up-dating of the data. Since dramatic reduction of wetlands has probably occurred, especially in certain forming regions of the state since 1954, the values stated in Table 6 probably underestimate the value of wetlands in heavy forested states (op. cit. p17). This would be especially true in the northeastern portion of Minnesota or where little or no drainage has been conducted (op. cit. p2).

A second bias may occur from the necessity to draw boundaries to the number of dots (each dot = 10,000 acres) occurring within the four areas compared. These, in order of decreasing size, were St. Louis County, Lake County, the 2000mi^2 study area (Appendix A, Fig. 1). The data in Table 8 is thus only approximation of the relative importance of wetlands in the above four areas, but is believed to be an adequate representation of each area and its importance in the state as a whole.

According to data presented by Shaw and Fredine (op. cit Table 6), Minnesota is ranked fourth out of the 48 states in wetlands with 5,044,900 of 74,439,300 acres (6.8 percent) within its boundaries. Of this, roughly two million acres was classified as 'primary' and 3 million of 'lesser' importance (Table 8) for definition of these terms) while the state is relating well in lowed with wetlands, the northeastern portion contains only small quantities of 'primary' wetlands, with an estimated 3.2 percent of this type occurring in St. Louis and Lake Counties, combined. However, these counties do contain 16.5 percent of the states 'lesser' importance wetlands. The 2000mi^2 study area may contain about 9 percent of this later figure. Since the major impact of copper-nickel mining will occur within the mineral resource ore it is doubtful that this could directly affect more than 0.5-1.0 percent of the states wetlands used by waterfowl.

8.0 MINNESOTA'S BREEDING DUCK POPULATION AND FALL HARVEST RELATIVE TO NORTH AMERICA, THE UNITED STATES AND THE MISSISSIPPI

Some of the many inherant problems of any surveys, especially aerial surveys, have already been briefly summarize in section 2.4, with a number of references listed for indepth inquiry by interested readers. However, since it is important to obtain population indixs (direct data from aerial census) which can then be used to calculate population estimates (adjusted for ducks not seen by the aerial census crew, air: ground ratios) each year for determining hunting bog limits and season length, aerial census is the only practial method. These cencus are used to predict the continental waterfowl breeding population, yearly production and along with winter counts and hunter statistics, annual hunting mortalit. These findings are published as Waterfowl Status Reports by the Fish and Wildlife Service.

Minnesota and the Study Area can be placed in perspective with the entire United States by using generalized data from several recent F and WS Waterfowl Status Reports and population trend reports.

The total breeding population (adjusted for visibility bias, excluding mergansers, _____, _____ and _____ and 10 species of "game" ducks in North America from 1955-1977 has averaged about 37 million birds (U.S. F and WS, 1977 (21009)). Total duck hill in the United States in 1971 and 1972 was approximately 17 million (includes unretrived ducks), with about 1 million ducks taken each year in Minnesota (Benning et al. 1975, p69,86 (02033)). Minnesota's normal harvest is about one-fifth of the approximate 5 million ducks taken in the Mississippi Flyway (op. cit. p86).

Breeding season census during the two spring periods of the current study calculated the duck population in North America to be 39.6 million in 1976 and 38.0 million in 1977 (US F and WS 1977 (21009)). A total of 676,000 and 695,000 breeding ducks were estimated for Minnesota during these same two years, respectively (census conducted by R.L. Jessen and J. Parker, MDNR).

9.0 ESTIMATED SPRING BREEDING POPULATION IN THE STUDY REGION AND THE STATE

We concluded that a five year breeding duck census conducted in Wisconsin (March et al. 1973, 1965-70 (13064)) would provide the best comparative estimate of duck densities over an expansive (25,700mi^2) northern forested regions. The boundaries of the "Low Density" and "northwest" regions in the northern half of the state are nearly identical to the outline of the northern forest (Curtis 1959, p171 (03033)). Much of this forest is classified as northern mesic, predominated by maple and hemlock (op cit. p185), but pine, lowland conifer (tomarach, lack spruce and cedar) and a small portion of the boreal (in the northwest) are also included.

The Wisconsin census counted all of the species predominant in Minnesota including mergansen, but excluded golend eyes because they only rarely breed in Wisconsin. The estimated number of breeding ducks per square mile (connected separately for air:ground ratios of mallards, blue-winged teal and all others wer calculated by dividing the estimated number of breeding

ducks using the low density region each year (1965-70) by the size of the area (25,700mi^2; op. cit., Table 4)). The results (ducks per square mile and square kelomiters) were as follows: 1965 = 2.39mi^2 (0.92 km^2), 1966 - 3.09mi^2 (1.19km^2), 1967 = no data, 1968 = 1.85mi^2 (0.71km^2), 1969 = 2.12mi^2 (0.82km^2), 1970 = 3.93mi^2 (1.51km^2), average (all years) = 2.68mi^2 (1.03km^2). Three 'probable' population in the present study area were calculated from the low estimate (1968), the high (1970) and the average (Table 9). The data suggest that approximately 5360 ducks were present on the 2000mi^2 area. (Using average no./mi^2, all years, estimated confidence limits of $\pm$ 18 percent at p = 0.05, March op. cit., p8) Using the 1977 Minnesota statewide breeding population estimates of 695,000 ducks (US F and WS, 1967, p6 (21009)), it appears that 0.77 percent and 0.22 percent of the total state spring population of ducks may breed in the 2000mi^2 study area.

