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Interim report on waterfowl breeding pair surveys in northern Ontario, 1980–83

by R.K. Ross[1]

Abstract

The methodology used for an extensive helicopter survey of breeding waterfowl in the Shield and clay belt regions of northern Ontario is described, together with the interim results of that survey. In the Precambrian Shield, the survey employed a double-systematic sampling design using 25 quadrats (2 × 2 km each) as the basic units, laid out over each of the selected blocks of 100 × 100 km on the Universal Transverse Mercator grid. Total waterfowl densities in the six blocks examined were fairly constant (approximately one indicated pair per square kilometre) although the estimates for individual species were more variable. Wetland occupancy and wetland density were also variable and acted together in a compensatory manner. Analysis of co-occurrence of species on the survey plots showed a basic division between dabbling and diving ducks, associated with their preferences for different depths of water. The Mallard (*Anas platyrhynchos*) and Black Duck (*A. rubripes*) occurred in different sub-groups, reflecting the much more restricted habitat occupied by the Mallard at present. Comparisons with surveys in 1972–73 are also made.

Introduction

The distribution and abundance of waterfowl in northern forested regions, particularly the boreal forest, have attracted little study until recently. Breeding densities have been considered low (Wellein and Lumsden 1964) and, because of the perceived static nature of the habitat, populations were thought to be stable. The operational hazards of low-level flying in eastern boreal Canada were also a deterrent to the execution of detailed surveys. Consequently, the standardized North American surveys run annually since 1955 to provide forecasts of fall waterfowl populations for the purpose of setting hunting regulations in the USA have been limited to large-scale aerial transects in the prairies and western boreal region (Voelzer *et al.* 1982). These surveys produce indices which can only detect and track fluctuations in western stocks of abundant species. The data from forested regions have proven to be very difficult to interpret for species with low survey efficiencies (i.e., hard to detect), such as the American Black Duck (*Anas rubripes*) and Green-winged Teal (*A. crecca*) (Chamberlain and Kaczynski 1965; Dennis 1974a). A better understanding of waterfowl distribution in northern Ontario and Quebec is required because the vastness of this region makes its overall contribution to continental stocks highly significant. The lack of quantitative information on eastern-breeding waterfowl has led to management decisions which have relied too much on information from the prairies.

Northern Ontario has been estimated to support 84% (approximately 2 million potential breeders) of the waterfowl breeding in the province Waterfowl management (plan for Ontario 1984). This rough figure has been based on limited local studies (e.g., Hansen *et al.* 1949; Dennis 1974b) and educated guesses. To confirm the importance of waterfowl breeding in the region, I developed a survey methodology (Ross 1985) and started a large-scale, but detailed, breeding pair survey. This work, patterned on a study by Haapanen and Nilsson (1979) in northern Scandinavia, aims not only to determine population estimates and distribution patterns but also to elucidate habitat preferences and examine waterfowl community structures throughout the region. The survey area covers all of the boreal forest in Ontario together with those sectors of the Great Lakes–St. Lawrence forest (Rowe 1977) on the Precambrian Shield that have strong boreal elements (see Fig. 1). In this interim report, the numbers of waterfowl on four survey blocks extending from Huntsville northwest to Fort Hope on the exposed Precambrian Shield are compared with those from two survey blocks centred mostly on the clay belt. Data on the ecologically similar Common Loon (*Gavia immer*) are also included.

Methods

Survey regions

Northern Ontario was divided into two survey regions: (a) the Precambrian Shield including the clay belt, and (b) the Hudson Bay Lowlands. So far, operational surveys have been restricted to the former area. Survey plots (2 × 2 km) have been laid out throughout this region in a two-stage systematic design following the Universal Transverse Mercator (UTM) mapping grid, which divides the region into blocks of 100 km per side (convergences ignored). An initial block was arbitrarily selected to be the one (Code 15-U-VE) covering part of Lake-of-the-Woods. Then every second block in either direction was designated for coverage as long as it fell completely within the boundaries formed by provincial and international borders and the edge of the Precambrian Shield (as in Rowe 1977). Plots were then set out in each of the 13 designated blocks (Fig. 1) in a grid starting at the southwest corner of each block, and every 20 km to the north and east, making 25 per block. Where local surveys were needed for other studies, such as the acid rain investigation, blocks other than those designated were surveyed using the same format.

