EFFECTS OF COVER CONVERSION UPON WATERFOWL RECRUITMENT ON MODIFIED ASPEN FOREST RANGE

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ON ASPEN FOREST RANGE

INTRODUCTION

In the transition forest, converted rangelands associated with suitable wetland habitats furnish prime duck nesting areas if managed to maintain some diversity of vegetation cover. In deforested clearings in the transition forest, vegetation succession following range conversions creates a diversity of habitat comprising regenerating aspen stands, shrub patches and mixed seeded and native grasses. In this heterogeneous mosaic, moderate grazing intensities result in uneven forage removal, ensuring some carry over of residual woody and herbaceous cover which is utilized by nesting ducks. Ongoing burning and spraying with defoliant chemicals are practices designed to eliminate regenerating woody cover. These practices modify the structure, dispersion and density of cover patches leading to more uniform utilization of the range by grazing livestock.

The effects of these range cover conversions on waterfowl recruitment have not been adequately monitored. Patches of dense residual cover consisting of shrubs and unpalatable grasses furnish good nest concealment on moderately grazed range. Removal of these cover patches through range conversions reduces diversity and interspersion and simplifies vegetation structure. These alterations of cover may influence waterfowl nest site selection and reduce nesting success rates due to changes in waterfowl nesting patterns and to increased vulnerability of nests to predators.

In May 1988, a preliminary field investigation was initiated on two 259 ha (1 mi^2) replicate study areas located on grazed modified rangeland in the Royal PFRA Community Pasture. The influence of vegetation management

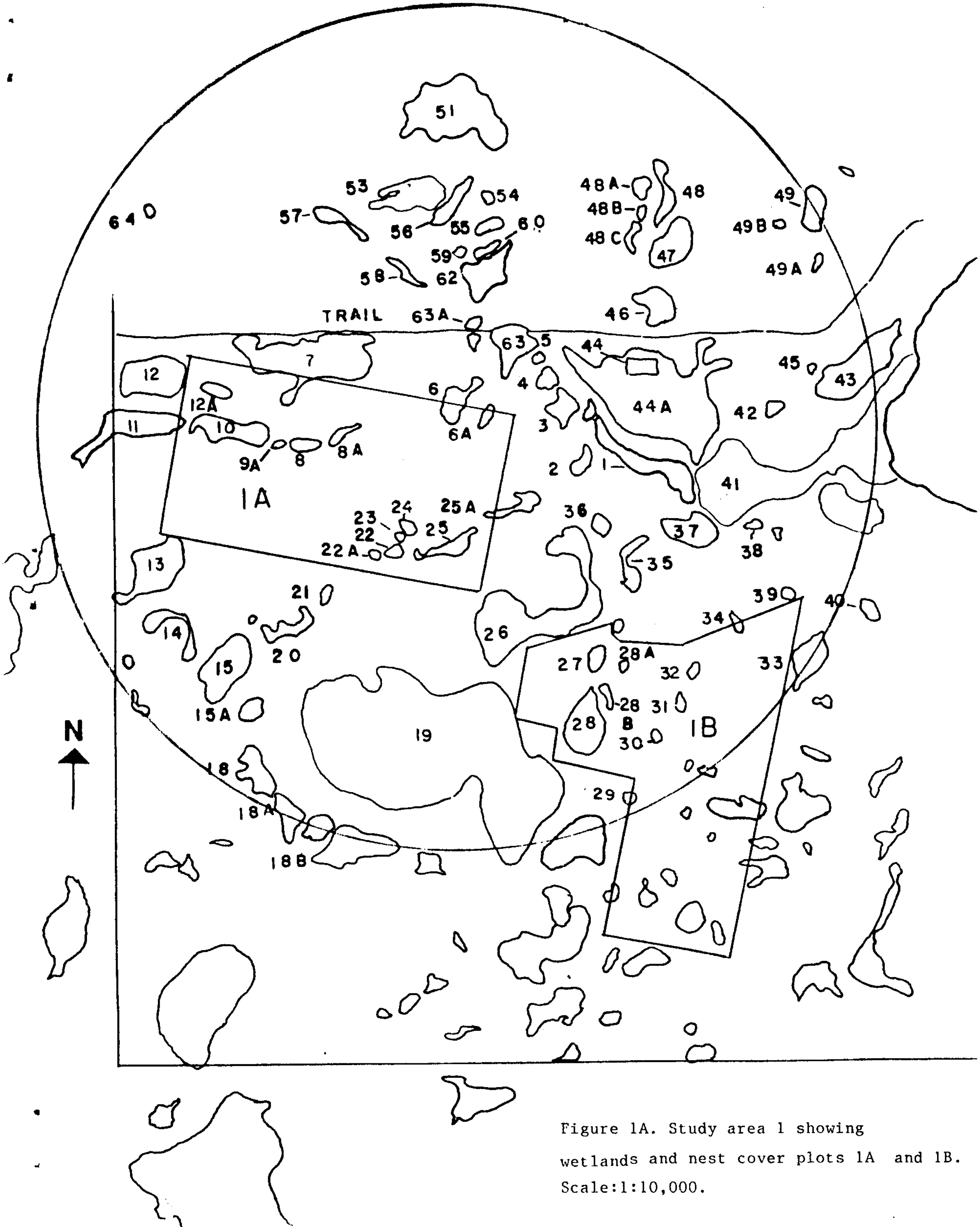

Figure 1A. Study area 1 showing wetlands and nest cover plots 1A and 1B. Scale:1:10,000.