10.0 CONCLUSION

The forested watersheds (or portions of waterheds) lying within the study area censused during spring migration contained relatively low duck densities compared to prairie and parkland ecosystems. Densities on the study area are probably 1 or 2 pair (2 to 4 individuals) per square mile (0.4-.8 pairs/km^2) compared to; 95 pair/895 acres in Manitoba and 52 pair/mi^2 in Saskatchawan, Canada (Dzubin 1967, p224 (04020)); max of 21, 24 and 55 pair/mi^2 on three different study areas on the prairie of Minnesota (moyle(ed) 1964, p12, (13063)); 1 brood (on the average) mile of shoreline at Lake Itasca, Minnesota, an ecotone area between the forst and the prairie (Marshall 1959 p124 (13049); 8.9 pairie/mi^2 in Chippawa National Forest, also a transitional forest area (Mathison 1966; calculated from values of 20,900 pair on entire forest (p29) totaling 1,500,000 acres (13049)). However, other studies have recently emphasized the potential future importance of all forested regions to waterfowl population levels (Section 1.1).

The two study areas may contain 0.77 and 0.22 percent (2000mi^2 and 560mi^2, respectively) of the estimated state breeding population. Spring migrants (and presumably breeders) are primarily mallards, common golden eye and common mergansern, moderate numbers of ring-necked duck, blue-winged teal, and black ducks, and scattered observations of green-winged teal, hooded merganen and buffle head. Canadian geese migration stop-overs were uncommon and snows and blues used the area only rarely, and in fall. Whictling

swans were likewise rarely seen, with only 1 observation. Loons, great blue herons, and herring gulls are present during the migration and breeding period.

The most heavily used watersheds during migration (and presumably during the breeding season) by ducks are the St. Louis, Stony and Kawishiwi. Within these areas, the highest concentrations (total numbers largest percentage of all ducks seen) were observed on Stone, Long, Birch and Seven Beaver Lakes, and on St. Louis, North and Sough Kawishiwi Rivers. It appears that any alteration of these water areas that would be deleterious to waterfowl would dimish the already low density of waterfowl in the mineral resource area by 80-90 percent, at least for migrating bird usage.

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Table 6. Numbers and Locations of Geese, Loons, Great Blue Herons and Gulls Observed Durir 1977 Aerial Duck Census. (Values are uncorrected for visibility bias)

Key to Abbreviations and Symbols Used in Table 6:

U.N.L. = Unnamed Lake
U.N.C. = Unnamed Creek
L. = Lake
P. = Pond
C. = Creek
R. = River

GBH = Great Blue Heron (Ardea Herodias)
GE = Canadian Geese (Branta Caladensis)
LO = Loons (Gavia immer)
GU = Gulls (mostly herring gull, obs. recorded (Larus Argentatus) only on 6 May)
Blanks = 0 observations

* = not included in Minesite Area proper.

Table 1. The 1977 Spring Migration Aerial Duck Census by Watershed.
(Values are Uncorrected for Visibility Bias)

Key to Abbreviation & Symbols used in Table 1:

U.N.L. = Unnamed Lake
U.N.C. = Unnamed Creek
L. = Lake
P. = Pond
C. = Creek
R. = River

Symbol for Unit of Measure

Key to How Density Estimates are Presented in Table:

Data From Each Flight

A = No. of Ducks Observed - Ducks Per Acre - Ducks Per Hectare

B = No. of Ducks Observed - Ducks Per Mile - Ducks Per Milometer

Data, All Flights Averaged

C = Avg. No. of ducks observed per acre for 3 census periods combined for entire watershed.

$$= \frac{\text{Total ducks obs. on lakes-ponds}}{\text{Total Acres Censused}} \div 3$$

D = Avg. No. of ducks observed per hectare for 3 census periods for entire watershed

$$= \frac{\text{Total ducks obs. on lakes-ponds}}{\text{Total hectare censused}} \div 3$$

E = Avg. No. of Ducks observed per mile of creek-river for entire watershed

$$= \frac{\text{Total ducks obs. on rivers-creeks}}{\text{Total miles censused}} \div 3$$

F = Avg. No. of ducks observed per kilometer of creek-river for entire watershed

$$= \frac{\text{Total ducks obs. on rivers-creeks}}{\text{Total km censused}} \div 3$$

Blanks = 0 ducks observed
* = not included in subregion

Table 1.