Field procedure

The methodology detailed in Ross (1985) is summarized briefly below. The surveys were undertaken from a Bell 206 B helicopter equipped with a range extender on the main fuel tank and bubble windows on the back doors. These windows allowed the observers to extend their heads approximately 25 cm outside the original body of the aircraft so that visibility was greatly increased.

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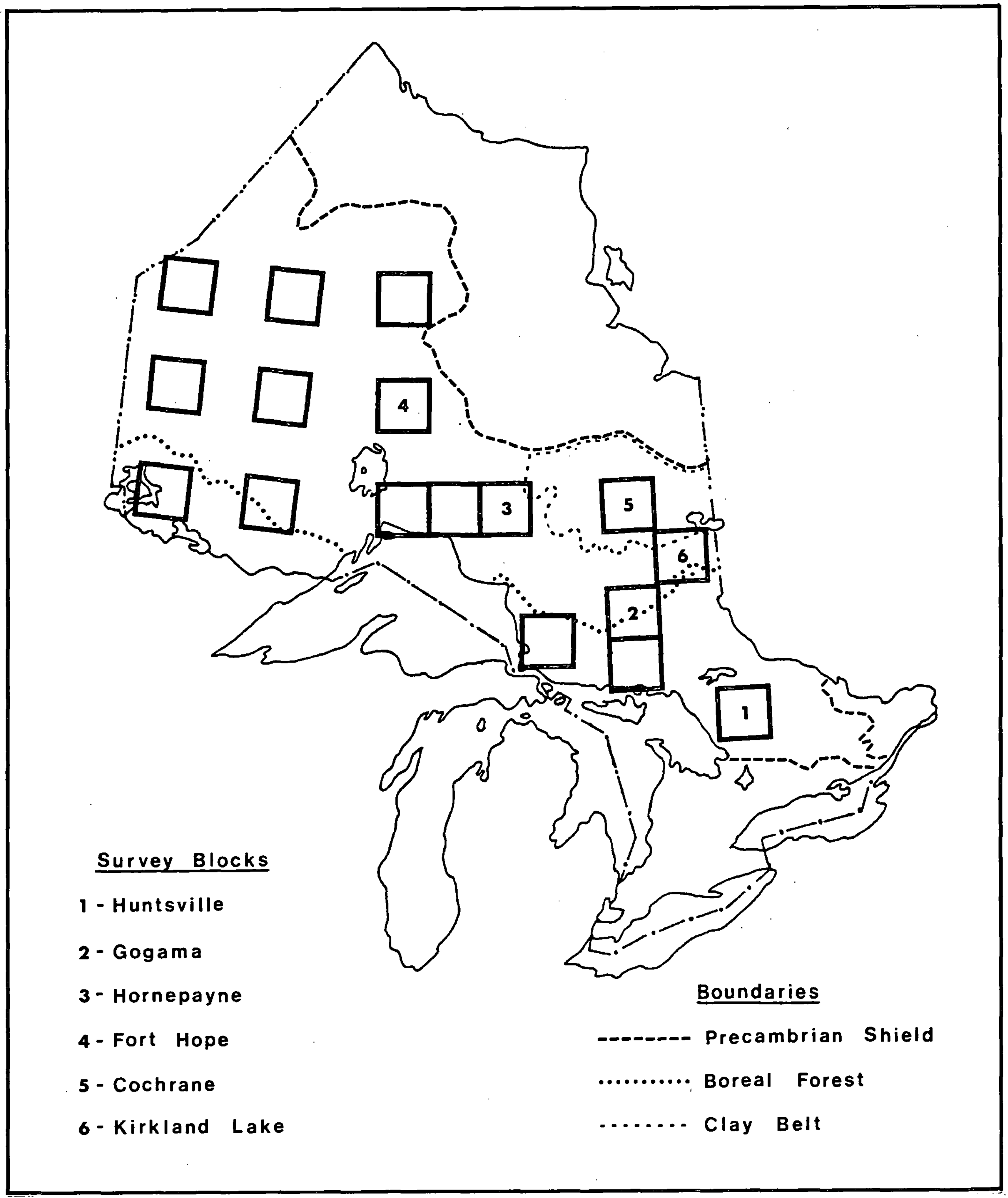
Figure 1
Map of Ontario showing habitat boundaries and locations of waterfowl survey blocks in the Precambrian Shield



An observer sitting in the front passenger seat of the helicopter acted as navigator and data recorder and alerted the other observers when birds were spotted. These observers sat at the back of the aircraft by each window and notified the navigator of waterfowl sightings through an intercom system. The species, sex, number, and exact location of all birds seen were recorded directly on acetate-covered aerial photographs on which the boundaries of the plots were drawn. The aircraft passed over all wetland habitat within each study plot at altitudes as low as 20 m above the ground, at speeds ranging from a hover to 100 km/h. Multiple passes were made over some wetlands where the presence of birds was suspected or where the sex and species of the birds could not be ascertained on the first pass. Because the wetlands on the Ontario Shield are usually small and clearly bounded, total coverage of the appropriate habitat was obtained by following the shorelines, and no transects were employed.