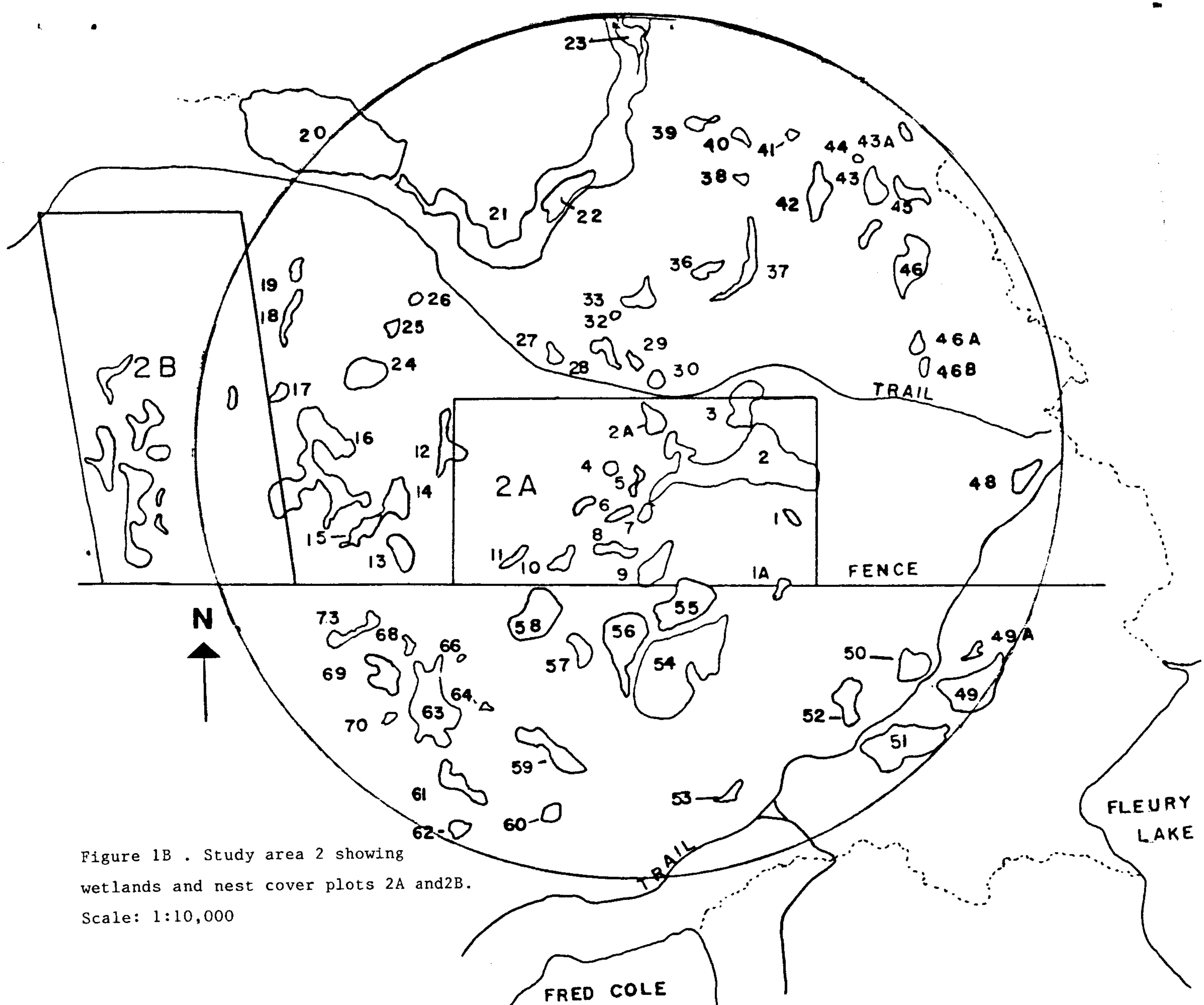

Figure 1B . Study area 2 showing wetlands and nest cover plots 2A and2B.

Scale: 1:10,000

treatments was studied by locating one 32 ha nest cover plot on early succession range and one 32 ha plot on late succession range (the latter includes a greater dispersion of regenerating trees and shrubs). The late succession treatment was replicated on both study areas. Higher duck nesting densities and nesting success rates and consequently higher recruitment is assumed to be correlated with increased habitat diversity and shrub cover found on late succession range, provided that suitable wetland habitat requisites are present to attract waterfowl.

In 1988, the study areas were surveyed to document duck breeding pair use, nest densities, nesting success and brood occupancy. Population and habitat parameters were related and compared between study areas. Results of this initial year will assist in evaluating methodology, size of study areas and validity of sample sizes for testing significance of differences between study areas and for predicting effects of habitat variables upon recruitment.

STUDY AREAS

The two study areas (Fig. 1) were standardized by using criteria which matched areas with similar site features and habitat suitabilities (Adams 1988). Study area 1 (19-46-8-W3) in Field A4 contained 80 wetlands of which 20% were semipermanent or permanent; study area 2 (19 and 29-46-8-W3) in Fields A5 and A4 contained 75 wetlands of which 11% were semipermanent or permanent (Table 1). Each area had similar ratios of temporary and seasonal wetlands. The study area centers were located 2 km apart and not more than 890 m from large (> 5 ha) permanent water bodies which are utilized as spring waterfowl staging and foraging areas (Fig. 1).

Study area 1 encompassed two physiognomically different range types: (1) brush rangeland (late succession) and (2) open-low shrub rangeland

Table 1. Wetland characteristics on study areas 1988.

Study Area	Total	Number of Wetlands/Mi^2 Temporary	Seasonal	SemiPerm	Perm	Proximity m to large Wetland (>5 ha)
1	80	35	29	13	3	370
2	75	32	35	4	4	890

(early succession). Nest cover plot 1A represented (1) and plot 1B represented (2) (Fig. 1). Plot 1A was distinguished from 1B by higher frequencies of shrubs including more interspersed mid-shrubs (> 50 cm, < 1 m) and saplings (Table 2). On study area 2, plot 2A resembled plot 1A with lower frequencies of shrubs, whereas plot 2B was essentially a replicate of 2A. No replicate for type 1B was available on area 2.

Range site condition as determined by vegetation composition and plant height/density varied little from plot to plot. Except for some over grazed patches, livestock utilization was relatively uniform between areas despite some differences in stocking rates (Table 2). Vegetation profile densities measured in May and early June varied from 80 to 88% (0-10 cm) and from 33 to 66% (10-20 cm) on nest cover plots (Table 2). These values are lower than the index value of 100% (0-20 cm) for high quality dense nesting cover (Duebbert et al. 1981); nevertheless these values infer good range vegetation carry over and moderately good nesting cover.

The dominant herbaceous plant species found on both study areas include northern wheatgrass (*A. dasystachyum*), awned wheatgrass (*A. subsecundum*), slender wheatgrass (*A. trachycaulum*), Russian wild rye (*Elymus junceus*), smooth brome (*Bromus inermis*) and Kentucky blue grass (*Poa pratensis*), northern bed straw (*Galium boreale*), wild strawberry (*Fragaria* spp.), wild peavine (*Lathyrus* sp.), and vetches (*Vicia* spp.). Common shrubs include wild rose (*Rosa* sp.), soapberry (*Shepherdia canadensis*), willows (*Salix* spp.), gooseberry (*Ribes* spp.) and red-osier dogwood (*Comus stolonifera*). Wetland plant species include marsh reed grass (*Calamagrostis canadensis*), sedges (*Carex* spp.) and cattail (*Typha latifolia*).

Table 2. Stocking rates, range vegetation density and cover, study areas 1980.