KAWISHIWI WATERSHED (CU-NI NO. 5)

Census Area	Symbol for Unit of Measure		Date of Census Flight 22 April	27 April	6 May	All Periods Total - No. Ducks	Percent
Crocket L.	A	=	4-.16-.10			4	
U.N.L.	A	=	2-.35-.22			2	
White Iron L.	A	=	22-.11-.07	7-.03-.02	3-.01-.01	32	
S. Kawishiwi R.	B	=	30-4.41-2.75	7-1.03-.64	32-4.70-2.94	69	
Total ducks obs.			58	14	35	107	5.2%
Percent per watershed						C=.05 D=.13	
Per census period			7.2%	1.7%	7.9%	E=3.38 F=2.11	

ISABELLA WATERSHED (CU-NI NO. 7)

U.N.L.	A	=					
U.N.L.	A	=					
Shamrock L.	A	=					
Starting L.	A	=	8-.94-2.35			8	
Climber L.	A	=					
Baird L.	A	=					
Leatherleaf L.	A	=	2-.23-.59			2	
August C.	B	=	2-.39-.24		6-1.18-.73	8	
Labrador P.	A	=					
Norway L.	A	=		1-.07-.18	2-.14-.35	3	
Gesend P.	A	=	9-.63-1.58	3-.21-.53		12	

ISABELLA WATERSHED (CU-NI NO. 7) (cont.)

Census Area	Symbol for Unit of Measure		Date of Census Flight 22 April	27 April	6 May	All Periods Total No. Ducks	Percent
U.N.L.	A	=		3-.86-2.14		3	
August L.	A	=	2-.01-.02			2	
Total ducks obs			23	7	8	38	1.8%
Percent per watershed						C=.10 D=.25 E=.52 F=.32	
Per census period			2.9%	0.9%	1.8%		

BIRCH LAKE WATERSHED (CU-NI NO. 9)

S. Kawishiwi R.	B	=	8-1.07-.67	2-.27-.17	8-1.7-.67	18	
Birch L.	A	=	91-.01-.03	59-.01-.02	21-.003-.008	171	
Kangas L.	A	=			2-.08-.20	2	
Kangas C.	B	=					
Little L.	A	=	5-.07-.17		1-.01-.03	6	
Total ducks obs.			104	61	32	197	9.6%
Percent per watershed						C=.01 D=.02 E=.80 F=.50	
Per census period			13.0%	7.5%	7.2%		

UNNAMED CREEK WATERSHED (CU-NI NO. 9A)

Unnamed C. (this is the actual creek name)	B						
Total ducks obs.						0	0.0%
						E=.00 F=.00	

KEELEY CREEK WATERSHED (CU-NI NO. 9B)

Census Area	Symbol of Unit of Measure		Date of Census Flight 22 April	27 April	6 May	All Periods Total No. of Ducks	Percent
Heart L.	A	=		2-.06-.15	3-.09-.22	5	
Total ducks obs.				2	3	5	0.2%
Percent per watershed						C=.05	
Per census period				0.2%	0.7%	D=.12	

STONY RIVER WATERSHED (CU-NI NO. 11)

*Sand L.	A	=	9-.02-.04	20-.04-.1	13-.03-.06	42
Bonga L.	A	=		30-.24-.60	49-.39-.10	79
U.N.L.	A	=	38-4.47-11.18	2-.24-.59		40
Fools L.	A	=		7-.22-.56	2-.06-.16	9
Jackpot L.	A	=	3-.26-.65	2-.18-.43		5
Jackpot C.	B	=	9-1.76-1.10	1-.10-.12	1-.10-.12	11
Fran L.	A	=		1-.06-.15	4-.24-.59	5
Chow L.	A	=	6-.15-.38	2-.05-.13		8
U.N.L.	A	=	2-.71-1.8			2
U.N.C.	B					
Stony R.	B	=	12-1.54-.96	4-.51-.32	18-2.31-1.44	34
U.N.L.	A					
Slate L.	A	=	32-.13-.34	14-.06-.15	3-.01-.03	49
U.N.C.	B					
Swallow L.	A	=	9-.06-.16	5-.03-.09	3-.02-.05	17

STONY RIVER WATERSHED (CU-NI NO. 11) (cont.)

Census Area	Symbol for Unit of Measure		Date of Census Flight 22 April	27 April	6 May	All Periods Total No. Ducks - Percent	
Two Deer L.	A	=	2-.05-.12	2-.05-.12	5-.12-.29	9	
Alsike L.	A	=			2-.10-.25	2	
U.N.L.	A						
U.N.L.	A						
Highlife L.	A	=		2-.12-.29	1-.06-.15	3	
Dunnigan L.	A	=	1-.01-.03	2-.02-.06		3	
Harris L.	A	=	14-.13-.32	4-.04-.09		18	
Nira C.	B	=	2-.35-.24		7-1.35-.84	9	
Total ducks obs.			139	98	108	345	16.8%
Percent per watershed						C=.07 D=.17 E=.57 F=.36	
Per census period			17.4%	12.1%	24.4%		

ST. LOUIS WATERSHED (CU-NI NO. 13)

Bird L.	A	=	2-.10-.25	3-.15-.38		5	
Lillian L.	A	=		4-.47-1.18	1-.12-.29	5	
Hush L.	A	=		2-.10-.25		2	
St. Louis R.	B	=	135-5.04-3.15	92-3.43-2.14	64-2.39-1.49	291	
U.N.L.	A	=		6-.13-.33	13-.29-.71	19	
Long L.	A	=	132-.30-.75	78-.18-.44	60-.14-.34	270	
Seven Beaver L.	A	=	39-.03-.07	104-.07-.19	15-.01-.03	158	

ST. LOUIS WATERSHED (CU-NI NO. 13) (cont.)