For this study, a wetland was defined as any body of open water visible on an aerial photograph (scale 1 : 15 840). The latest available photographs were used, although these may have been as much as 10 years old. Individual bodies of standing water (lakes, ponds, sloughs) were usually easily identified. Where they were irregularly shaped or occurred in a series along a drainage line, each was delimited by the presence of a clearly visible outlet stream. Streams and rivers were usually treated as separate wetlands unless very small, in which case they were considered part of the nearest lake or pond with which they were associated. Small interconnecting streams were divided among the associated standing water bodies. Occasionally wetlands had been changed and, in some cases, new ones created by beaver activity since the photographs had been taken; a note of any changes was made, and the new shoreline was sketched on the aerial photos during the survey.

Timing

Surveys were undertaken during a limited period or "survey window" when most of the local breeders had started nesting. This period begins when the migrants have passed through the area and before the desertion by the males during incubation (as in Dzubin 1969 and Dennis 1974a). The extent of this period in northern Ontario is not well known because no detailed phenological studies have been made there. For this survey, I used a conservatively short period of two weeks starting one week after the smallest wetlands (<10 ha) were free of ice, which normally occurred in early to mid-May. Particular care in the timing must be taken in the more northerly blocks because of the later breeding period and the greater chance of migrants heading farther north being stalled there by bad weather. As only one survey flight was made, it was not always possible to sample each species within its ideal window. Population density estimates for late-nesting species, particularly the Ring-necked Duck (*Aythya collaris*) may be less precise, because these species nest almost one month after most other species, although their actual migration appeared to be complete before the survey flights.

Surveyed years of the six blocks examined in this note are as follows: Hornepayne — 15, 16 May 1980; Huntsville — 5, 6 May 1981; Gogama — 8, 10 May 1981; Cochrane — 19 May 1982; Kirkland Lake — 22 May 1983; Fort Hope — 26, 27 May 1983.

Coverage

Because of restrictions imposed by the short survey window and a limited budget, only 4–6 blocks could be covered each year. The 13 designated blocks and 4 extra blocks were surveyed between 1980 and 1984 inclusive (see Fig. 1).

Analysis

Results are expressed in numbers of "indicated pairs" per species, which for dimorphic waterfowl are derived from observation of the numbers of lone males, pairs, and males in flocks of five males or fewer (as in Dzubin 1969). As the sex of the Black Ducks could not usually be determined in the field, indicated pair estimates were made using the observed sex ratios of the closely related Mallard (*Anas platyrhynchos*), as in Dennis (1974a). To do this, the following multiple regression was developed using all breeding pair survey data available for Ontario wetlands where Mallards were found.

$$Y = 0.0700 + 0.632\,X_1 + 1.1166\,X_2 + 0.7398\,X_3$$

$$R^2 = 0.9577,\ p < 0.00001$$

where Y = number of indicated pairs of Mallards
X_1 = number of lone Mallards
X_2 = number of flocks of two Mallards
X_3 = number of Mallards in flocks between 3 and 10

Indicated pair figures for Black Ducks can then be produced by substituting Black Duck sighting information for Mallard sighting information in the equation. Wetlands which had no Black Ducks ($X_1 = X_2 = X_3 = 0$) were assumed to have no indicated pairs ($Y = 0$); in other words, the equation was not employed under these circumstances.

The Common Loon is also monomorphic. Because these birds are very strongly territorial, indicated pairs were determined from the presence of either a single bird or a pair in close proximity. For Canada Geese (*Branta canadensis*), indicated pairs were counted for each single, pair, or flock of three; larger flocks were ignored, because they were likely to consist largely of pre-breeders, one and two years old.

Breeding densities are expressed as the number of indicated pairs per 100 km², accompanied by an estimate of standard deviation generated using a formula developed by G.E.J. Smith for systematic samples (see App. 1).