Study Area	Stocking Rate[1] A.U.M./Ha	Nest Cover Plot	Mean[2] Vegetation Height (cm)	Shrub3 Frequency %	Density[4] Profiles 0-10 cm	11-20 cm
1	2.1 (Field A4)	1A	24.8	58	80	33
		1B	27.9	42	88	66
2	1.4 (Field A5)	2A	27.7	41	87	64
		2B	28.3	44	87	58

[1]A.U.M./Ha Animal unit months per hectare (not corrected for available range less wetlands).

[2]Mean vegetation height in cm taken with vertical profile board late May and June.

[3]Shrub frequency: the number of shrub stem intercepts in a 3-dimensional box 30x20x20 cm - sampled at 25 m intervals. Includes low, medium and tall shrubs.

[4]Density profiles: % vertical obscurred cover values as measured at height intervals of 10 cm.

METHODS

1. Waterfowl Surveys: Ground surveys were conducted weekly of waterfowl populations utilizing available surface water within each 259 ha study area. Counts of waterfowl pairs, lone birds and groups were made from elevated points, using a 20x telescope when observing large ponds. We reduced duplications of counts by watching the flight patterns of flushed waterfowl and noting their destinations within the study area. Calculations of indicated pairs were based upon standard air-ground census procedures (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1977) but including all lone females as pairs except bufflehead (*Bucephala albeola*), and deleting lone male lesser scaup (*Aythya affinis*) during the first three survey periods. Counts were tallied by wetland over five census periods from May 14 to June 23.

At weekly intervals during July and early August we counted duck broods occupying wetlands. We made passive counts from elevated observation points to minimize disturbance of the broods, recording data on species use, age and size of broods according to Gollop and Marshall (1954). Within each study area we did not assign brood occupancy to ponds within treatment plots due to potential movements of duck broods between the closely associated plots.

2. Nest Searches: The 32 ha plots were selected as intensive nest search areas for documenting species utilization, densities and nesting success. Each nest cover plot was located at least 100 m from large permanent ponds to reduce this attraction effect which may function to increase concentrations of nesting waterfowl. During late May and in mid-June two intensive nest searches were conducted on the four study plots with two all-terrain vehicles (Honda four trax) towing a cable-chain drag

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25 m in length. The cable-chain sweep devised by the U.S. Fish and Wildlife Service functions to flush nesting hens off nests (Klett et al. 1986). A third planned nest drag was not conducted because late delivery of the vehicles prevented an early search in mid-May. In addition, ground beat outs were carried out in mid-May around wetland edges and brushy patches on plots 1A and 2A. Nests found were marked with two canes, and nest sites were plotted on maps. Information was recorded on computer entry forms regarding species, clutch size, incubation age of eggs, concealment and vegetation cover around nest sites. We revisited nests approximately every 2 weeks to determine the nest fate: whether hatched, destroyed or abandoned, and attempted to determine the agent responsible for disturbances.

3. Vegetation Sampling

A. Vegetation Profiles: In order to assess quality of nesting cover and to compare range conditions among plots, we sampled height/density of herbaceous and shrubby vegetation during late May and June. On each 800 x 400 m nest cover plot, we located 15 transects spaced 50 m apart at right angles to the long axis. On 6 randomly chosen transects we sampled vegetation at point intervals of 25 m, so that 86 to 96 points were sampled on each plot. We estimated percent cover of vegetation obscuring each 10 cm stratum interval shown on a 0.25 x 1 m high profile board (modified after Nudds 1977), as viewed from a distance of 4 m and a height of 50 cm.

In addition to profile data at each point we recorded the vegetation type, horizontal vegetation density, maximum height of vegetation and number of shrub stem hits occurring within a 6 dm^2 x 2 dm space. The latter estimates frequency of occurrence and dispersion of primary shrub stems on the study plots, but does not discriminate between shrub height classes.

B. <u>Vegetation Crown Cover</u>: During July, horizontal cover of several vegetation layers was assessed by visual estimates of the percent of quadrat area (0.5 m^2) occupied by stems and foliage (Hayes et al. 1981). On three plots (1A, 1B, 2A) we selected randomly about 50 locations on a 30 m grid and placed a 1 m x 0.5 m quadrat frame oriented with the long axis east-west. We estimated mid-point percentiles of crown cover occupied by tall shrub, mid shrub, low shrub, forb and grass layers. Percentile classes were estimated by referral to standardized diagrams of cluster patterns (Terry and Cholingar 1955). The sample quadrats should estimate on a micro habitat scale the relative spatial coverage of the vegetation components.

4. <u>Nesting Habitat Evaluation</u>: Several parameters were measured to assess effective structure, cover and concealment at the nest sites for comparisons with background vegetation values sampled on the treatment plots. Significant deviations in these parameter values at nest sites from background plot values may signify some habitat selection cues utilized by nesting waterfowl. Various physical parameters were recorded such as the nest site location in relation to the slope, aspect, distance to water or situation on the edge of a wetland. In late May and June we described vegetation types and measured heights of herb and shrub components within a 5 m radius of the nest site. In addition, we obtained vegetation profile scores, measured vegetation heights and estimated concealment percentiles of vegetation at the nest site. A second profile and vegetation height measurement was obtained after the nest was terminated. In July and August, we assessed vegetation crown cover percentiles at the nest sites.

5. Habitat Classification and Mapping: Preliminary field maps were prepared from available 1:10,000 aerial photographs (1980) of the study areas showing outlined wetlands and wooded vegetation. Recent habitat changes such as tree succession and the establishment of new beaver ponds were not identified on these photographs, but were approximated from ground truth surveys. All wetlands were located annotated and classified in May and July according to permanency, current water levels and vegetation types on margins and basins (U.S. Fish and Wildlife Service, Canadian Wildlife Service 1977).

Three of the study plots were mapped by chaining distances along compass bearings taken from baseline benchmarks and by recording the intercept distances of major features such as ridgetops, wetlands and dense woody vegetation (Figs. 1 a, 1 b). Mapping of numerous dispersed clumps of shrubs was not a feasible exercise due to the great complexity of the habitat. Livestock trampling of survey flag markers made resurveys of plot boundaries from benchmarks necessary in order to conduct nest drags or to layout transects for vegetation surveys. The study plot maps were essential guides for more exact placement of vegetation quadrats, mapping nest sites or for spatial measurements.