Census Area	Symbol for Unit of Measure		Date of Census Flight 22 April	27 April	6 May	All Periods Total No. Ducks	Percent
Round L.	A	=	9-.02-.06	4-.01-.03		13	
Mud L.	A	=	2-.04-.10	2-.04-.10	4-.08-.20	8	
Stone L.	A	=	72-.27-.68	169-.64-1.60	39-.15-.37	280	
Swamp L.	A	=	1-.01-.03	15-.20-.50	3-.04-.10	19	
North R.	B	=	15-3.06-1.92	43-8.78-5.51	7-1.43-.90	65	
Lake Culkin	A	=	6-.10-.24	5-.08-.20	8-.13-.32	19	
Continental L.	A	=		13-.51-1.27		13	
Lobo L.	A	=	2-.01-.03	8-.06-.14		10	
U.N.L.	A	=	2-.57-1.43	14-4.00-10.00	29-8.28-20.7	45	
U.N.L.	A	=		7-7.0-17.5		7	
U.N.L.	A	=	38-3.33-8.26	2-.18-.43		40	
Total Ducks obs.			455	571	243	1269	61.8%
Percent per watershed per census period			56.8%	70.5%	55.0%	C=.10 D=.26 E=3.74 F=2.34	

PARTRIDGE RIVER WATERSHED (CU-NI NO. 14)

Stubble C.	B	=	3-1.15-.71			3	
Partridge R.	B	=	3-.22-.16	9-.65-.41	10-.72-.45	22	
Big L.	A	=	13-.02-.04	31-.04-.10	3-.004-.01	47	
Total ducks obs.			19	40	13	72	3.5%
Percent per watershed Per census period			2.4% 100.1%	4.9% 99.9%	2.9% 99.9%	C=.02 D=.05 F 51 F .32	

Census Area	Symbol for Unit of Measure	Date of Census Flight			All Periods	
		22 April	27 April	6 May	Total No. Ducks	Percent
Total Duck obs. by census period		801	810	442	2053	99.9%
Percent obs. by census period		39.1%	39.4%	21.5%		

Table 2. Importance Values (I.V.) and Rank of 11 Lakes Containing The Largest Concentrations of Spring Migrating Ducks

Lake Names	No. Duck Obs.	% of Duck Obs.	÷	% of Census Area (B)	=	I.V.	Rank
Stone	280	22.9		2.5		9.16	3
Long	270	22.1		4.2		5.26	5
Birch	171	14.0		63.8		0.22	10
*Sand	42	3.4		4.9		0.69	8
Bonga	79	6.5		1.2		5.42	4
U.N.L. (T59,R11,Sec 11)	40	3.3		0.1		33.0	2
Slate	49	4.0		2.3		1.74	6
Seven Beaver	158	12.9		13.3		0.97	7
U.N.L. (T59,R11,Sec 22)	45	3.7		0.03		123.33	1
U.N.L. (T59,R11,Sec 15)	40	3.3		0.1		33.0	2
Big	47	3.8		7.5		0.51	9
Total	1221	99.9%		99.9%			

A. Pecentages of ducks observed and water area censused were calculated from total observations and total acreage censused on these 11 lakes only (total observation on all lakes, n = 1507).

B. See Appendix Table 1

C. Sand Lake is adjacent to, but not within the boundary of the Minesite Area. It was included as an efficent use of flight time since census of other lakes in the area was deemed important.

Table 3. Importance Values (I.V.)(A) and Rank of 6 Rivers Used By Spring Migrating

River Names	No. Duck Obs.	% of Ducks Obs.	÷	% of Census Area(B)	=	I.V.	Rank
South Kawishiwi	87	16.9		18.9		0.89	3
Dunka	16	3.1		10.7		0.29	5
Stony	34	6.6		10.3		0.64	4
St. Louis	291	56.5		35.4		1.60	2
North	65	12.6		6.5		1.94	1
Partridge	22	4.3		18.2		0.24	6
Total	515	100.0		100.0			

A. Percentages of ducks observed and distance (in miles-km) of river censused were calculated from observation census distances on these 6 rivers only.

Table 4. Importance Values (A) (I.V.) and Rank of 9 Watersheds Based on Concentrations of Spring Migrating Ducks Using Lakes and Ponds.