Results

Breeding densities in the six survey blocks are shown in Tables 1 and 2 (see Fig. 1 for locations). Four blocks are situated on the exposed Precambrian Shield along a northwest-southeast axis. Two of these (Huntsville and Gogama) lie primarily in the Great Lakes–St. Lawrence forest habitat (Rowe 1977), while Hornepayne and Fort Hope are set in boreal forest. The Cochrane block is located entirely in the boreal clay belt, while the Kirkland Lake block covers both boreal (clay belt and exposed Shield) and Great Lakes–St. Lawrence (little clay belt).

Table 1
Waterfowl community parameters for six survey blocks in northern Ontario

	Great Lakes–St. Lawrence		Boreal Precambrian		Mixed	Boreal Clay Belt
	Block 1 Huntsville	Block 2 Gogama	Block 3 Hornepayne	Block 4 Fort Hope	Block 6 Kirkland L.	Block 5 Cochrane
Total waterfowl breeding density (indicated pairs/100 km^2)	99.8	97.4	107.8	75.0	89.4	82.2
Indicated pairs per wetland	0.69	1.07	1.40	0.84	0.85	1.35
No. of wetlands/100 km^2	144	91	77	89	106	61
Percentage of occupancy of wetlands	33.3	39.6	55.8	36.0	33.3	49.2
Total no. of species	9	8	11	9	10	10
Diversity	1.84	1.87	2.08	1.91	2.08	1.99
Evenness	0.84	0.90	0.87	0.87	0.90	0.87

Table 2
Breeding density by species of ducks, geese, and loons in six survey blocks in northern Ontario, in May 1980–83.

	Great Lakes–St. Lawrence				Boreal Precambrian				Mixed		Boreal Clay Belt	
	Block 1 Huntsville		Block 2 Gogama		Block 3 Hornepayne		Block 4 Fort Hope		Block 6 Kirkland L.		Block 5 Cochrane	
	IP*	SD	IP	SD	IP	SD	IP	SD	IP	SD	IP	SD
Common Loon (*Gavia immer*)	11.0	4.34	21.0	5.04	17.0	4.65	16.0	6.02	9.3	3.1	2.0	1.36
Canada Goose (*Branta canadensis*)	—	—	—	—	—	—	4.0	1.93	—	—	1.0	0.79
Wood Duck (*Aix sponsa*)	1.0	0.96	—	—	—	—	—	—	0.9	1.03	1.0	1.11
Green-winged Teal (*Anas crecca*)	4.0	2.36	2.0	1.47	4.0	1.76	4.0	2.22	6.5	3.46	4.0	2.67
American Black Duck (*Anas rubripes*)	30.8	6.71	18.4	5.34	23.8	7.71	3.0	2.06	12.6	3.69	10.2	2.83
Mallard (*Anas platyrhynchos*)	14.0	4.94	5.0	2.61	6.0	2.78	10.0	3.20	15.7	3.93	21.0	8.83
Mixed pairs (Mallard–Black)	—	—	2.0	1.37	1.0	1.11	—	—	0.9	0.89	—	—
Blue-winged Teal (*Anas discors*)	3.0	2.22	—	—	2.0	1.47	—	—	4.6	3.68	6.0	5.64
American Wigeon (*Anas americana*)	—	—	—	—	1.0	0.96	—	—	1.9	1.46	—	—
Ring-necked Duck (*Aythya collaris*)	19.0	7.73	27.0	9.81	21.0	6.44	15.0	5.64	19.4	6.71	18	9.76
Common Goldeneye (*Bucephala clangula*)	—	—	14.0	3.93	19.0	4.82	11.0	7.23	7.4	3.5	11.0	3.60
Bufflehead (*B. albeola*)	2.0	1.47	6.0	4.38	7.0	4.45	1.0	1.11	—	—	—	—
Hooded Merganser (*Lophodytes cucullatus*)	16.0	5.64	14.0	5.73	8.0	3.81	—	—	11.1	5.19	4.0	2.08
Common Merganser (*Mergus merganser*)	10.0	3.56	9.0	2.67	12.0	3.34	22.0	8.95	8.33	4.13	6.0	2.42
Red-breasted Merganser (*M. serrator*)	—	—	—	—	3.0	2.89	5.0	4.52	—	—	—	—
Total waterfowl	99.8	19.49	97.4	19.65	107.8	21.32	75.0	19.24	89.4	20.91	82.2	26.57

Community characteristics

Total waterfowl densities (Table 1) were generally low, with proportionally high standard deviations, yet were quite similar among the blocks. The most northerly block (Fort Hope) showed the lowest density, although this was not statistically different from the other communities. There was little difference in community evenness (Pielou 1966) among the blocks, which indicates a common form of the species abundance distribution, not unexpected given the broad similarity of the habitats. Waterfowl diversity (Shannon-Weiner) and number of species showed more variability, with the higher values being associated with blocks either straddling or lying near the boundary between clay belt and exposed Shield (Hornepayne and Kirkland Lake).