RESULTS

1. Waterfowl Breeding Populations

A. Species Composition: Breeding waterfowl species composition differed between the two study areas by less than 4 percentiles. The most abundant species ranked in decreasing numerical order were the lesser scaup, blue-winged teal (*Anas discors*), mallard (*A. platyrhynchos*), northern shoveler (*A. clypeata*), ruddy duck (*Oxyura jamaicensis*), and green-winged teal (*A. carolinensis*) (Table 3). Species each of which

Table 3. Indicated breeding pairs of dabbling ducks by census period and study area - Royal Pasture, 1988.

		Census Period and Julian Date				
		1 (134/135)	2 (140/141)	3 (153)	4 (162)	5 (174)
Mallard	A4	17	12	12	13	16
	A5	11	8	11	6	12
Gadwall	A4	4	7	8	11	8
	A5	6	6	3	3	3
Wigeon	A4	3	4	4	9	17
	A5	7	6	2	6	4
G-W Teal	A4	7	11	9	13	21
	A5	5	9	4	2	10
B-W Teal	A4	23	20	25	23	31
	A5	16	17	12	12	13
Shoveler	A4	9	16	8	10	3
	A5	3	7	9	7	7
Pintail	A4	1	0	0	0	1
	A5	3	3	1	0	1
Total	A4	64	70	66	79	97
	A5	51	56	42	36	50

* Calculations follow Standard Operating Procedures Manual for Air-Ground Surveys.

Table 3a. Indicated breeding pairs of diving ducks by census period and study area - Royal Pasture, 1988.

		Census Period and Julian Date				
		1 (134/135)	2 (140/141)	3 (153)	4 (162)	5 (174)
Redhead	A4	4	4	1	3	0
	A5	0	0	2	3	6
Canvasback	A4	1	0	0	1	3
	A5	5	2	1	0	0
Lesser Scaup	A4	58	76	53	48	45
	A5	28	36	29	34	20
Ring-Necked Duck	A4	1	0	1	1	0
	A5	0	1	2	2	1
Ruddy Duck	A4	12	12	15	15	13
	A5	6	9	6	7	10
Bufflehead	A4	2	0	1	0	0
	A5	1	2	2	5	2
Common Goldeneye	A4	0	0	0	0	0
	A5	1	4	4	4	0
White-Winged Scoter	A4	0	0	0	1	0
	A5	0	0	0	0	0
Total	A4	78	92	71	69	61
	A5	41	54	46	55	39

* Calculations follow Standard Operating Procedures Manual for Air-Ground Surveys.

comprised less than 3% of the population included northern pintail (A. acuta), redhead (Aythya americana), canvasback (A. valisineria), ring-necked duck (A. collaris), bufflehead and common goldeneye (Bucephala clangula). The low numbers of pintail, redhead and canvasback are probably a function of low mid-continental populations of the species (U.S. Fish and Wildlife Service 1988) rather than a function of habitat availability. Conversely, populations of breeding bufflehead and common goldeneye were probably limited by a shortage of tree snags with diameters larger than 20 cm (Erskine 1971). Dabbling ducks comprised 53% (study area 1) versus 49% (study area 2) of the total indicated breeding pairs as determined by the optimum census count.

B. Nesting Chronology: The optimum census selected to represent the number of assigned indicated breeding pairs of each species actually in residence coincided with inferred median dates of the initiation of incubation (Table 3). Mallard, pintail, canvasback and bufflehead counts were assigned early dates (census 1); American wigeon (Anas americana), northern shoveler, green-winged teal and redhead counts were assigned to census 2; gadwall (A. strepera) and blue-winged teal as intermediate nesters were assigned census 3; and lesser scaup, ring-necked duck and ruddy duck were assigned census 4.

Indicated breeding pairs fluctuated seasonally depending upon population turnover and composition of lone and grouped males. Mallard numbers showed two peaks, the latter in late June represented more grouped males which probably included some transients (Fig.2). Peak numbers of American wigeon, green-winged teal and blue-winged teal in census 5 likely indicated an influx of lone or grouped males (Table 3). More indicated pairs and lone males of lesser scaup recorded during the first or second