Watershed No.	Name	No. Ducks Obs.	% of Ducks Obs.	÷	% of Census Area	=	I.V.	Rank
5	Kawishiwi	38	2.5		1.9		1.32	3
7	Isabella	30	2.0		3.0		0.66	6
9	Birch Lake	179	11.9		53.8		0.22	8
9A	Unnamed Creek	No Lake Area Censused						
9B	Kelly Creek	5	0.3		0.3		1.00	4
10	Dunka River	4	0.3		0.4		0.75	5
11	Stony River	291	19.3		11.2		1.72	2
13	St. Louis	913	60.6		23.3		2.60	1
14	Partridge River	47	3.1		6.2		0.50	7
Total		1507	100.1		100.1			

(A) Percentages of ducks observed and water area censused were calculated from total observations and total acreage censused on all lakes and ponds on each watershed.

Table 5. Importance Values (A) (I.V.) and Rank of 9 Watersheds Based on Concentrations of Spring Migrating Ducks Using Rivers and Creeks.

Watershed No.	Name	No. Duck Obs.	% of Duck Obs.	÷	% of Census Area	=	I.V.	Rank
5	Kawishiwi	69	12.6		7.1		1.78	2
7	Isabella	8	1.5		5.3		0.28	6
9	Birch Lake	18	3.3		8.6		0.38	4
9A	Unnamed Creek	0.0	0.0		1.1		0.00	8
9B	Kelly Creek	No Rivers - Creeks Censused						
10	Dunka River	16	2.9		8.4		0.34	5
11	Stony River	54	9.9		19.4		0.51	3
13	St. Louis	356	65.2		32.9		1.98	1
14	Partridge River	25	4.6		17.0		0.27	7
Total		546	100.0		99.8			

(A) Percentages of ducks observed and miles (km) of stream-creek censused were calculated from total observations and total distance censused for each watershed.

Table 6

Kawishiwi Watershed (Cu-Ni No. 5)

Census Area	Date of Census Flight											
	22 April			27 April			(May					
	GBH	GE	LO	GBH	GE	LO	GBH	GI	LO	GU		
Crocket L.												
U.N.L.												
White Iron L.										2		
South Kawishiwi R.												
Total Obs.										2		

Isabella Watershed (Cu-Ni No. 7)

U.N.L.												
U.N.L.												
Shamrock L.					1				2			
Starting L.												
Climber L.												
Baird L.												
Leatherleaf L.												
August L.										6		
Labrador P.												
Norway L.												
Gesend P.												
U.N.L.												
August L.												
Total Obs.					1				2	6		

Table 6 cont.

Birch Lake Watershed (Cu-Ni No. 9)

Census	Date of Census Flight											
	22 April				27 April				6 May			
	GBH	GE	LO		GBH	GE	LO		GBH	GE	LO	GU
South Kawishiwi R.							1				2	5
Birch L.	1						2		3	2		7
Kansas L.												
Kansas C.												
Little L.												8
Totals	1						3		3	2	2	20

Unnamed Creek Watershed (Cu-Ni No. 9A)

Unnamed C.
(This is the actual creek name)

Totals

Keeley Creek Watershed (Cu-Ni No. 9B)

Heart L.

Totals

Table 6 c t.

Dunka River Watershed (Cu-Ni No. 10)

Census Area	Date of Census Flight											
	22 April				27 April				6 May			
	GBH	GE	LO		GBH	GE	LO		GBH	GE	LO	GU
U.N.L.												
U.N.L.												
Snort L.												
Dunka R.												
U.N.L.												
Total												

Stony River Watershed (Cu-Ni No. 11)

* Sand L.												
Bonga L.					2							
U.N.L.											2	
Fools L.												
Jackpot L.												
Jackpot C.												
Fran L.												
Chow L.												
U.N.L.												
U.N.C.												
Stony R.												1
U.N.L.												
Slate L.												
U.N.C.												
Swallow L.												3

Table 6 cont.

Stony River Watershed (cont.) (Cu-Ni No. 11)

Census Area	Date of Census Flight											
	22 April				27 April				6 May			
	GBH	GE	LO		GBH	GE	LO		GBH	GE	LO	GU
Two Deer L.			2									
U.N.L.												
U.N.L.												
Highlife L.												
Dunnigan L.												
Harris L.												
Nira C.												2
Totals			2			2					2	6

St. Louis Watershed (Cu-Ni No. 13)

Bird L.												
Lillian L.												
Hush L.											2	
St. Louis R.	1	10			1				1			
U.N.L.												
Long L.		2				4						
Seven Beaver L.	1	2										8
Round L.	2											1
Mud L.												
Stone L.												3
Swamp L.												1
North R.												
Lake Culkin	1											

Table 6 cont.

St. Louis Watershed (cont.) (Cu-Ni No. 13)

Census Area	Date of Census Flight: 22 April			27 April			6 May			
	GBH	GE	LO	GBH	GE	LO	GBH	GE	LO	GU
Continental L.										
Lobo L.	1	2						1		
U.N.L.										
U.N.L.										
U.N.L.									2	
Total	6	16		1		4	1	1	4	13

Partridge River Watershed (Cu-Ni No. 14)

Stubble C.										
Partridge R.										1
Big L.			1							3
Total			1							4

Total Obs. by Census Period	GBH	GE	LO	GBH	GE	LO	GBH	GE	LO	GU
	7	16	3	1	2	8	4	3	10	51

Table 7

SPECIES, NUMBER AND FREQUENCY OF DUCKS OBSERVED ON THE NATURAL RESOURCE STUDIES SUBREGION DURING 1976-77 (April to November).

