BREEDING WATERFOWL SURVEYS IN THE LIARD PLAIN AND TESLIN RIVER BASIN, NORTHERN BRITISH COLUMBIA, 1989.

W. Nixon

J. Majiski



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ABSTRACT

Four replicate surveys were flown in May 1989 on selected boreal forest wetlands in the Liard Plain and Teslin River Basin of northern British Columbia. In the 812 km² Liard Plain study area, population estimates ranged from 856 (\pm 240) pairs on the fourth survey to 1647 (\pm 424) pairs on the second survey. In the 812 km² Liard Plain study area, population estimates ranged from 2089 (\pm 688) pairs on the first survey to 2691 (\pm 1332) pairs on the third survey. Stratifying by wetland size did not improve the precision of the population estimates. Density estimates ranged from 2.0 -2.2 pairs/km² in the Liard Plain to 2.3 - 2.6 pairs/km² in the Teslin River Basin. The most common species observed in both study areas were Scaup, Mallard and Goldeneye. Common Loon and Pacific Loon were frequently observed in the Liard Plain.

The precision of the population estimates for the two areas surveyed could be improved by increasing sample size with an extended range helicopter (or fuel caches), but the cost would be much higher. Helicopter surveying is the only feasible method to use in these low density wetlands. Fixed wing transects would require too much time to cover a sufficient number of wetlands, and very few of the wetlands are accessible for roadside surveys. A mapping exercise is recommended to produce realistic breeding population estimates for the Northern Boreal Mountains Ecoprovince of northern British Columbia.

Résumé

Quatre recensements par répétition ont été effectués par les airs en mai 1989 au-dessus de certains terrains marécageux de la forêt boréale de la plaine de la Liard et du bassin de la Teslin au nord de la Colombie-Britannique. Dans la superficie de 812 km^2 recensée au-dessus de la plaine de la Liard, le compte de la population se situait entre 856 paires (±240) au quatrième recensement et 1647 paires (±424) au deuxième recensement. Dans la même zone, le compte de la population se situait entre 2089 paires (± 688) au premier recensement et 2691 paires (± 1332) au troisième recensement. La stratification par superficie n'a pas amélioré la précision des données. La densité de la population variait entre 2 et 2,2 pairs/km² dans la plaine de la Liard et 2,3 et 2,6 pairs/km² dans le bassin de la Teslin. Les espèces les plus communément observées lors de ces deux recensements furent le morillon, le canard colvert et le garrot à oeil d'or. Des huarts à collier et des huarts du Pacifique ont souvent été observés dans la plaine de la Liard.

La précision des données démographiques pour les deux zones recensées pourrait être améliorée si on pouvait augmenter la superficie de la zone recensée avec un hélicoptère ayant un plus grand rayon d'autonomie (ou des caches à carburant), mais ceci augmenterait considérablement les coûts de recensement. Le recensement par hélicoptère est la seule méthode pratique pour l'étude des populations de faible densité vivant dans les zones marécageuses. Des transects par avoin demanderaient trop de temps pour qu'on puisse couvrir un nombre suffisant de terrains marécageux et très peu de terrains marécageux sont accessibles par Un exercice de cartographie est recommandé pour la route. faciliter la production d'études démographiques réalistes pour la l'écorégion des montagnes boréales du nord de la Colombie-Britannique.

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1.	Total	bird	s, t	otal	male	s, i	ndio	cated	pai	rs	and	d c	bse	erv	red			
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2.	Wetlar	nd ch	arac	teri	stics	(fi	eld	forms	3).		• •	•	•			•	•	24

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INTRODUCTION

Background

In the spring of 1989, Canadian Wildlife Service initiated a surveys of breeding waterfowl to estimate populations in selected areas of northwest British Columbia. The secondary objective of the study was to determine the species composition of waterfowl breeding in these areas. Two study areas were chosen to represent boreal forest wetlands between 600m and 800m elevation; south of Teslin Lake in the headwaters of the Teslin River (referred to herein as the Teslin River Basin) and southwest of Watson Lake in the Liard Plain (Figure 1). Ducks Unlimited Canada (Yukon) provided funding for surveys in the Liard Plain.

Prior to this study, the only detailed survey conducted in this area was in the Teslin River corridor, where the focus was primarily on geese (McEwan and Johnston 1983). Ducks Unlimited did a reconnaissance flight in the B.C. portion of the Teslin River Basin in the summer of 1984. Canadian Wildlife Service conducted staging surveys in the same area in fall 1988 and spring 1989.

This technical report contains a brief review of survey methodologies, and the results of breeding pair surveys conducted in northwest B.C. Total numbers and mean number of birds per wetland are presented for total birds observed as well as for indicated pairs. Breeding population estimates for the two study areas are also presented.

Breeding Pair Survey Methodology

Aerial surveys have been used extensively throughout North America to obtain estimates of waterfowl breeding populations. Transect surveys are often flown over vast wetland complexes, but block surveys or surveys of individual wetlands have also been used (Dennis et. al. 1989).

Most breeding pair surveys are conducted by small fixed wing aircraft, and a sightability correction factor is applied (U.S.F.W.S. and C.W.S. 1987). These correction factors are somewhat standardized, and do not account for the variation in northern boreal forest wetland areas. Some recent survey trials have used helicopter surveys to determine the sightability correction factor for extensive fixed wing surveys (Hines et. al. 1989). The underlying assumption is that surveys done by helicoptor sight all of the birds on a given wetland (Hines et. al. 1989; Ross 1985).

In the past, most surveys were flown once, or at most twice, to include both early breeders (most dabblers) and late breeders (most divers). Population estimates based on a single "point in time" may not accurately reflect the true population, due to annual variation in timing of migration and/or the presence of migrants (ie. non-breeders) in the wetlands surveyed. Ideally, surveys should begin before males desert incubating females and after non-



Figure 1. Liard Plain and Teslin River Basin study areas - northwest British Columbia - May 1989.

breeding migrants have passed through the survey area. If only one survey is done, it is difficult to chose a time that is suitable to all species (Ross 1987).

More recently, survey methodologies have been refined to get an accurate estimate of the number of breeding pairs of waterfowl in south central B.C. (McKelvey et al. 1989). The standard proceedure has been to survey several wetlands from the ground repeatedly over a 6 week period, to include both early and late breeders in the estimate. This method of replicate surveys was adapted and applied to wetlands in the boreal forest of northwest B.C. in the spring of 1989.

Study Areas

Both study areas were located in the Northern Boreal Mountains ecoprovince of northern B.C. The Liard Plain study area is part of the Liard Basin ecoregion. The Teslin River Basin study area is found in the northern extent of the Stikine Plateau ecosection (Campbell et al 1990).

Wetlands in the Liard Plain and Teslin River Basin are typically small (less than 15 hectares), shallow and scattered, with varying amounts of emergent vegetation. Some common species of emergent vegetation in the Teslin River Basin include Carex rostrata, Equisetum fluviatile, and C. aquatilis. Floating leaved macrophytes include Nuphar sp. and Polygonum amphibium (McEwan and Johnston 1983). Willow shrubs are common in wet areas, and upland vegetation is primarily spruce and aspen.