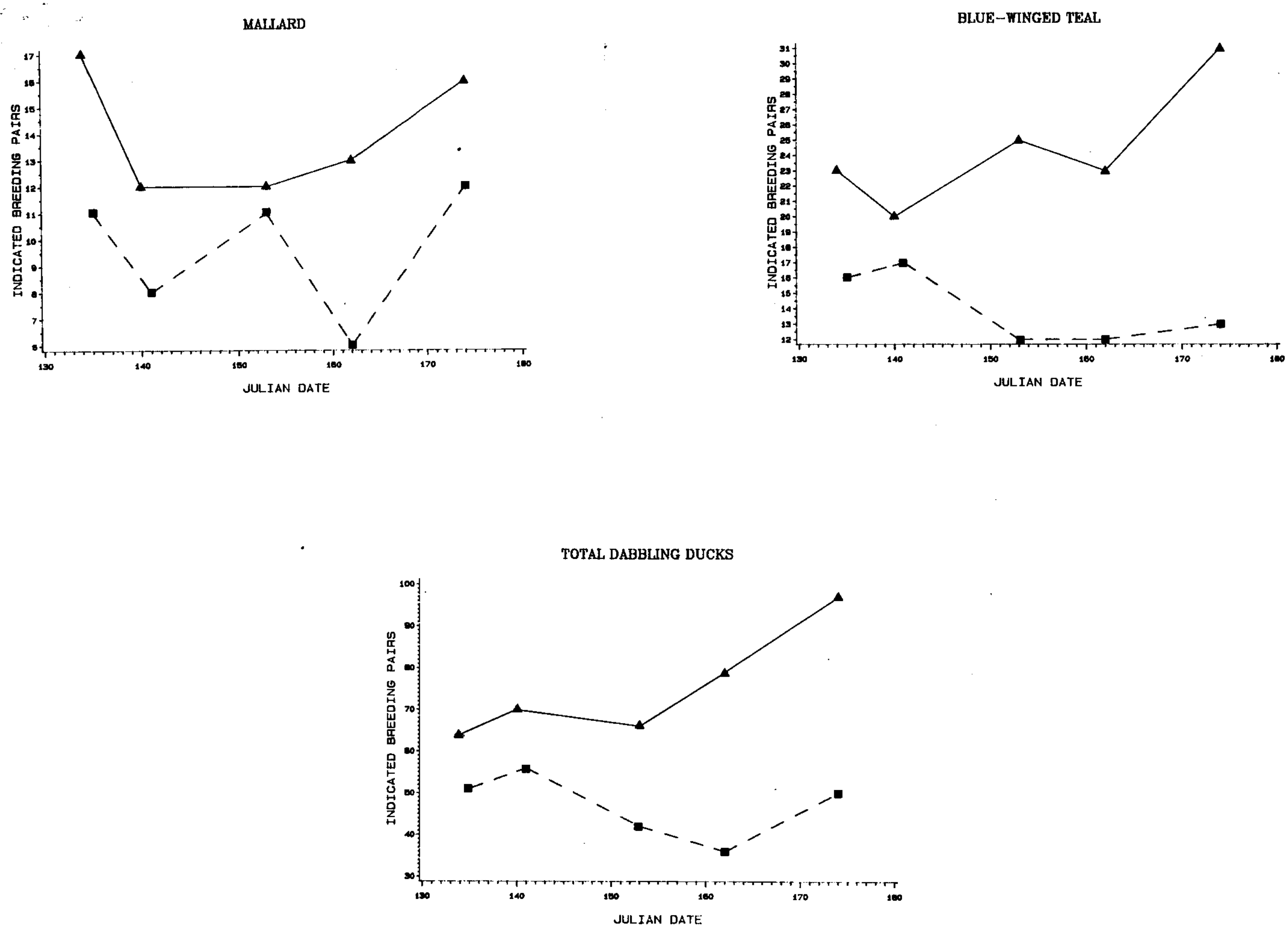

Figure 2A. Seasonal counts of indicated waterfowl breeding pairs, Area 1 and 2. 1988.

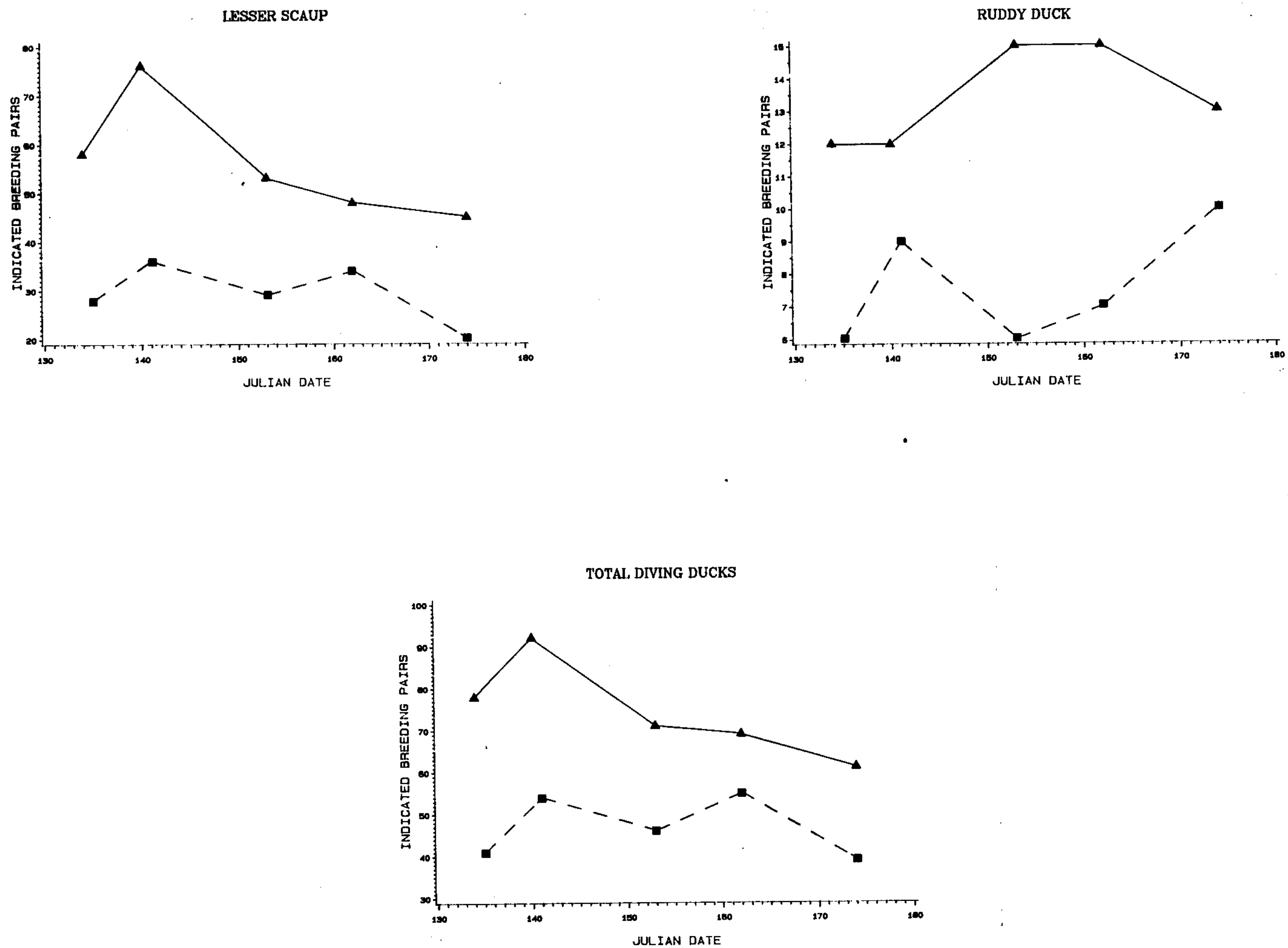

Figure 2B. Seasonal counts of indicated warerfowl breeding pairs, Areal and 2. 1988.

count probably included non-residents and non-breeders. A high sex ratio for lesser scaup favoring males tends to inflate calculations of indicated pairs. Secondary peaks in indicated pairs of early nesting species were probably indicators of renesting attempts.

C. Breeding Pair Densities: Consistently higher numbers of indicated breeding pairs were counted on area 1 where peak counts of 63/km^2 were reached, compared to 41/km^2 on area 2. Breeding pair densities based upon optimum census counts for the species were 60 km/^{2} and 40/km^2, respectively (Table 3). On both areas, 25% to 40% of the total breeding pairs were recorded on a large single pond (> 3 ha). Higher pair densities on area 1 were attributed to the larger accumulated area of permanent ponds, as duck breeding pair densities usually increase proportionally with accumulated area of ponds (Lokemoen 1973, Ruwaldt et al. 1979).

2. Nesting Activity

A. Incidence of Nesting: Nest searches revealed a variable number of active nests located on the four nest cover plots. Densities of discovered nests were 13/km^2 on plot 1A, 53/km^2 on plot 1B, 16.5/km^2 on plot 2A and 3.3/km^2 on plot 2B. Compared to expected average densities of nesting ducks in the range of 27/km^2 found in grazed mixed grass prairie (Duebbert et al. 1986), the observed nesting incidences were comparatively low on three of the plots. Likely this represents an incomplete record of nest initiations biased by the absence of an early nest drag in May. This is substantiated by missing nest data on mallards; an early nesting species, and by the high mean age of clutches when found (Table 5).