Greater ranges were evident in the measures of percentage of occupancy of wetlands, number of wetlands per block, and number of indicated pairs per wetland. There is a significant negative correlation between wetland numbers and percentage of occupancy ($R_s = -0.84$, $p < 0.05$). The importance of this relationship can only be assessed through a more detailed habitat study which is at present under way. It appears that the numbers of those wetlands suitable for supporting waterfowl are more constant than the total numbers of wetlands in each block.

Species accounts

The Common Loon was moderately common on the Shield blocks, particularly on the larger lakes; the most were seen on the Gogama block (21 pairs/100 km^2) and the fewest on the Huntsville block (11 pairs/100 km^2). The loon was much less numerous in the clay belt.

The Canada Goose was encountered in small numbers only in the most northerly blocks closest to the Hudson Bay Lowlands (Fort Hope, Cochrane).

Single pairs of Wood Ducks (*Aix sponsa*) were recorded in the Huntsville, Kirkland Lake, and Cochrane blocks. The sightings in the last two blocks were north of the recorded breeding range (Godfrey 1986).

The Green-winged Teal was noted infrequently but fairly uniformly throughout the six blocks and was usually found in older swamps which contained many dead and fallen trees.

The American Black Duck was among the most common ducks recorded in the three eastern Shield blocks; counts were much lower in the Fort Hope block, which lies closer to the northwestern edge of the range. There were fewer in the clay belt blocks than in the eastern Shield.

The Mallard was more common than the Black Duck in the Fort Hope and clay belt blocks but much less common than the Black Duck in the three eastern Shield blocks. Possible mixed pairs (Black-Mallard) were recorded in three blocks (Gogama, Hornepayne, Kirkland Lake).

The Blue-winged Teal (*Anas discors*) was noted in small numbers in two Shield blocks (Huntsville, Hornepayne) and in both the clay belt blocks. It appeared to be more common in the clay belt, probably as a result of the greater extent of cultivated land.

The American Wigeon (*A. americana*) was noted in the Hornepayne and Kirkland Lake blocks, only in the most productive habitat and always in the company of other waterfowl.

The Ring-necked Duck was among the most abundant waterfowl in all blocks and occurred in a wide range of habitats. Standard deviation estimates were higher than most as this species usually gathered in pre-nesting flocks.

The Common Goldeneye (*Bucephala clangula*) was moderately common in all blocks except Huntsville, where it was not seen. It appeared to be slightly less common in the clay belt than in the Shield.

The Bufflehead (*B. albeola*) was uncommon, being found only in the Shield blocks.

The Hooded Merganser (*Lophodytes cucullatus*) was recorded in moderate numbers in the Huntsville block. Breeding densities declined steadily ($R_s = -0.9$; $p < 0.05$) the more northerly and westerly the block. None were recorded in the Fort Hope block.

The Common Merganser (*Mergus merganser*) was moderately common in the three eastern Shield blocks and slightly less so in the clay belt. Many more were seen in the Fort Hope block, although the standard deviation of the estimate was very high.

The Red-breasted Merganser (*M. serrator*) occurred in small numbers in the two most westerly blocks, always associated with larger lakes.