The irregular hummocky terrain in the Liard Plain is characterized by eskers, kettles and abandoned river channels resulting from glacial, fluvioglacial and post-glacial erosion and deposition (Gabrielse 1963). Surficial features in the Teslin River Basin include kame and kettle topography, moraines, shorelines of glacial lakes and esker complexes (Gabrielse 1969). The source of these features is primarily glacial drift and alluvium (Aitken 1959). There are a few larger, deeper lakes found throughout the study areas.

METHODS

Survey Method

Prior to surveying, wetlands were stratified on 1:50,000 topographic maps into 3 different sizes to reduce variance of the sample population (Doyle et. al. 1987; Rutherford and Hayes 1976). The size classification was less than or equal to 1.5 hectares, 1.5 to 15 hectares, and greater than 15 hectares up to 300 hectares. The larger lakes (>300 hectares) were excluded from the survey sample because it was not feasible to get an accurate count of waterbirds. The total land area of each study area was approximately 812 km2 for the Liard Plain and 1175 km2 for the Teslin River Basin. Within each size category, a sample of wetlands were chosen randomly and the most direct flight line was mapped out. However, the time required to survey each wetland was underestimated. Flight lines were therefore modified and more distant wetlands were omitted once the survey was underway.

Selected wetlands in the Liard Plain and the Teslin River basin were surveyed in a Bell 206 helicopter every 6 days, for a total of 4 replicate surveys between May 11 and 30. In the Liard Plain, wetlands were surveyed on May 11, 17, 23 and 29. Wetlands in the Teslin River Basin were surveyed on May 12, 18, 24 and 30.

Observers were seated right front and right rear in the helicoptor. All navigation was done by the observer in the right front using 1:50,000 topographic maps. Each wetland was circled by helicoptor, except for a few narrow wetlands which were flown through the middle lengthwise. When large groups of waterfowl were encountered, the helicopter hovered in one place for several seconds. Number, species and sex of birds were recorded into a tape recorder by both observers. The front observer recorded birds seen along shore, while the rear observer recorded birds seen offshore. The number of birds observed were classified as observed pairs, indicated pairs, total males and all birds. "Observed pairs" included territorial pairs and other obviously isolated pairs which were separate from other groups or individuals. "Indicated pairs" included observed pairs plus males in groups of less than 5. "Total males" included lone males, males in groups, and paired males. "Total" birds included all birds seen on a survey. Wetland characteristics were recorded primarily by the rear observer.

Data Analysis

All data were transcribed from tapes to coding sheets and entered on a SAS data base on the Yukon Government mainframe computer. Data summaries and analyses were produced using SAS (SAS Institute 1985).

Means for species and species groups were calculated over the 4 replicate surveys and by wetland. Standard Error as a percent of the mean was used to indicate precision of the estimate. The wetlands sampled were not entirely random, therefore non-parametric analysis of variance was used to determine if sample means were significantly different between surveys. Population estimates for number of indicated pairs of waterfowl and loons breeding in each study area were calculated based on the sample means per wetland. Estimates were produced from stratified samples as well as from all samples regardless of wetland size.

SURVEY RESULTS

Waterfowl populations

Total and mean numbers of waterfowl observed

A total of 57 wetlands were surveyed in the Liard Plain, and 41 wetlands in the Teslin River Basin (Table 1). For both study

WETLAND SIZE	STUDY AREA										
		Liard Plai	n	Teslin River Basin							
	number surveyed	total in area	percent surveyed	number surveyed	total in area	percent surveyed					
SMALL (<=1.5 ha)	14	67	21	13	189	7					
MEDIUM (1.5-15 ha)	30	191	16	23	254	9					
LARGE (>15 ha)	13	152	9	5	106	5					
TOTAL	57	410	14	41	549	7					

Table 1. Number of wetlands surveyed in relation to the total number of wetlands in each study area in northern B.C.

areas, the total numbers of birds and mean total number of birds per wetland were highest on the second survey (Tables 2 and 3). The total males and observed pairs observed were also highest on the second survey (Appendix 1). In the Liard Plain, the number of indicated pairs and mean number of indicated pairs per wetland were also highest on the second survey (Table 2 and 4). In the Teslin River Basin, the number of indicated pairs was higher on the third survey due to the high number of Scaup observed (Table 2).

The mean total number of birds observed over all surveys was 291 (S.E.= 42.2) in the Liard Plain and 394 (S.E.= 31.8) in the Teslin River Basin. Fewer wetlands were surveyed in the Teslin River Basin, but a higher number of birds per wetland were observed there (Table 5).

For most species there was no significant difference in numbers observed between surveys. However, in the Teslin River Basin, the total numbers and indicated pairs of Ring-neck Ducks observed between surveys were significantly different (Nonparametric ANOVA p<0.05). This may be related to migrant birds that did not remain in the area to breed.

In the Liard Plain, Loon sp. had the most precise estimates (based on S.E. as a percent of the mean) followed by Goldeneye sp. and Mallard (Table 4). In the Teslin River Basin, Scaup had the most precise estimates followed by Mallard and Goldeneye sp. At the species level, even the most precise estimates of mean numbers per wetland were not sufficient to determine a population change of less than 50 percent. Table 2. Total birds and total indicated pairs observed on surveys in northern B.C. - May 1989.

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SPECIES				SUR	/EY			
		1	:	2	1	5	1	4
	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS
GREEN-WINGED TEAL	25	8	18	13	8	5	15	12
AMERICAN WIGEON	17	10	5	3	6	3	4	2
BUFFLEHEAD	12	1 7	26	16	16	9	10	į ,
BLUE-WINGED TEAL	3	3	2	1	5	3	4	2
CANADA GOOSE	4	2	10	5	6	3	6	3
DABBLER SP.	1	0	0	0	2	1	6	
DIVER SP.	2	1	3	1 1	0	0	0	
DUCK SP.	0	0	4	1 2	0	0	2	1 1
GOLDENEYE SP.	30	19	1 54	25	38	24	34	2
LOON SP.	14	7	48	24	40	20	1 23	12
MALLARD	53	34	77	63	42	29	36	1
NORTHERN PINTAIL	1 7	4	0	1 0	1	1	0	; (
NORTHERN SHOVELER	14	1 7	0	i o	3	1 1	1 1	1 1
RING-NECKED DUCK	1 9	1 7	22	7	16	10	20	14
SCAUP SP.	1 77	30	121	62	77	43	34	19
SCOTER SP.	0	0	16	8	32	12	5	4
ALL SPECIES	268	1 139	406	230	292	164	200	119