The two study plots which sample 25% of the study area size should account for about 39 indicated pairs rather than 20 nesting pairs as found on plots 1B and 1B. Numbers of nests appear to be unevenly distributed among the study plots; and greater clustering in plot 1B may suggest a departure from a random distribution. The apparent nest density in plot 1B may be biased by the relative ease of locating nests with nest drag techniques in more homogeneous habitat, compared to more heterogeneous habitat on the brush-covered plot 1A. The presence of mid-shrubs and saplings on the latter plot presents obstacles for the drag-chain, and may divert the chain over occupied nests without flushing the hens. In order to locate more of the active nests within shrub patches, we will need to conduct repeated supplementary ground beat outs. Therefore it is too early to determine whether densities of active duck nests are actually higher on the early succession plot.

Another variable which may influence nest densities is the distance of the nest from available surface water. On the open plot 1B, nest sites on uplands were located on average distance of 77 m from surface water in June; compared to 115 m from surface water for nest sites found on plots 1A and 2A. Also, centers of plots 2A and 2B were located at greater distances from large permanent ponds (Table 1). Thus nest distance to water may be a factor in attracting nesting ducks and may influence duck brood survival, especially during a summer drought, which has caused seasonal declines in water levels on seasonal wetlands.

B. Nesting Cover: Due to the small nest sample we combined upland nest data from study plots, including several sites located outside plots, and grouped them into sites located on uplands versus sites located in dry wetlands or meadows. Mean heights of herbaceous vegetation measured at upland nest sites in late May and June were higher than mean height values for plots (Table 4). Similarly profile density scores (0-30 cm) differed substantially between wetland/meadow and upland (Fig. 3). Profile

Table 4. Comparison of vegetation cover at nest site with nest cover plots 1988.

Site or Plot	Mean Height Vegetation	N	% Crown Cover Forb	Grass	Shrub	N
Upland Nests	34.3 (2.78)[1]	16	11.6 (1.19)	33.9 (2.37)	12.7 (1.94)	19
Plot 1A	25.5 (2.26)	96	19.4 (1.15)	29.1 (1.92)	11.0 (1.92)	57
Plot 1B	28.1 (1.07)	86	15.8 (1.14)	26.4 (1.87)	7.6 (1.28)	52
Plot 2A	28.6 (1.84)	88	16.6 (2.26)	32.3 (1.95)	9.5 (1.16)	54

[1]Figures in brackets are standard errors of the mean.

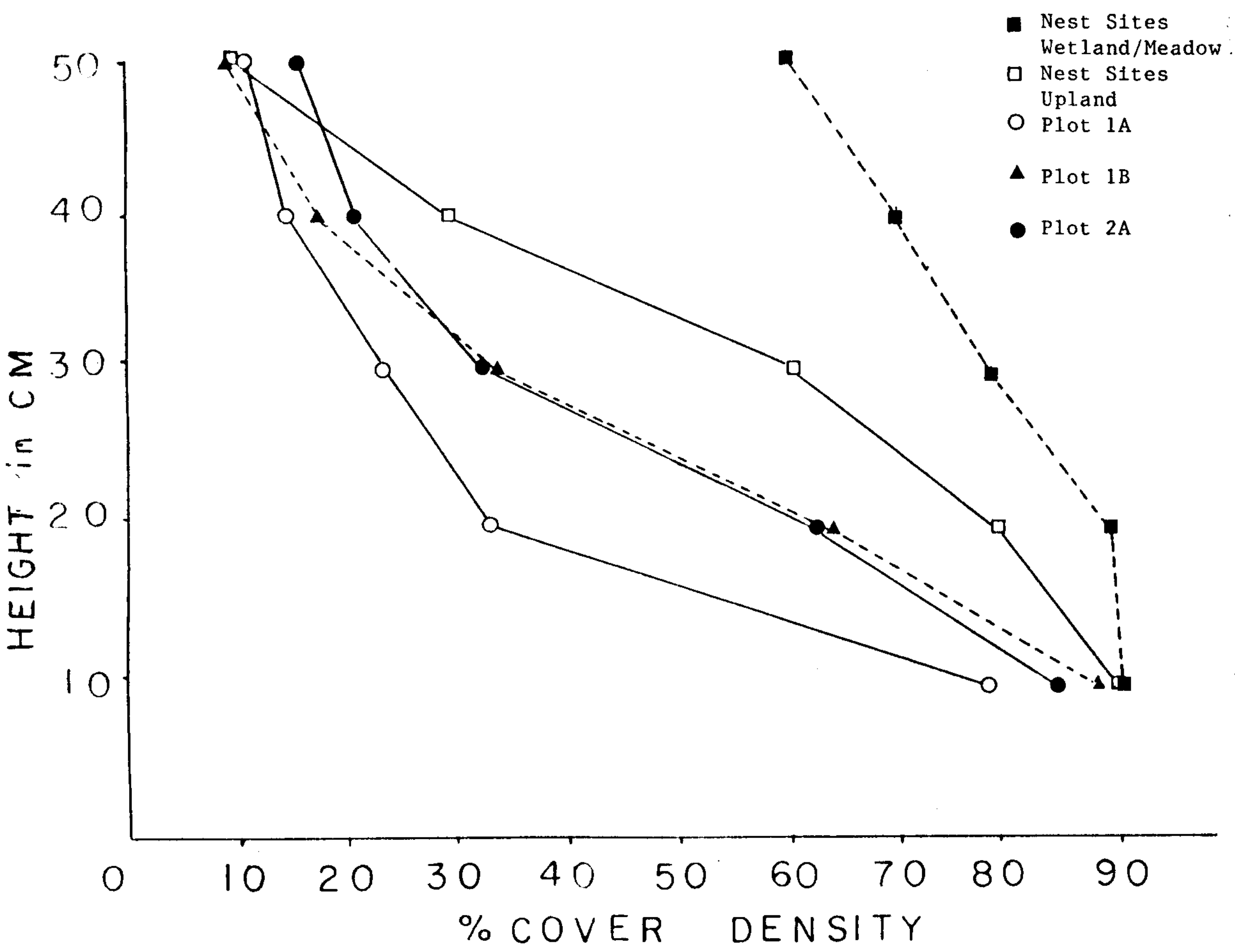

Figure 3. Vegetation profile scores at nest sites compared to mean profile scores on nest cover plots.

densities (0-10 cm) taken at upland nest sites approached a mean of 90%, similar to background values measured on plots 1B, 2A and 2B, but higher than values on plot 1A (Fig. 3). However, profile densities at the 10-20 cm stratum were 80-90% at nest sites compared to plot values of 33 to 65% (Table 2). These results suggest that upland nesting ducks select cover at nest sites that is denser and taller than mean cover measurements sampled on cover plots. Also, there are no apparent differences in mean heights of vegetation cover at successful and unsuccessful nests (47.5 versus 49.3 cm respectively). The greatest divergence in cover values between plots and nest sites occurs at stratum intervals of 20 to 40 cm in height, although dense vegetation with heights of 50 cm or more is preferred by nesting ducks (Klett et al. 1984). According to Duebbert et al. (1986), the use of nesting habitat by blue-winged teal is maximized when dense residual cover shows a height-density reading of 5 cm or more.