Species	Year	April 1-10	April 11-20	April 21-30	May A	May B	May C	No.	%	June A	June B	June C	July A	July B	July C	Aug. A	Aug. B	Aug. C	Sept. A	Sept. B	Sept. C
* Mallard	1976				7	3		10	24.4	3									24		20
	1977		23	4	11	34	2	74	37.9	(1)		1	6	(1)							
*Goldeneye, common	1976				2			2	4.9				(2)			(2)					
	1977		23		2			25	12.8												
*Merganser, common	1976				4	2		6	14.6		(1)		(1)								(1)
	1977		21			4		25	12.8		1	2									
*Ring-Necked Duck	1976				2	3		5	12.2			(1)									
	1977		2	9		4		15	7.7												
*Blue-Winged Teal	1976				4	1	4	9	22.0					(1)					2		3
	1977					15		15	7.7	6		1									
*Black Duck	1976				7		2	9	22.0	1											4
	1977				3	7	1	11	5.6												2
*Wood Duck	1976							--		1											4
	1977		8		4	2	3	17	8.7	4											
Lesser Scaup	1976							--													
	1977				6			6	3.1												
Green-Winged Teal	1976							--													
	1977					2		2	1.0												
Hooded Merganser	1976							--													
	1977		2					2	1.0												
Bufflehead	1976							--													
	1977					3		3	1.5												
Totals						41	(76)	195	(76)												

Table 7 (con

Species	Year	Oct A	Oct B	Oct C	Nov A	Nov B	Nov C	No.	$\%A_1$	No.	$\%B_1$
*Mallard	1976					4		51	52.2	61	49.6
	1977							9	36.0	83	37.7
*Goldeneye, common	1976							4	4.9	6	4.9
	1977							--	----	25	11.4
*Merganser, common	1976					2		5	6.1	11	8.9
	1977							3	12.0	28	12.7
*Ring-Necked Duck	1976							1	1.2	6	4.9
	1977							--	----	15	6.8
*Blue-Winged Teal	1976					2		8	9.8	17	13.8
	1977							7	28.0	22	10.0
*Black Duck	1976							5	6.1	14	11.4
	1977							2	8.0	13	5.9
*Wood Duck	1976							5	6.1	5	4.1
	1977							4	16.0	21	9.5
Lesser Scaup	1976			3				3	3.6	3	2.4
	1977							--	----	6	2.7
Green-Winged Teal	1976							--		--	----
	1977							--	----	2	0.9
Hooded Merganser	1976							--		--	----
	1977							--	----	2	0.9
Bufflehead	1976							--		--	----
	1977							--	----	3	1.4
Totals						82 (76)		25(77)		123 (76)	220 (77)

Key to Symbols :

*=Known to breed in St. Louis or Lake Counties, or both (Green and Janssen, 1975 ( )).

A_1=Percent of observation, June-Nov, incl.. brood recorded as 1 observation (Ao?) due to high and variable mortality rate of yg-of-the-yr compared to adult 'size' bird

B_1=Percent of observations, April-Nov, incl.. brood records counted as in A.

(1) =Numbers in circles are brood observations (ex., 1 brood recorded)

Table 8

Distribution of Wetland and their Relative Values to Waterfowl in the Study Region and the State.[A]

(values in thousands, rounded to nearest 10 thousand)

Type of Wetland	Minnesota		St. Louis County			Lake County			2000 mi^2			Minesite		
	Acres	%	Acres	%D	%E	Acres	%D	%E	Acres	%D	%E	Acres	%D	%E
'Primary' importance[B]	2050	41	130	17	2.6	30	13	0.6	80	18	1.6	0	0	0
'Lesser' importance[C]	2990	59	630	83	12.5	200	87	4.0	360	82	7.1	90	100	
Totals	5040	100	760	100	15.1	230	100	4.6	440	100	8.7	90	100	1.8

A Data obtained from Shaw and Fredine, 1971 (19070); Table 6 and Plate 21 (see Appendix B, Fig. 1)

B 'Primary' includes classes 'High' ("Habitat of highest waterfowl use in persent condition...") 'Moderate' ("Habitat of significant waterfowl use in present condition...") (op. cit, p16, 17)

C 'Lesser' includes classes 'Low' ("Habitat receiving relatively low waterfowl use under natural conditions...") and 'Negligible' (none classified for Minn.) (op. cit., p16, 17)

D Percent of land in county and study areas classed 'primary or 'lesser

E Percent of total Minnesota wetlands in county and study areas classed 'primary' or 'lesser'

Table 9

1977 Estimated Duck Breeding Population in Study Region
(No. of Individuals)

Population Estimate (A)	2000 mi^2 (5200 km^2)	560 mi^2 (1456 km^2)
High	7860	2201
Low	3700	1036
Average	5360	1501

(A) Values from calculated from March, 1973 (13064), Table 4. See Text, P___.