LIARD PLAIN - MAY 1989 Total Number of Birds observed on Each Survey

TESLIN RIVER BASIN - MAY 1989 Total Number of Birds observed on Each Survey

SPECIES				SUR	/EY			
		1		2	1	5 1	4	
	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS
GREEN-WINGED TEAL	1	1	13	9	9	5	6	3
AMERICAN WIGEON	13	7	12	7	16	11	7	5
BUFFLEHEAD	34	19	42	18	32	19	17	9
BLUE-WINGED TEAL	0	(0	1	1	8	6	4	2
CANADA GOOSE	14	7	8	4	24	12	8	4
CANVASBACK	5	3	0	0	0	0	0	0
DABBLER SP.	4	2	0	0	2	1	0	0
DIVER SP,	0	1 0	2	1	2	1	2	0
DUCK SP.	1 19	0	0	0	0	0	4	2
GOLDENEYE SP.	46	22	40	21	1 39	20	34	19
LOON SP.	4	1 2	8	4	1 7	3	4	2
MALLARD	1 50	34	41	31	1 36	21	25	17
MERGANSER SP.	0	0	0	i 0	4	1	0	0
NORTHERN PINTAIL	7	4	6	4	0	0	3	1
NORTHERN SHOVELER	2	1	20	5	1	1	0	l 0
OLDSQUAW	0	0	0	0 +	0	0	2	1 +
RING-NECKED DUCK	4	2	32	13	0	0	38	17
SCAUP SP.	1 134	52	178	67	227	1 92 +	180	102
SCOTER SP.	0	0	65 +	0	19	9 +	13 +	7 +
ALL SPECIES	337	150	468	185	426	202	347	191

Table 3. Mean number of total birds observed per wetland on surveys in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

SPECIES		SURVEY										
		1	ļ		2			3			4	
	MEAN	SE AS	ME	AN	SE OF	AS % MEAN	MEAN	SE OF	AS % MEAN	MEAN	SE OF	AS % MEAN
AMERICAN GREEN-WINGED TEAL	1 0.4	!	1	0.3	1	40	0.1	1	49	0.3	1	40
AMERICAN WIGEON	0.3	1 1	9	0.1	ļ	59	0.1	İ.	61	0.1	1	70
BUFFLEHEAD	1 0.2	1	01	0.5	1	26	0.3	İ.	32	0.2	İ	35
BLUE-WINGED TEAL	0.1	1	4	0.0	ļ	100	0.1	i	59	0.1	i •	70
CANADA GOOSE	0.1	1	0	0.2	İ.	66	0.1	İ.	57	0.1	i •	57
DABBLER SP.	1 0.0	1	0	0.0	Ĭ		0.0	İ	100	0.1	İ	51
DIVER SP.	1 0.0	1	01	0.1	İ.	74	0.0	i		0.0	Ì	
DUCK SP.	0.0	1	.1	0.1	i	70	0.0	Ì.		0.0	i +	100
GOLDENEYE SP.	0.5	1	26]	0.9	İ	28	0.7	i	24	0.6	Ì +	26
LOON SP.	0.2	Í .	56	0.8	İ	17	0.7	i	18	0.4	Ì	26
MALLARD	0.9		28	1.3	i	23	0.7	1	24	0.6	ļ +	35
NORTHERN PINTAIL	1 0.1	1	37]	0.0	İ		0.0	i	100	0.0	İ	
NORTHERN SHOVELER	0.2		51	0.0			0.1	1	100	0.0	ļ +	100
RING-NECKED DUCK	0.2	1	71	0.4	İ	44	0.3	1	48	0.4	1	35
SCAUP SP.	1.4	ļ	¥5	2.1	1	25	1.4	1	23	0.6	 +	33
SCOTER SP.	0.0	1	.1	0.3	i	58	0.6	1	77	1 0.1	İ.	72

LIARD PLAIN - MAY 1989 MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND (D=57)

TESLIN RIVER BASIN - MAY 1989 MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND (N=41)

SPECIES				SUR	/EY			
		1		2		3		4
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.0	100	0.3	42	0.2	54	0.1	56
AMERICAN WIGEON	0.3	42	0.3	70	0.4	55	0.2	61
BUFFLEHEAD	0.8	29	1.1	30	0.8	45	0.4	47
BLUE-WINGED TEAL	0.0	· ·	0.0	100	0.1	74	0.1	70
CANADA GOOSE	0.3	35	0.2	48	0.6	38	0.2	48
CANVASBACK	0.1	82	0.0		0.0		0.0	
DABBLER SP.	0.1	1 70	0.0		0.0	100	0.0	
DIVER SP.	0.0	· ·	0.0	100	0.0	100	0.0	70
DUCK SP.	0.5	100	0.0	· · ·	0.0		0.1	1 70
GOLDENEYE SP.	1.1	1 28	1.0	27	1 1.0	37	0.8	30
LOON SP.	0.1	1 70	0.2	48	0.2	57	0.1	1 70
HALLARD	1.2	25	1.0	25	0.9	30	0.6	41
MERGANSER SP.	0.0		0.0	i .	0.1	100	0.0	!:
NORTHERN PINTAIL	0.2	1 57	0.1	1 74	0.0		0.1	1 100
NORTHERN SHOVELER	0.0	1 100	1 0.5	i 71	0.0	100	0.0	
OLDSQUAW	0.0	·	0.0	1	1 0.0		0.0	100
RING-NECKED DUCK	0.1	1 100	0.8	39	0.0		0.9	46
SCAUP SP.	3.3	43	4.3	28	5.5	24	4.4	1 20
ISCOTER SP.	1 0.0	1 .	1.6	81	0.5	48	1 0.3	50

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Table 4. Mean number of indicated pairs observed per wetland on surveys in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

SPECIES	1	SURVEY											
		1		2	1	3	4						
	MEAN	ISE AS %	MEAN	ISE AS %	MEAN	SE AS %	MEAN	SE AS %					
AMERICAN GREEN-WINGED TEAL	0.1	49	0.2	40	0.1	52	0.2	42					
AMERICAN WIGEON	0.2	1 55	0.1	57	1 0.1	57	0.0	1 70					
BUFFLEHEAD	0.1	50	0.3	28	0.2	31	0.2	35					
BLUE-WINGED TEAL	0.1	74	0.0	100	0.1	57	0.0	70					
CANADA GOOSE	0.0	70	0.1	66	0.1	57	0.1	57					
DABBLER SP.	1 0.0		0.0		0.0	100	0.0	1 70					
DIVER SP.	1 0.0	100	0.0	100	0.0		0.0						
DUCK SP.	0.0		0.0	70	0.0		0.0	1 100					
GOLDENEYE SP.	0.3	27	0.4	24	0.4	24	0.4	24					
LOON SP.	0.1	36	0.4	17	0.4	18	0.2	26					
MALLARD	0.6	26	1 1.1	23	0.5	29	0.2	38					
NORTHERN PINTAIL	0.1	1 79	0.0		0.0	100	0.0						
NORTHERN SHOVELER	0.1	65	0.0	į .	0.0	100	0.0	100					
RING-NECKED DUCK	1 0.1	65	0.1	41	0.2	48	0.2	1 37					
SCAUP SP.	0.5	44	1.1	25	0.8	23	0.3	34					
SCOTER SP.	1 0.0	i .	0.1	63	0.2	1 70	0.1	1 70					

LIARD PLAIN - MAY 1989 MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND (N=57)

TESLIN RIVER BASIN - MAY 1989 MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND (N=41)