Species associations

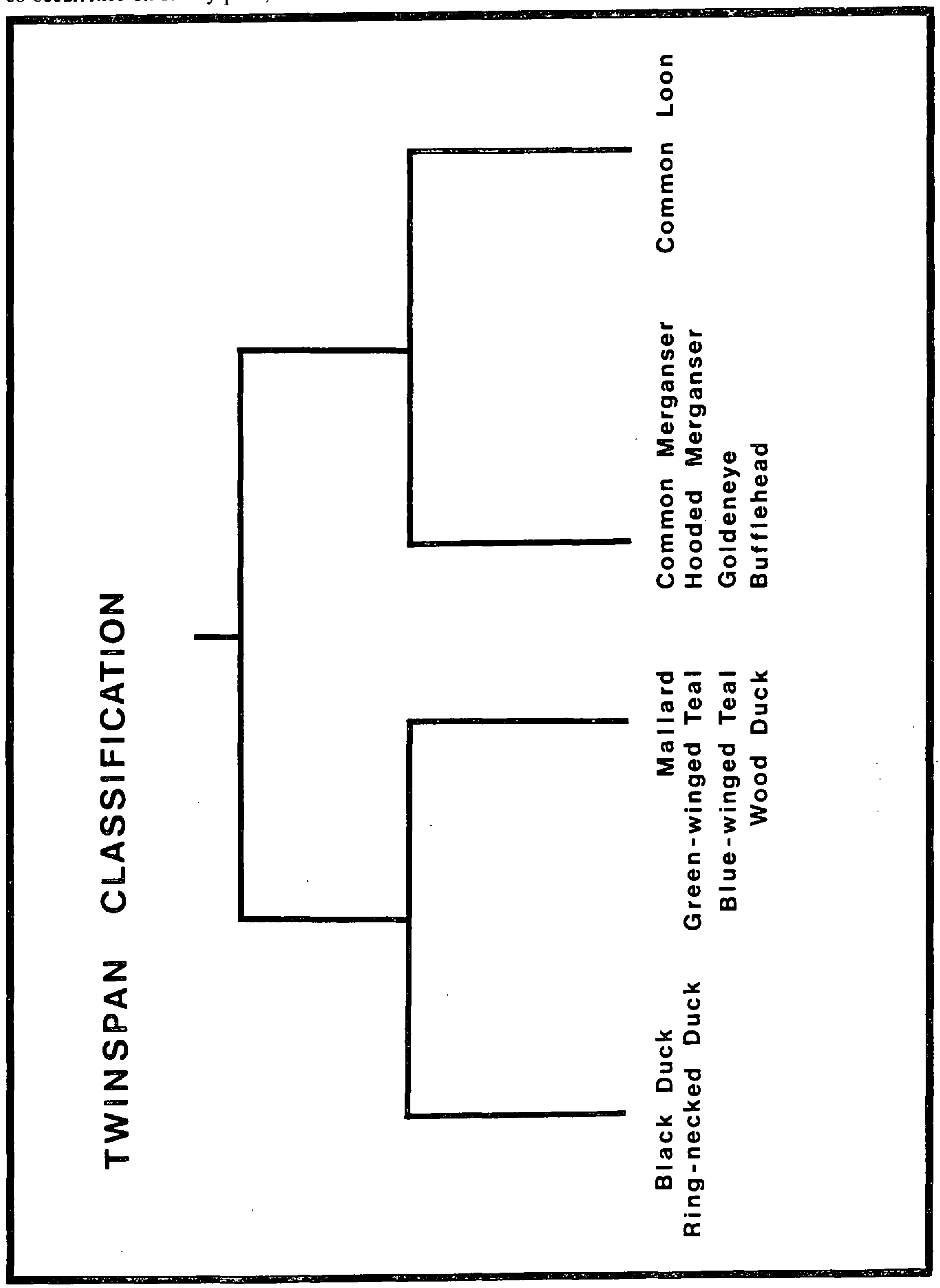
The relationships among the co-occurrences on survey plots of the ten most common waterfowl species together with the Common Loon were examined through a two-way indicator species analysis (TWINSPAN, Hill 1979). This procedure produced an ordered two-way table (App. 2) in which the plots were assembled according to their degree of waterfowl community similarity as determined by reciprocal averaging. Based on this ordination, the species were aligned according to their degree of co-occurrence and hence ecological similarity. (The results are summarized in Fig. 2.) Not unexpectedly, the species separated essentially into divers and dabblers. Although habitat analysis is not yet complete, it appears that this division reflects the preference of the divers for deeper lakes and that of the dabblers for shallow lakes with beds of emergent vegetation. A further division occurs in the diver group between the Common Loon and the *Mergini* tribe, probably based on the loon's preference for larger water bodies. Within the dabbler and bay-duck group, the Ring-necked Duck and Black Duck split off from the others, as they use a wider range of habitats. (See distribution of occurrences in App. 2.) The two teal, Mallard, and Wood Ducks form a separate sub-group with more limited ecological preferences. It is noteworthy that the Mallard and Black Duck are in different sub-groups, the latter occupying a much wider range of habitats at present, although some Mallards occurred in habitats where Black Ducks were not found (App. 2); many of these wetlands were influenced by agricultural activities.