Another component of vegetation cover at nest sites concerns the spatial and structural aspects of herbaceous and shrubby plants which are distributed in layers. Percent horizontal crown cover of herbaceous and woody plants at upland nest sites was slightly higher but probably not significantly different from background cover values on plots 1A and 2A (Table 4). Given a sufficiently large sample size, it may be possible to estimate threshold nest site values based upon percent cover or other shrub parameters. The proximity, height, density and cover of shrubby plants may play a role in nest site selection by some waterfowl species (Greenwood et al. 1987, Duebbert et al. 1986).

C. Nesting Success: Comparisons of nesting success rates among the study plots was not possible due to the small nest sample size. However, approximate nesting success rates could be estimated for combined dabbling ducks nesting on all four plots (Table 5). Calculations of nesting success followed the Mayfield method and shortcut method (Klett et al. 1986, Johnson and Klett 1985). Both methods yielded the same results (0.12) which was considerably lower than the apparent rate of 0.32. If this nesting success rate was typical of nesting duck populations on the two areas in 1988, it is below the minimum replacement rate or threshold level required to maintain populations of mallards (Cowardin et al. 1985) and other species (Klett et al. 1988). Average percent nest success observed in grazed grasslands during 1980-84 in North Dakota was 14% for all duck species (Klett et al. 1988).

3. Recruitment

A. Brood Occupancy: Total broods occupying study area ponds were estimated by accumulating individual broods during successive counts on each pond, and deleting probable replicates due to similarity in brood size and in chronological progression in age class (Table 6). Interpond brood movement was assumed to be negligible. Most brood ponds were large and semipermanent in nature, and only 2 ponds on which broods were observed dried up completely during the survey period. Ingress of broods from outside of study area 1 was possible due to the presence of several large permanent ponds within 0.5 km. However, the largest pond (no. 19) on the periphery of the area, had no recorded broods of dabblers which are the most mobile over land travellers. There was less likelihood of ingress onto study area 2 from permanent ponds which were located at least 1 km from brood ponds on the area. Broods moving this distance over land would be very vulnerable to avian predators such as northern harriers (*Circus cyaneous*) and ravens (*Corvus corax*).

Table 5. Estimated nesting success for dabbling ducks combined study areas 1988.

Parameter	Number	Apparent Success Rate	Mayfield Success Rate	Shortcut Method Success Rate
Total nests	22	.32	.12	.12
Nests failed	15[1]			
Nests hatched	7			
Mean exposure days	11.8			
Mean age of clutch when found (days)	14.9			

[1]Fate of all failed nests was due to predation.

More broods were observed on study area 1 because of the presence of more permanent water (Table 6). Broods were present on 8 ponds on study area 1 and on 6 on study area 2. Most broods were found on impoundments; 19 were observed on a 2 ha beaver pond on study area 1, and 17 were observed on a 3 ha stock dam impoundment on study area 2. The most abundant species arranged in descending order were blue-winged teal, lesser scaup, ruddy duck and green-winged teal (Table 6). Only broods of mallard and lesser scaup were more numerous on area 2. Brood densities (20/km^2) on study area 1 are considerably lower than brood densities of 29 to 46/km^2 which were recorded on a brushy (previously burned) pasture study area during 1980-82 (Adams 1985).

B. Recruitment Rates: Differences in calculated brood/pair ratios between the study areas are more likely explained by sample variation, although brood/pair ratios for combined species are identical (Table 6). The ratios imply that up to a third of the total indicated breeding pairs were successful in bringing broods to water. The least successful species were lesser scaup, northern shoveler, and mallard. This is a surprising low ratio for lesser scaup which usually nests on edges of sedge meadows or over water. However, this species did have brood/pair ratios as low as .19 and .22 on study areas observed in 1981 and 1982 (Adams 1985). The low ratios in the previous study were due to heavy predation of nests near the water's edge. Heavy predation is also suggested by the nest records in this study despite the small sample size. A nest success rate of .12 is not in agreement with the overall dabbler brood/pair ratio of .39. Therefore the nest data is probably biased by species interaction, small sample size, incompleteness of records, and the possibility of substantial renesting efforts. Cowardin and Johnson (1979) list nest success and the

Table 6. Duck broods and brood/pair ratios by species and area 1988.

	Area	MAL	GAD	WIG	GWT	BWT	SHO	DAB	SCP	RUD	BUF	DIV	Total
						Species							
Total broods	1	02	05	05	07	11	02	34	05	06	03	18	52
	2	05	01	00	03	06	02	18	09	05	01	17	35
Combined Area Total	C	07	06	05	10	17	04	52	14	11	04	35	87
Broods/Pairs[1]	1	.12	.63	1.20	.64	.44	.13	.44	.10	.40	1.00	.25	.34
	2	.45	.33	00	.33	.50	.29	.35	.26	.71	.50	.32	.34
Broods/Pair Combined Area	C	.25	.55	.50	.50	.46	.17	.39	.17	.50	1.00	.28	.34

[1]Brood/pair ratio is based upon optimum pair census count for a species. Ratios of 1:00 or higher are erroneous due to small sample size or inappropriate assignment of indicated pairs.

number of renests as crucial parameters affecting the maintenance of mallard populations.

The brood/pair ratios may reflect relative differences between species in regard to levels of recruitment. However, these ratios are biased because they do not account for differential mortality of broods from age class 1 to fledglings. Some entire broods either disappeared or were not visible again during successive counts on the ponds. In 1982 brood mortality rates for mallard and blue-winged teal calculated from hatching to age class 2, were estimated at 30% and 26%, respectively (Adams 1985). According to Dzubin and Gollop (1972) brood mortality rates between age class 2 and 3 are negligible. Therefore adjusted recruitment rates based upon the assumed above mortality rates would be 0.18 (mallard) and 0.34 (blue-winged teal). These rates are still comparatively higher than nesting success rates reported for most unmanaged farmland habitats (Klett et al. 1988). More reliable estimates of duckling mortality would probably be obtained from observations of marked individuals or from more fequent counts.