SPECIES		SURVEY									
		1		2		3	4				
	MEAN	SE AS % Of Mean	MEAN	SE AS % Of Mean	MEAN	SE AS % Of mean	MEAN	SE AS % OF MEAN			
AMERICAN GREEN-WINGED TEAL	0.0	100	0.2	49	0.1	51	0.1	56			
AMERICAN WIGEON	0.2	40	0.2	73	0.3	58	0.1	59			
BUFFLEHEAD	0.5	28	0.5	33	0.5	43	0.2	46			
BLUE-WINGED TEAL	0.0		0.0	100	0.1	82	0.0	70			
CANADA GODSE	0.2	35	0.1	48	0.3	38	0.1	48			
CANVASBACK	0.1	74	0.0		0.0		0.0				
DABBLER SP.	0.0	70	0.0	į .	0.0	100	0.0				
DIVER SP.	0.0		0.0	100	0.0	100	0.0				
DUCK SP.	0.0		0.0	i .	0.0		0.0	70			
GOLDENEYE SP.	0.5	28	0.5	27	0.5	36	0.5	32			
LOON SP.	0.0	70	0.1	48	0.1	56	0.0	70			
MALLARD	0.8	25	0.8	26	0.5	31	0.4	46			
MERGANSER SP.	0.0	•	0.0		0.0	100	0.0				
NORTHERN PINTAIL	0.1	60	0.1	78	0.0	i .	0.0	100			
NORTHERN SHOVELER	0.0	100	0.1	51	0.0	100	0.0				
OLDSQUAW	0.0		0.0		0.0	i .	0.0	100			
RING-NECKED DUCK	0.0	100	0.3	37	0.0	į .	0.4	29			
SCAUP SP.	1.3	28	1.8	33	2.4	27	2.5	22			
SCOTER SP.	0.0		0.0		0.2	63	0.2	50			

AREA	SURVEY	TOTAL	BIRDS	INDICA	TED PAIRS
		mean	S.E. as % of mean	mean	S.E. as % of mean
LIARD PLAIN	1	4.7	24	2.4	22
(n=57)	2	7.1	14	4.0	13
	3	5.1	17	5.1	15
	4	3.5	[.] 15	3.5	14
TESLIN RIVER	1	8.2	21	3.8	16
BASIN (N=41)	2	11.4	21	4.5	18
	3	10.3	23	4.9	24
	4	8.4	17	4.6	18

Table 5. Mean number of birds per wetland for each survey in northern B.C. - May 1989.

Population estimates for waterfowl and loons

Indicated pairs were used to calculate the estimated breeding population in order to exclude larger groups of non-breeders (ie. migrants) from the estimate. Species observed in small numbers on only one of four surveys may also be non-breeders, but this only occurred with Canvasback in the Teslin River Basin.

Based on the sample means of indicated pairs per wetland, regardless of wetland size, the overall population estimate for waterfowl and loons ranged from 856 to 1647 pairs in the Liard Plain and from 2089 to 2691 pairs in the Teslin River Basin study areas (Table 6). The population estimates using stratified samples were slightly higher, but in most cases stratifying by wetland size did not improve the precision of the estimate (Table 6). Based on these estimates, the density of indicated breeding pairs in the Liard Plain was approximately 2.0 to 2.2 pairs/km2 compared to 2.3 to 2.6 pairs/km2 for the Teslin River Basin. The estimated breeding pair density of 2.3 to 2.6 pairs/ km2 in the Teslin River Basin was only slightly higher than the 2.1 pairs/km2 observed in the Kawdy Plateau directly to the southeast (Hawkings and Majiski 1991).

Waterfowl distribution

Relationship between waterfowl and wetland characteristics

Small waterbodies generally had the lowest mean number of birds per wetland and large waterbodies had the highest mean number of birds per wetland both for total birds (Table 7) and number of indicated pairs observed (Table 8). The large standard errors associated with these mean values is related in part to the small sample size of waterbodies within each size category. Table 6. Population estimates for indicated pairs using wetlands stratified by size vs. all wetlands in each study area.

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SURVEY	SAMPLE TYPE	POPULATION ESTIMATE	S.E.	S.E. as % of ESTIMATE
1	stratified	1020.8	233.6	23%
	unstratified	999.8	223.9	22%
2	stratified	1816.8	247.0	14%
	unstratified	1647.2	212.2	13%
3	stratified	1347.4	234.0	17%
	unstratified	1179.6	185.9	16%
4	stratified	865.0	133.3	15%
	unstratified	855.9	119.8	14%

LIARD PLAIN (sampled wetlands n=57, N=410):

TESLIN RIVER BASIN (sampled wetlands n=41, N=549):

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SAMPLE TYPE	POPULATION ESTIMATE	S.E.	S.E. as % of ESTIMATE
stratified	2179.3	355.7	16%
unstratified	2088.9	344.1	16%
stratified	2676.5	513.2	19%
unstratified	2490.6	459.7	18%
stratified	3064.4	730.6	24%
unstratified	2691.4	666.0	25%
stratified	2765.1	453.3	16%
unstratified	2557.5	466.7	18%
	SAMPLE TYPE stratified unstratified stratified unstratified unstratified stratified unstratified unstratified	SAMPLE TYPEPOPULATION ESTIMATEstratified2179.3unstratified2088.9stratified2676.5unstratified2490.6stratified3064.4unstratified2691.4stratified2765.1unstratified2557.5	SAMPLE TYPE POPULATION ESTIMATE S.E. stratified 2179.3 355.7 unstratified 2088.9 344.1 stratified 2676.5 513.2 unstratified 2490.6 459.7 stratified 3064.4 730.6 unstratified 2691.4 666.0 stratified 2765.1 453.3 unstratified 2557.5 466.7

Table 7. Mean number of total birds observed per wetland in small (<=1.5 ha) medium (1.5 – 15 ha) and large (>15 ha) wetlands surveyed in northern B.C. – May 1989. (Standard Error is expressed as a % of the mean).

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SPECIES	WETLAND SIZE						
	S	MALL	MEI	HUIC	LAF	RGE	
<i>.</i>	MEAN	ISE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	
AMERICAN GREEN-WINGED TEAL	0.2	54	0.3	42	0.5	34	
AMERICAN WIGEON	0.0	i .	0.2	47	0.2	41	
BUFFLEHEAD	0.2	48	0.3	19	0.3	45	
BLUE-WINGED TEAL	0.0	100	0.1	49	0.1	60	
CANADA GOOSE	0.1	70	0.1	40	0.2	65	
DABBLER SP.	0.1	60	0.0	100	0.1	70	
DIVER SP.	0.0	1	0.0	60	0.0		
DUCK SP.	0.0		0.0	70	0.0	100	
GOLDENEYE SP.	0.4	34	0.8	18	0.8	27	
LOON SP.	0.0	1	0.7	13	C.8	18	
MALLARD	0.6	41	0.9	18	1.3	23	
NORTHERN PINTAIL	0.0	100	0.0	100	0.0	100	
NORTHERN SHOVELER	0.0	100	0.1	59	0.0		
RING-NECKED DUCK	1 0.1	45	0.4	30	0.3	47	
SCAUP SP.	1.5	41	1.2	21	1.6	30	
SCOTER SP.	0.1	1 79	0.1	66	0.8	65	