Discussion

This survey has shown that waterfowl in general breed in a fairly constant but low density (approximately one indicated pair per square kilometre) across those exposed Shield and clay belt areas examined up to now. Overall percentage of occupancy and wetland density were much more variable, but together they acted in a compensatory manner to produce overall uniformity in breeding density, even though densities of individual species could vary considerably.

Table 3 compares these results with previous work in the Shield and clay belt undertaken by Dennis (1974b), who made a ground survey of a stratified sample of accessible plots (one half-mile square each). To provide comparable figures from the present survey, the clay belt values have been obtained by averaging those for the Kirkland Lake and Cochrane blocks, while the Shield values have been derived

Figure 2
TWINSPAN classification of the more common waterfowl species in northern Ontario according to ecological similarity (based on co-occurrence on survey plots)



from means of the Gogama and Hornepayne blocks. In the case of the clay belt, the total waterfowl breeding density value was 55% higher during the earlier survey, owing in part to the high counts of Black Ducks, a species which has declined significantly in recent years. The other major decreases occurred in American Wigeon and Common Goldeneye, which have not shown widespread population declines. The Common Goldeneye can be counted with equal efficiency from the air or the ground (Ross 1985); the American Wigeon, while not tested in this regard, would also appear to be equally visible. Whether the observed differences were due to annual variability or some survey bias remains unresolved. Results for the Shield sector were much more similar, although again the Common Goldeneye showed higher values during the earlier survey and the Black Duck count suggested a slight decline over time. Interestingly, the Mallard densities were very similar between the two surveys, suggesting that this species was not taking over the habitat left by the Black Duck.

Only the Black Duck and Ring-necked Duck seemed to frequent a wide range of lakes. Mallards occupied only a part of the ecological range covered by Black Ducks and also some wetlands not used by that species. Studies at present under way will give a much clearer assessment of habitat segregation between these two species and whether competition is a factor in habitat selection.

The systematic aerial survey has proven to be well suited to the Precambrian Shield of northern Ontario because of the relatively even distribution of the many small wetlands in which the waterfowl concentrate. There are very few large wetlands where navigation difficulties preclude satisfactory coverage. Because of this habitat pattern, it has been possible to survey a 4-km^2 plot and move to the next plot 20 km distant in the same time that it would take to cover a 20-km transect 200 m wide at 100 km/h. Costs are therefore no higher using the quadrat method rather than transects. Moreover, the method is more easily repeatable, makes habitat study easier, and allows for multiple passes when identification problems are encountered. The UTM grid system provides a ready framework for the survey data base and allows for inclusion of future counts, either by repeating blocks for population trend data or by surveying new blocks where more detailed and local information is required such as the assessment of environmental impact. Data transfers to other UTM-based systems such as the Ontario Breeding Bird Atlas can be easily accomplished.

Breeding pair surveys have also been extended into the Ontario Hudson Bay Lowlands, where brief test flights were undertaken during the springs of 1982, 1985, and 1986. The sampling regime, however, had to be changed because cost efficiency (number of indicated pairs per hour of flying time) fell steeply. This was due to the time taken in surveying very extensive amounts of apparently suitable habitat which proved, however, to support very few birds. Instead, the waterfowl were found concentrated, often quite heavily, in distinctive sites around larger water bodies; these will be sampled preferentially using plot stratification based on air photo interpretation. Work in this area will necessarily be costly given that the region is even less accessible than the

Table 3
Comparison of waterfowl densities 1973 (Dennis 1974b) and 1980–83 (present study). As different methods were employed in these two surveys, detailed comparisons are not warranted.

	Precambrian		Clay Belt	
	1973	1980–83	1973	1982–83
Canada Goose	0	0	0	0.9
Wood Duck	1.5	0	0	0.9
Green-winged Teal	1.2	3	9.7	5.3
Black Duck	27.8	21.1	31.3	11.4
Mallard	7.3	5.5	23.2	18.3
Mixed pairs	—	1.5	—	0.5
Blue-winged Teal	0	1	6.2	5.3
American Wigeon	0	0.5	17.8	0.9
Northern Shoveler	3.5	0	0	0
Pintail	0	0	1.5	0
Scaup spp.	1.2	0	0	0
Ring-necked Duck	29.4	24	12.3	18.7
American Goldeneye	25.1	16.5	27.8	9.2
Bufflehead	3.5	6.5	0	0
Hooded Merganser	13.5	11.0	3.1	7.6
Common Merganser	4.2	10.5	0	7.2
Red-breasted Merganser	0	1.5	0	0
Total	118.2	102.6	132.9	85.8

Precambrian Shield, that suitable locations for fuel caching are few in this largely flooded area, and that navigation at low altitude is difficult in the flat, rather featureless terrain.