Appendix B, Table 1

The Name, Technical Discription and Area or Distance
Censused During Aerial Survey, Spring 1977

Key to Abbreviations and Symbols Used in Table 1:

U.N.L. = Unnamed Lake

U.N.C. = Unnamed Creek

L. = Lake

P. = Pond

C. = Creek

R. = River

Blanks = 0 acres or miles censused

* = Not included in Minesite Area property

Appendix B, Table 1

KAWISHIWI WATERSHED (CU-NI NO. 5)

Census Area	Township (north)	Range (west)	Section	Size of Area Censused			
				Miles	KM	Acres	Hectars
Crocket L.	62	11	15			25.6	10.2
U.N.L.	62	11	16			5.7	2.3
White Iron L.	62	11	18			207.3	82.9
South Kawishiwi R.	62	11	30	6.8	10.9		
Totals				6.8	10.9	238.6	95.4

ISABELLA WATERSHED (CU-NI NO. 7)

U.N.L.						4.3	1.7
U.N.L.						0.7	0.3
Shamrock L.						54.0	21.6
Starting L.						8.5	3.4
Climber L.						5.7	2.3
Baird L.						31.2	12.5
Leatherleaf L.						8.5	3.4
August L.				5.1	8.2		
Labrador P.						5.7	2.3
Norway L.						14.2	5.7
Gesend P.						14.2	5.7
U.N.L.						3.5	1.4
August L.						222.3	88.9
Totals				5.1	8.2	372.8	149.2

Apper · B, Table 1. (cont.)

BIRCH LAKE WATERSHED (CU-Ni NO. 9)

Census Area	Township (north)	Range (west)	Section	Size of Area Censused Miles	KM	Acres	Hectares
South Kawishiwi R.	61	11	6	7.5	12.0		
Birch L.	61	11				6656.0	2656.0
Kangas L.	61	12	14			25.6	10.2
Kangas C.	61	12	22	0.8	1.3		
Little L.	61	12	11			73.8	29.5
Totals				8.3	13.3	6755.4	2695.7

UNNAMED CREEK WATERSHED (CU-NU NO. 9A)

Unnamed Creek (This is the actual creek name)				1.1	1.8		
Totals				1.1	1.8		

KEELEY CREEK WATERSHED (CU-NI NO. 9B)

Heart L.						34.1	13.6
Totals						34.1	13.6

Appendix B, Table 1. (cont.)

DUNKA RIVER WATERSHED (CU-NU NO. 10)

Census Area	Township (north)	Range (west)	Section	Size of Area Censused Miles	KM	Acres	Hectares
U.N.L.						8.5	3.4
U.N.L.						22.7	9.1
Snort L.						14.2	5.7
Dunka R.				8.1	13.0		
U.N.L.						5.7	2.3
Totals				8.1	13.0	51.1	20.5

STONY RIVER WATERSHED (CU-NI NO. 11)

*Sand L.	59	11	23			506.4	202.5
Bonga L.	59	11	14			125.0	50.0
U.N.L.	59	11	11			8.5	3.4
Fools L.	59	11	11			31.2	12.5
Jackpot L.	60	11	24			11.4	4.6
Jackpot C.	60	11	25	5.1	8.2		
Fran L.	60	11	11			17.0	6.8
Chow L.	60	11	11			39.8	15.9
U.N.L.	60	11	9			2.8	1.1
U.N.C.	60	11	9	0.05	0.08		
Stony R.	60	11	17	7.8	12.5		
U.N.L.	60	10	17			1.5	0.6
Slate L.	60	10	8			237.1	94.8

Apper : B, Table 1. (cont.)

STONY RIVER WATERSHED (CU-NI NO. 11) (cont.)

Census Area	Township (north)	Range (west)	Section	Size of Area Censused Miles	KM	Acres	Hectares
U.N.C.	60	10	9	0.5	0.3		
Swallow L.	60	10	10			144.8	57.9
Two Deer L.	60	10	14			42.6	17.0
Alsike L.	60	10	15			19.9	8.0
U.N.L.	60	10	15			3.0	1.2
U.N.L.	60	10	16			2.5	1.0
Highlife L.	60	10	16			17.0	6.8
Dunnigan L.	60	10	5			85.2	34.1
Harris L.	61	11	24			107.9	43.2
Nirac.	61	11	23	5.2	8.3		
Totals				18.6	29.4	1403.6	561.4

ST. LOUIS WATERSHED (CU-NI NO. 13)

Bird L.	58	14	25			19.9	8.0
Lillian L.	58	14	25			8.5	3.4
Hush L.	58	14	26			19.9	8.0
St. Louis R.	58	14	33	26.8	42.9		
U.N.L.	58	12	31			45.4	18.2
Long L.	58	12	33			442.1	176.8
Seven Beaver L.	58	12	23			1390.6	556.2

Appendix B, Table 1. (cont.)

ST. LOUIS WATERSHED (CU-NI NO. 13) (cont.)