LIARD PLAIN - MAY 1989 MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND IN RELATION TO WETLAND SIZE

TESLIN RIVER BASIN - MAY 1989 Mean Number of total birds observed per Wetland In Relation to Wetland Size

	WETLAND SIZE					
	SH	ALL	I MED	CUM	LARGE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.2	52	0.1	36	0.3	73
AMERICAN WIGEON	0.2	40	0.3	41	0.4	71
BUFFLEHEAD		35	0.8	22	1.8	42
BLUE-WINGED TEAL	0.0		0.1	48	0.0	
CANADA GOOSE	0.3	36	0.4	30	.0.3	55
CANVASBACK	0.0		0.0	100	0.0	100
DABBLER SP.	0.0		1 0.0	100	0.2	69
DIVER SP.	0.0		0.1	52	0.0	
DUCK SP.	0.0		0.0	100	1 1.0	90
GOLDENEYE SP.	0.5	30	0.7	17	1 3.5	23
LOON SP.	0.0	1	0.0	70	1 0.9	26
MALLARD	0.6	1 32	1 1.0	19	1.5	l 27
MERGANSER SP.	0.0		0.0		0.2	100
NGRTHERN PINTAIL	1 0.0		0.1	45	0.2	100
NORTHERN SHOVELER	0.0	100	0.1	59	0.8	88
OLDSQUAW	0.0	۱ .	0.0	100	0.0	
RING-NECKED DUCK	0.6	66	1 0.4	28	0.5	49
SCAUP SP.	2.0	54	4.9	15	8.3	1 26
SCOTER SP.	0.0		0.2	52	4.1	1 62

Table 8. Mean number of indicated pairs observed per wetland in small (<=1.5 ha) medium (1.5 - 15 ha) and large (>15 ha) wetlands surveyed in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

SPECIES	WETLAND SIZE					
	SM	ALL	MED	CUM	LA	RGE
	MEAN	SE AS %	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.1	61	0.1	32	0.4	34
AMERICAN WIGEON	0.0	I .	0.1	48	0.1	39
BUFFLEHEAD	0.1	46	0.2	20	0.2	45
BLUE-WINGED TEAL	0.0	100	0.0	49	0.1	60
CANADA GOOSE	0.0	70	0.0	40	0.1	65
DABBLER SP.	0.0	100	0.0		0.0	70
DIVER SP.	0.0	1	0.0	70	0.0	
DUCK SP.	0.0		0.0	70	0.0	100
GOLDENEYE SP.	0.3	34	0.5	15	0.4	26
LOON SP.	0.0		0.3	13	C.4	18
MALLARD	0.3	39	0.6	20	0.9	25
NORTHERN PINTAIL	0.0	100	0.0	100	0,0	100
NORTHERN SHOVELER	0.0	100	0.1	58	0.0	
RING-NECKED DUCK	0.1	43	0.2	31	0.2	47
SCAUP SP.	0.8	33	0.6	22	0.7	24
SCOTER SP.	0.0	100	0.0	57	0.3	58

LIARD PLAIN - MAY 1989 MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND IN RELATION TO WETLAND SIZE

TESLIN RIVER BASIN - MAY 1989

SPECIES	WETLAND SIZE					
	SM	ALL	MEI	DIUM	LAF	RGE
	MEAN	SE AS %	MEAN	SE AS % Of Mean	MEAN	SE AS % Of Mean
AMERICAN GREEN-WINGED TEAL	0.1	61	0.1	34	0.1	73
AMERICAN WIGEON	0.1	39	0.2	43	0.3	73
BUFFLEHEAD	0.2	37	0.4	21	1.1	40
BLUE-WINGED TEAL	0.0		0.1	55	0.0	
CANADA GOOSE	0.1	36	0.2	30	0.1	55
CANVASBACK	0.0		0.0	100	0.0	100
DABBLER SP.	0.0		0.0	100	0.1	69
DIVER SP.	0.0	l .	0.0	70	0.0	
DUCK SP.	0.0	i .	0.0	100	0.0	100
GOLDENEYE SP.	0.3	29	0.4	18	1.8	24
LOON SP.	0.0		0.0	70	0.4	25
MALLARD	0.4	33	0.7	21	1.2	27
MERGANSER SP.	0.0	I .	0.0		0.0	100
NORTHERN PINTAIL	0.0		0.1	46	0.1	100
NORTHERN SHOVELER	0.0	100	0.0	57	0.1	73
OLDSQUAW	0.0		0.0	100	0.0	
RING-NECKED DUCK	0.1	74	0.3	28	0.3	49
SCAUP SP.	0.5	37	2.2	16	4.8	26
SCOTER SP.	0.0	i .	0.1	58	0,3	55

In the Liard Plain, the mean number of total birds and indicated pairs per wetland in wetlands with emergent vegetation present was slightly higher than in wetlands with sparse emergent vegetation (Tables 9 and 10). In the Teslin River Basin, the opposite was true.

Species Composition

The most common species observed in both study areas were Scaup, Mallard and Goldeneye (Table 1). Loons were more common in the Liard Plain than in the Teslin River Basin. This may be related to the fact that a greater proportion of large (and usually deeper) wetlands were surveyed in the Liard Plain. Smaller wetlands would not have the food base required for loons. In both study areas, Common Loons were observed with twice the frequency of Pacific Loons.

Other divers commonly observed in both areas included Bufflehead and Ring-necked Ducks. Other dabblers commonly observed included American Green-winged Teal and American Wigeon. Surf Scoters were present in both areas but not seen on all surveys. Canada Geese were appeared in small numbers on each survey.

The species composition observed in the Liard Plain and Teslin River Basin was similar to that of two boreal forest areas surveyed in southern Yukon (Johnston et al. 1985; Nixon et al. (in prep.)). Other boreal forest wetlands surveyed in southern Yukon indicate that American Wigeon are more common than Mallard (Nixon 1989; Mossop (in prep)). In all other boreal forest wetlands surveyed in southern Yukon, Scaup were consistently the most common species observed.

Habitat

Larger lakes in the survey area were still up to 90% ice covered when the surveys commenced May 10, but were ice free by May 16. Most of the surveyed wetlands were ice free on May 10, with the exception of some large wetlands, and a few deeper potholes in the medium and small size category (Appendix 2).