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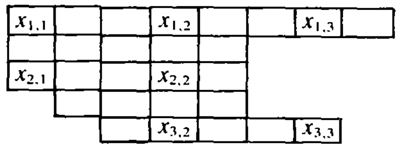
Appendix 1

Estimating the mean and variance from a systematic sample by G.E.J. Smith

There are few formulas in the literature for estimating the standard error of means and totals in a two-dimensional systematic sampling plan. Below, I outline an extension of formula 8.44 in Cochran (1977) that I consider appropriate for the waterfowl survey data in this paper.

Consider the following systematic sampling plan on an irregular area over which a rectangular grid has been placed. Let the count for the quadrat in the i^{th} sampled row and j^{th} sampled column be $x_{i,j}$. An example in which every second row and every third column were sampled is:



For all possible pairs of adjacent observations such as $(x_{i,j}, x_{i,j+1})$ or $(x_{i,j}, x_{i+1,j})$, calculate the squared differences $d^2 = (x_{i,j} - x_{i,j+1})^2$ and $d^2 = (x_{i,j} - x_{i+1,j})^2$, respectively. Let $T = \sum_i \sum_j d^2$ be the sum of all the squared differences and m be the number of pairs of observations. Then the variance of the mean

$$\bar{x} = \frac{1}{n} \sum_i \sum_j x_{i,j}$$

where n is the number of sampled quadrats, is estimated by

$$\text{var}\ \bar{x} = \frac{N-n}{Nn} \cdot \frac{T}{2m}$$

where N = number of quadrats (both sampled and unsampled) in the population.

In the above formula, each quadrat or block is treated as a stratum, and certain assumptions about the randomness of the underlying distribution are required. These assumptions are normally satisfied in data, such as those discussed in this paper, that do not have periodicity corresponding to the sample design.

Reference: Cochran, W.G. 1977. Sampling techniques. John Wiley and Sons, NY. 428 pp.

Appendix 2

TWINSPAN synthesis table for waterfowl survey data for six plots in northern Ontario (based on pseudospecies cut levels of 0 and 1.1 indicated pairs per plot)

Abundance value 1: 1 indicated pair per plot
2: > 1 indicated pair per plot

	111 1 1 11 1 1 1 1 1 1 1 11 1	
Plots*	45779901199461 58 14550 601 1 1130666771234613703922488902445535787808124788924568240036810 112357115139269236379	Species
Species	72267830410633432917905982656762502451894787555293033041345193414869117761520894307752828040943468195138566669120782	dichotomies
Black Duck	—11-121-22221222222222222222222222222112121—111-22-1221—2121—1-11—2222-1—	00
Ring-necked Duck	—1-1-22221-11111222122—211122222222222121211212—221-22111—2—1—2—	00
Mallard	1111111112—222222222222221—2-1—1—1-2—2—1—211-121-1—12—1—	01
Green-winged Teal	—111222-1-1—122-1—1111—1—1—1—	01
Blue-winged Teal	—1-2-2-2—11—1-1—	01
Wood Duck	—1—1—1—	01
Common Merganser	—1—1—1-1-11—1-111-22222122222211-2—11—121112111111111—	10
Hooded Merganser	1—1-11-11—1—2—1—1-2—12—11—1-1121-221222122—11—	10
Common Goldeneye	—1—2—2-112-1—111112221221-211—2121221212—11—1—	10
Bufflehead	—1—11—1—1-1—222—	10
Common Loon	—1—1—1-21—1—1—11111112-11-11—2-1—2-2212-1—121-11-2—1-1-1—211222222111	11
Plot dichotomies	0000000000000000000000000000000000000000000000000111111111111111111111111111111111111111111111111111111111	
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	0111110000110111111000001100001110011111100000111100011011111000001111 00111111	

*Block assignments
Plot no. 1–21 Huntsville
22–41 Gogama
42–58 Cochrane
59–81 Hornepayne
82–98 Fort Hope
99–116 Kirkland Lake

Note that plots with no waterfowl are eliminated from the analysis.