Census Area	Township (north)	Range (west)	Section	Size of Area Censused Miles	KM	Acres	Hectares
Round L.	58	12	26			357.8	143.2
Mud L.	58	12	21			51.1	20.4
Stone L.	58	12	20			264.1	105.6
Swamp L.	58	12	15			76.7	30.7
North R.	58	12	13	4.9	7.8		
Lake Culkin	59	11	17			62.5	25.0
Continental L.	59	11	21			25.6	10.2
Lobo L.	59	11	22			144.8	57.9
U.N.L.	59	11	22			3.5	1.4
U.N.L.	59	11	22			1.0	0.4
U.N.L.	59	11	15			11.4	4.6
Totals				31.7	50.7	2924.9	1170.0

PARTRIDGE RIVER WATERSHED (CU-NI NO. 14)

Stubble C.				2.6	4.2		
Partridge R.				13.8	22.1		
Big L.						783.8	313.5
Totals				16.4	26.3	783.8	313.5
Totals, all areas				96.2	153.6	12564.3	5019.3

Appendix B
Map 1

T. 62 N., R. 12 W.

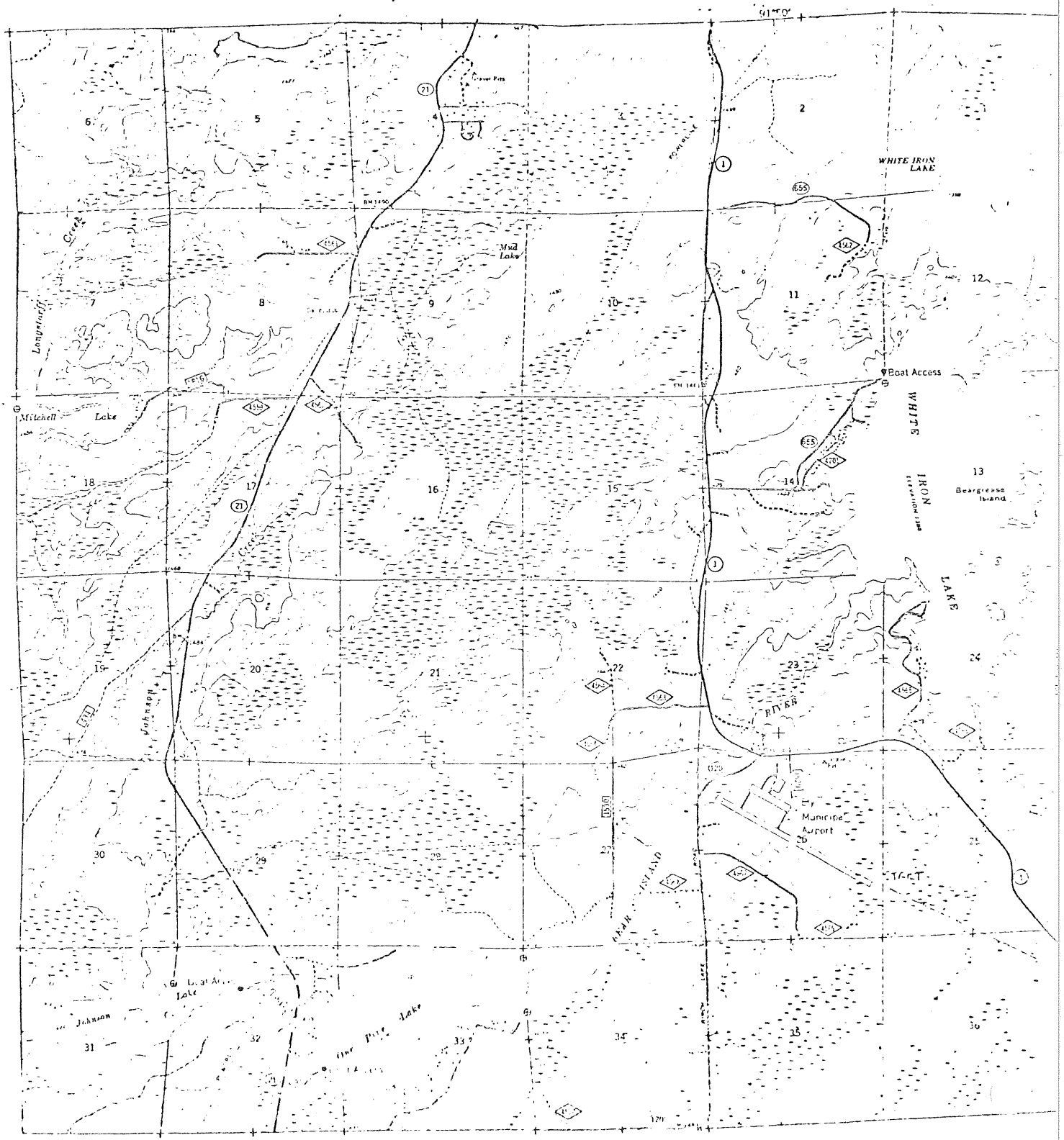

Fig. 1. ...te of 1977 Aerial Waterfowl Census Flown to Determine Migration Concentrations.