Although our collection of data on habitat characteristics was incomplete, the surveyed wetlands were classified to the level of subclass under the Cowardin system (Cowardin et al 1979). This system is very flexible in that more than one system, class or subclass can be applied to a single wetland (Tables 11 and 12). Wetlands with a variety of characteristics or "transition zones" can be classified without loss of unique features. Most wetlands surveyed had some persistant emergent vegetation (primarily sedges) present along the shoreline as illustrated in Figure 2. Other wetlands had little or no persistant emergent vegetation (Figure 3). Table 9. Mean number of total birds observed per wetland in relation to the presence of emergent vegetation - northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

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LIARD PLAIN - MAY 1989 MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND IN RELATION TO EMERGENT VEGETATION

SPECIES	EMERGENT VEGETATION			
	PR	ESENT	SP	RSE
	MEAN	SE AS % OF MEAN	MEAN	SE AS % Of Mean
AMERICAN GREEN-WINGED TEAL	0.3	28	0.2	46
AMERICAN WIGEON	0.1	34	0.2	69
BUFFLEHEAD	0.3	21	0.2	31
BLUE-WINGED TEAL	0.1	36	0.0	
CANADA GOOSE	0.1	42	0.1	49
DABBLER SP.	0.0	46	0.0	100
DIVER SP.	0.0	70	0.0	100
DUCK SP.	0.0	70	0.0	100
GOLDENEYE SP.	0.7	17	0.7	20
LOON SP.	0.5	15	3.0	16
MALLARD	1.0	15	0.6	35
NORTHERN PINTAIL	0.0	70	9.1	100
NORTHERN SHOVELER	0.0	74	0.2	71
RING-NECKED DUCK	0.3	23	0.2	82
SCAUP SP.	1.5	18	0.9	40
SCOTER SP.	0.3	50	0.0	

TESLIN RIVER BASIN - MAY 1989 Mean Number of Indicated Pairs observed per Wetland In Relation to Emergent Vegetation

SPECIES	EMERGENT VEGETATION				
	PR	ESENT	SPARSE		
	MEAN	SE AS % Of Mean	MEAN	SE AS % Of mean	
AMERICAN GREEN-WINGED TEAL	1 0.2	35	0.2	48	
AMERICAN WIGEON	0.2	1 38	0.41	40	
BUFFLEHEAD	0.4	29	1.2	23	
BLUE-WINGED TEAL	0.0	100	0.1	55	
CANADA GOOSE	0.3	26	0.41	35	
CANVASBACK	1 0.0		0.11	82	
DABBLER SP.	0.0	100	0.11	71	
DIVER SP.	0.0	74	0.01	74	
DUCK SP.	0.0	1.	0.3	8	
GOLDENEYE SP.	0.7	18	1.31	23	
LOON SP.	0.0	100	0.31	31	
HALLARD	0.8	19	1.1	23	
MERGANSER SP.	0.0		0.1	10	
NORTHERN PINTAIL	0.1	50	0.1	74	
NORTHERN SHOVELER	0.0	70	0.3	7!	
OLDSQUAW	1 0.0	100	0.01		
RING-NECKED DUCK	0.5	47	0.41	2	
SCAUP SP.	3.0	24	6.41	1	
SCOTER SP.	0.2	50	1.21	6. 6	

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Table 10. Mean number of total indicated pairs observed per wetland in relation to the presence of emergent vegetation – northern B.C. – May 1989. (Standard Error is expressed as a % of the mean).

SPECIES	EMERGENT VEGETATION				
	PRESENT I SPA		PRESENT I SPARSE		RSE
	MEAN	SE AS % Of Mean	MEAN	SE AS % Of mean	
AMERICAN GREEN-WINGED TEAL	0.2	26	0.1	46	
AMERICAN WIGEON	0.1	32	0.1	74	
BUFFLEHEAD	0.2	20	0.1	31	
BLUE-WINGED TEAL	0.1	36	0.0		
CANADA GOOSE	0.1	42	0.1	49	
DABBLER SP.	0.0	· 57	0.0		
DIVER SP.	0.0	70	0.0		
DUCK SP.	0.0	70	0.0	100	
GOLDENEYE SP.	0.4	15	0.5	21	
LOON SP.	0.2	14	0.4	16	
MALLARD	0.7	16	0.3	29	
NORTHERN PINTAIL	0.0	70	0.0	100	
NORTHERN SHOVELER	0.0	74	0.1	70	
RING-NECKED DUCK	0.2	23	0.0	100	
SCAUP SP.	0.8	16	0.5	45	
SCOTER SP.	0.1	. 421	0.01		

LIARD PLAIN - MAY 1989 MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND IN RELATION TO EMERGENT VEGETATION

TESLIN RIVER BASIN - MAY 1989 MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND IN RELATION TO EMERGENT VEGETATION

	EMERGENT VEGETATION			
	PRI	ESENT	SPARSE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % Of mean
AMERICAN GREEN-WINGED TEAL	0.1	40	0.1	46
AMERICAN WIGEON	0.1	43	0.3	41
BUFFLEHEAD	0.2	28	0.7	23
BLUE-WINGED TEAL	0.0	100	0.1	62
CANADA GOOSE	0.1	26	0.2	35
CANVASBACK	0.0		0.0	74
DABBLER SP.	0.0	100	0.0	70
DIVER SP.	0.0	100	0.0	100
DUCK SP.	0.0		0.0	70
GOLDENEYE SP.	0.4	18	0.7	23
LOON SP.	0.0	100	0.1	29
MALLARD	0.6	20	0.7	23
MERGANSER SP.	0.0	i .	0.0	100
NORTHERN PINTAIL	0.1	52	0.1	79
NORTHERN SHOVELER	0.0	70	0.1	52
OLDSQUAW	0.0	100	0.0	
RING-NECKED DUCK	0.1	1 39	0.3	29
SCAUP SP.	1.1	21	3.3	17
SCOTER SP.	0.1	63	0.1	50

Table 11. Characteristics of wetlands surveyed in the Liard Plain - May 1989. (Wetland classification according to Cowardin et al. 1979. Most wetlands contain elements of more than one system and class.)

SYSTEM	SUBSYSTEM	CLASS	SUBCLASS	WETLANDS
	Littoral	Unconsolidated bottom	mud or organic	2, 3, 5, 7, 8, 11, 13, 14, 15, 16, 18, 39, 40, 40A, 46, 48, 49A, 50, 51, 54, 54A, 55, 58, 58A, 60, 61, 63, 65A, 65B, 67, 81, 91
Lacustrine	Littoral	Unconsolidated bottom	cobble - gravel	42, 62A, 87a
	Littoral	Unconsolidated shore	cobble - gravel	13, 14, 16, 18, 22, 54, 54A, 63
	Littoral	Aquatic bed	rooted vascular	4, 6, 9, 46, 49, 49A, 62A, 65B, 81A
Palustrine		Unconsolidated bottom	mud or organic	12, 19, 18B, 51, 55A, 49
		Unconsolidated shore	cobble - gravel	12, 55A
		Emergent	persistant	2, 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 16, 18, 19, 21, 21b, 42, 44, 46, 49, 49A, 51, 52, 55A, 53, 54, 60, 60A, 62, 62A, 62B, 63, 65, 65B, 67, 81, 81A, 81B, 87A, 91
		Moss - lichen wetland	moss	2, 11, 13, 15, 16, 17, 49, 49A, 55, 62B, 65A
		Scrub - shrub wetland	broad leaved deciduous	17, 18, 40
		Forested	dead	41

SYSTEM	SUBSYSTEM	CLASS	SUBCLASS	WETLANDS
	Littoral	Unconsolidated bottom	mud or organic	10, 11a, 20, 21, 21A, 30, 35, 38B
Lacustrine	Littoral	Unconsolidated bottom	cobble - gravel	30, 34
	Littoral	Unconsolidated shore	cobble - gravel	8, 11A, 17, 19, 21A, 34, 38
	Littoral	Aquatic bed	rooted vascular	10, 10A, 11, 24, 26, 26A, 47, 47A
		Unconsolidated bottom	mud or organic	1, 2A, 3, 4, 20, 31, 35, 38A, 38B
		Unconsolidated shore	cobble - gravel	20, 32, 38
Palustrine		strine Emergent		1, 1A, 2, 2A, 3, 4, 5A, 5B, 6, 6A, 8A, 9, 9A, 10, 10A, 18A, 19, 20, 31, 35, 38, 38A, 38B, 40, 41, 47A, 47B
		moss – lichen wetland	moss	6, 6A, 8, 10, 11A, 19, 19A, 21A, 24, 26, 26A, 32, 50

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Table 12. Characteristics of wetlands surveyed in the Teslin River Basin - May 1989. (Wetland classification according to Cowardin et al. 1979. Most wetlands contain elements of more than one system and class.)