Recommendations for Future Studies

1. Logistics

a. Establish a base camp with more facilities such as a cabin trailer with a work space.

b. Increase the former crew size of 2 to 2 crews of 2 individuals with an experienced person on each crew. An extra crew plus occasional assistance by volunteers would enable simultaneous work on more than one activity. Waterfowl counts, nest drags and vegetation surveys need to be carried out within the same time frame. This would also allow simultaneous work on different areas.

c. Use of a trailer for transporting all-terrain vehicles would increase efficiency in travel time to the area.

2. Study Areas

a. Additional study areas are required in order to replicate the number of treatment plots to isolate treatment effects from site specific factors (Adams 1988). Establishment of one other study area probably to be located in the Spiritwood pasture (located about 48 km north of the Royal Pasture area) is recommended. This area would include 2 treatment plots.

b. On study area 2 nest plot 2B should be discontinued because it is situated too far from semipermanent water to attract ducks.

c. A replicate plot for 2B which is more similar in site characteristics and vegetation cover to plot 1B could be located east of plot 1B.

d. Nest plot sizes should be increased from the present 32 ha to 50 ha (120 acres) to accommodate more potential nesting ducks and increase sample sizes. This will require an extra day for nest drags.

3. Mapping

a. More detailed cover maps of the areas are necessary but are difficult to draft because aerial photographs (1980) are out dated. New aerial infrared photography at a scale of 1:5000 would be desirable to document dispersion of shrub cover and present status of wetlands.

b. Resurveying of plot boundaries was a time consuming task. More permanent markers are recommended subject to PFRA approval.

4. Surveys

a. Increase the number of nest drags.

b. Increase nest beat outs, subject to available manpower.

c. Increase replication of waterfowl pair and brood counts to increase efficiency of population estimates.

d. Increase sample sizes for vegetation sampling.

e. Monitor populations of potential nest predators on the study areas.

5. Management Practices

During the course of the study, PFRA may implement brush control practices such as prescribed burning or spraying on a portion of study area 1 to increase forage productivity. Coordination with PFRA may permit the implementation of spring burns on 2 nest cover plots which will be replicated by 2 unburned paired plots, one which is already located on study area 2. However, these plots must be monitored for waterfowl use and nesting at least one more year to collect baseline data before brush control practices are initiated.

LIST OF REFERENCES

Adams, G.D. 1985. Impacts of grazing and fire succession on duck populations in the mixed-wood forest. Can. Wildl. Serv. Ms. Rep. 31 pp.

Adams, G.D. 1988. Waterfowl recruitment on native and improved rangelands in the aspen parkland. Can. Wildl. Serv. new research proposal. 36 pp.

Cowardin, L.M., D.S. Gilmer and C.W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildl. Monogr. 92. 37 pp.

Cowardin, L.M. and D.H. Johnson. 1979. Mathematics and mallard management. J. Wildl. Manage. 43:18-35.

Duebbert, H.F., E.T. Jacobson, K.F. Higgins and E.B. Podoll. 1981. Establishment of seeded grasslands for wildlife habitat in the prairie pothole region. U.S. Dept. Int. Fish and Wildl. Serv. Spec. Sci. Rep. Wildl. No. 234.

Duebbert, H.F., J.T. Lokemoen and D.E. Sharp. 1986. Nest sites of ducks in grazed mixed-grass prairie in North Dakota. Prairie Nat. 18:99-108.

Dzubin, A. and J.B. Gollop. 1972. Aspects of mallard breeding ecology in Canadian parkland and grassland. In Population ecology of migratory birds: a symposium. U.S. Dept. Int. Wildl. Res. Rep. 2. Pp. 113-151.

Erskine, A.J. 1971. Buffleheads. Can. Wildl. Serv. Monogr. Ser. No. 4. Pp. 50-74.

Gollop, J.B. and W.H. Marshall. 1954. A guide for aging duck broods in the field. Mississippi Flyway Council Tech. Sec. Rep. 14 pp.

Greenwood, R.J., A.G. Sargeant, D.H. Johnson, L.M. Cowardin and T.L. Shaiffer. 1987. Mallard nest success and recruitment in prairie Canada. In Proc. 52 N. Am. Wildl. Nat. Res. Conf., Quebec City. 9 pp.

Hayes, R.L., C. Summers and W. Seitz. 1981. Estimating wildlife habitat variables. Western Energy and Land Use Team. Office of Biol. Serv. Fish and Wildl. Serv. FWS/OBS-81/47. 111 pp.

Johnson, D.H. and A.T. Klett. 1985. Quick estimates of success rates of duck nests. Wildl. Soc. Bull. 13:51-53.

Klett, A.T., H.F. Duebbert and G.L. Heismeyer. 1984. Use of seeded native grasses as nesting cover by ducks. Wildl. Soc. Bull. 12:134-138.

Klett, A.T., H.F. Duebbert, C.A. Faanes and K.F. Higgins. 1986. Techniques for studying nest success of ducks in upland habitats in the prairie pothole region. U.S. Dept. Int. Fish and Wildl. Serv. Res. Publ. 158. 24 pp.

Klett, A.T., T.L. Shaffer and D.H. Johnson. 1988. Duck nest success in the prairie pothole region of the United States. J. Wildl. Manage. 52: 431-440.

Lokemoen, J.T. 1973. Waterfowl production on stock-waterfowl ponds in the northern plains. J. Range Manage. 26:179-184.

Nudds, T.D. 1977. Quantifying the vegetative structure of wildlife cover. Wildl. Soc. Bull. 5(3):113-117.

Ruwaldt, J.J., L.D. Flake and J.M. Gates. 1979. Waterfowl pair use of natural and man-made wetlands in South Dakota. J. Wildl. Manage. 43:375-383.

Terry, R.D. and G.V. Chilingar. 1955. Summary of "Concerning some convential aids in studying sedimentary formations" by M.S. Shvetsov. J. Sedimentary Petrology 25(3):229-234.

U.S. Fish and Wildlife Service and Canadian Wildlife Service. 1977. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys.

U.S. Fish and Wildlife Service and Canadian Wildlife Service. 1988. 1988 status of waterfowl and fall flight forecasts. 37 pp.