Figure 2. Boreal forest wetland with emergent vegetation present along the perimeter.



Figure 3. Boreal forest wetland with steeply sloping shoreline and no emergent vegetation.

CONCLUSIONS AND RECOMMENDATIONS

A larger sample size would be required to reduce the variance to a level where population changes could be detected. Given the present precision in estimates, a population change of 25% to 50% would be necessary before a significant change could be detected. The 4 replicate surveys conducted during this study required a total of 22.5 helicopter hours and 24 person days. In both study areas, it would be difficult to increase the sample size without major expense because of the limited range of the helicopter. However, survey times could be increased with fuel caches, or extended range helicopters. Helicopter surveying is the only feasible method to use in these low density wetlands. Fixed wing transects would require too much time to cover a sufficient number of wetlands, and very few of the wetlands are accessible for roadside surveys.

The estimated mean number of pairs per wetland determined from these surveys could be applied to other boreal forest areas of northern B.C. An estimate of the number of waterbirds breeding in low elevation boreal forest wetlands could be calculated using the total number of wetlands found on topographic maps and/or satellite imagery. Similar breeding population estimates could be calculated for high elevation wetlands using the density estimates calculated by Hawkings and Majiski (1991). The Northern Boreal Mountains Ecoprovince (Campbell et al. 1990) would provide a logical boundary for such an exercise.

ACKNOWLEDGEMENTS

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LITERATURE CITED

- Aitken, J.D. 1959. Atlin map Area. B.C. (104 N). GSC Memoir 307.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, M.C.E. McNall. 1990. The Birds of British Columbia. Royal British Columbia Museum in association with Environment Canada, Canadian Wildlife Service.
- Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Fish and Wildlife Service. U.S. Dept of the Interior. 131 pp.
- Dennis, D.G., G.B. McCullough, N.R. North and B. Collins. 1989. Surveys of breeding waterfowl in southern Ontario, 1971-87. Progress Notes No. 180. Canadian Wildlife Service, 4 pp.
- Doyle T.J., M.A. Spindler, and K.F. Hall. 1987. Estimation of waterbird populations on the Selawik National Wildlife Refuge. Selawik National Wildlife Refuge Progress Report. 87-1.
- Gabrielse, H. 1963. McDame map area, Cassiar District, B.C. GSC Memoir 319.
- Gabrielse, H. 1969. Geology of the Jennings River map area. B.C. (104 O). Paper 68-55.
- Hines, J.E., R.W. Cole, A. Brazda, B. Conant, and J. Goldsberry 1989. Correcting for visibility biases in aerial surveys of boreal forest ducks. Final progress report. Unpublished.
- Johnston, W.G., J.J Majiski, D.J. Petkovitch and J.L. Valette. 1985. Waterfowl and invertebrate productivity investigations in riparian wetlands adjacent to the Dezadeash River, southern Yukon. Northern Biomes Technical Report No. 1. 76 pp.
- McEwan, C.A. and W.G. Johnston 1983. Inventory of Canada Geese and other waterfowl within the Yukon River basin. June -August 1983. for Canadian Wildlife Service, Pacific and Yukon Region. Yukon River Basin Study. Project Report: Wildlife No.5b.
- McKelvey, R.W. 1989. 1989 Waterfowl pair surveys. Unpublished report to contributors. CWS. Delta.
- Mossop, D.H. (in prep) Survey of the Waterbird Populations of the Needlerock Wetlands, Yukon 1985-87. Dept. of Renewable Resources, Gov't of Yukon.

Nixon, W. 1989. An assessment of waterfowl habitat and

distribution of waterfowl in the Kluane Planning Region. Wetland Research in the Kluane Region, Greater Kluane Land Use Plan. 45pp.

- Nixon, W. J. Majiski and J. Hawkings (in prep). Waterfowl Surveys along the Alaska Highway, southern Yukon, spring and summer 1989, and suggestions for an annual trend survey. Draft Report. Canadian Wildlife Service, Whitehorse, Yukon.
- Ross, R.K. 1985. Helicopter vs. ground surveys of waterfowl in the boreal forest. Wildl. Soc. Bull. 13:153-157.
- Ross, R.K. 1987. Interim report on waterfowl breeding pair surveys in northern Ontario, 1980 - 83. Progress Notes No. 18, Canadian Wildlife Service, 9 pp.
- Rutherford, W.H. and C.R. Hayes. 1976. Stratification as a means for improving waterfowl surveys. Wildl. Soc. Bull. Vol. 4 No. 2:74-78.
- SAS Institute. 1985. SAS User's Guide: Basics, version 5 edition. Cary, N.C.: SAS Institute Inc. 1290 pp.
- U.S.F.W.S and C.W.S. 1987. Standard Operating Procedures for aerial waterfowl breeding ground population and habitat surveys in North America.

APPENDIX 1. Total birds, total males, indicated pairs and observed pairs recorded on each of 4 surveys in the Liard Plain, northern B.C. - May 1989.

LIARD PLAIN - MAY 1989

SPECIES								SUR	VEY							
]					2			3				4	,	
	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. Pairs	OBS. Pairs	TOTAL	MALES	IND. PAIRS	OBS. PAIRS
GREEN-WINGED TEAL	25	17	8	5	18	13	13	5	8	5	5	3	15	12	12	2
AMERICAN WIGEON	17	10	10	7	5	3	3	2	6	3	3	1	4	2	2	2
BARROW'S GOLDENEYE	20	13	13	7	47	28	21	16	22	14	14	8	30	23	23	5
BUFFLEHEAD	12	7	7	4	26	16	16	6	16	9	91	7	10	9	9	1
BLUE-WINGED TEAL	3	3	3	0	2	1	1	1	5	3	3	2	4	2	2	2
CANADA GOOSE	4	2	2	2	10	5	5	5	6	3	3	3	6	3	3	3
COMMON LOON	14	7	7	7	22	11	11	11	26	13	13	13	12	6	6	6
DABBLER SP.	1	0	0	0	0	0	0	0	2	1	1	1	6	2	2	2
DIVER SP.	2	1	1	1	3	1	1	1	0	0	0	0	0	0	0	0
DUCK SP.	0	0	0	0	4	2	2	2	0	0	0	0	2	1	1	1
GOLDENEYE SP.	10	6	6	4	7	4	4	2	16	10	10	4	4	2	2	1
LOON SP.	0	0	0	0	6	3	3	3	0	0	0 1	0	1	1	1	0
MALLARD	53	34	34	16	77	63	63	9	42	29	29	10	36	20	13	6
NORTHERN PINTAIL	7	4	4	3	0	0	0	0	1	1 1	1	0	0	1 0	0	0
NORTHERN SHOVELER	14	7	7	7	0	0	0	0	3	1	1	0	1	1	1	0
PACIFIC LOON	0	0	0	0	20	10	10	10	14	7	7	7	10	5	5	5
RING-NECKED DUCK	9	7	7	2	22	13	7	5	16	10	10	4	20	1 14	14	6
SCAUP SP.	77	55	30	10	121	76	62	37	77	43	43	30	34	19	19	13
SCOTER SP.	0	0	0	0	0	0	0	. 0	1	1	1	0	0	0	0	0
SURF SCOTER	0	0	0	0	14	7	7	5	29	9	9	0	5	4	4	0
WHITE-WINGED SCOTER	0	0	0	0	2	1	1	1	2	1 2	2	0	0	0	0	0
ALL SPECIES	268	173	139	75	406	257	230	121	292	164	164	93	200	126	119	55

APPENDIX 1 (Continued). Total birds, total males, indicated pairs and observed pairs recorded on each of 4 surveys in the Teslin River Basin, northern B.C. - May 1989.

TESLIN RIVER BASIN - MAY 1989

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SPECIES								SUR	VEY							
		1	1			2	2		l		3				•	
	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS
GREEN-WINGED TEAL	1	1	1	0	13	9	9	4	9	5	5	4	6	3	3	3
AMERICAN WIGEON	13	7	7	6	12	7	7	5	16	11	11	3	7	5	5	1
BARROW'S GOLDENEYE	24	12	12	11	30	16	16	14	4	2	2	2	15	1 10	10	4
BUFFLEHEAD	34	19	19	15	42	26	18	12	32	19	19	9	17	9	9	7
BLUE-WINGED TEAL	0	0	0	0	1	1	1	0	8	6	6	1	4	2	2	2
CANADA GOOSE	14	7	7	7	8	4	4	4	24	12	12	12	8	1 4	4	4
CANVASBACK	5	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
COMMON LOON	0	0	0	0	4	2	2	2	5	2	2	2	4	2	2	2
COMMON MERGANSER	0	0	0	0	0	0	0	0	4	1	1	1	0	1 0	0	0
DABBLER SP.	4	2	2	2	0	0	0	0	2	1	1	1	0	1 0	0	0
DIVER SP.	0	.0	0	0	2	1	1	1	2	1	1	1	2	. 0	0	0
DUCK SP.	19	19	0	0	0	0	0	0	0	0	0	0	4	2	2	2
GOLDENEYE SP.	22	10	10	10	10	5	5	4	35	18	18	12	10	9	9	7
LOON SP.	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
MALLARD	50	34	34	11	41	31	31	8	36	27	21	8	25	1 17	17	4
MERGANSER SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN PINTAIL	7	4	4	3	6	4	4	2	0	0	0	0	3	1 1	1	0
NORTHERN SHOVELER	2	1	1	1	20	14	5	6	1	1	1	0	0	0	0	0
OLDSQUAW	0	0	0	0	0	0	0	0	0	0	0	0	2	1 1	1	1
PACIFIC LOON	0	0	0	0	4	2	2	2	2	1	1	1	0	0	0	0
RING-NECKED DUCK	4	2	2	2	32	21	13	7	0	0	0	0	38	32	17	6
SCAUP SP.	134	85	52	38	178	104	67	56	227	143	92	62	180	126	102	52
SCOTER SP.	0	0	0	0	0	0	0	0	14	4	4	2	6	3	3	3
SURF SCOTER	0	0	0	0	65	34	0	1	0	0	0	0	7	4	4	2
WHITE-WINGED SCOTER	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0
ALL SPECIES	337	208	156	110	468	281	185	128	426	259	202	121	347	230	191	100

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APPENDIX 2: WETLAND CHARACTERISTICS - NORTHWEST B.C.

<u>LOCATION</u> : LIARD PLAIN <u>DATE</u> 11-28 MAY 1989 <u>COMMENTS</u> : HELICOPTER SURVEY - BREEDING WATERBIRD POPULATIONS

	<u>517</u>	<u>X COVER</u>	<u>EI</u> Species	<u>1 ERGENT VE</u> 1 END	GETATION DISTRIBUTION BOTH SHORE ENTIRE LINE	CLUMPS	<u>AQUATIC BEI</u> HARL, ALGAE ROCK	D <u>SUBMERG</u> SPECIES	<u>ENT VEG</u> 3 %COVER	SHOREL INE	<u>upi</u> Shrubs	LAND VEGETATION SPRUCE OPEN CLOSED	MIXED ASPEN/POPLAR	<u>SNAGS</u>	BEAV DAM/H	<u>er</u> Iouse	SLOPE OF SHORE	H2O COLOUR	COMMENTS
2	>15 ha	flooded in sw corner				Carex clumps	Marl	8055	>50% at edge			closed spruce some standing dead, sw corner		Ρ	1	1	moderate all sides	clear	island with sedge to the east deep in centre, shallow elsewhere
3	med size	<1m	Carex	sedge at 1 end	·······		Marl	- <u>-</u>				closed spruce	some poplar in north	P		1	mod stope	clear	isolated pothole 70% ice cover survey 1
4	<1 5 ha				sedge thin strip			may be Pot.sp/ eelgrass	approx. Sm band	flooded Carex	flooded willow in sections	closed spruce at perimeter	<5% aspen on shore/mixed further back				mod to north	turbid	small, 40% open water in basin shallow at south edge, channels throughout sedge
5	<1.5 ha	<5% very sparse at edge	Carex				Mari	none seen		flooded spr 20yds border		closed spr. to basin	aspen slopes /mixed behind		1 to W	1 old	steep to south	clear	small, ice 85% survey 1 shallow with 1 deep hole slope to north is moderate
6	<1 5 ha	100%	Carex			tussocks to west	Veget- ation			spruce in south		closed		<u>.</u>				dark	covered with ice and snow for first survey, no open water by survey 3
7	med size	flooded sedge at sw.corner			some along shore		flarl dark green	moss other			flooded villov sv end	closed/ flooded sw end	mixed back off shore	lots			·	clear	bar across the middle 2 deep holes
8	med size						Marl algae				some flooded willow	closed some at shore flooded	mixed behind spruce	1				clear	shallow
9	med size	70'.	Carex		sedge	sedge tussocks		lilies other	52 sparse	sedge willow	•••	closed spr. to basin	mixed behind spruce						spruce island in centre deeper water in centre
10	<1.5 ha	100%	flooded serige				Veget- ation					closed	· <u>························</u> ···				very low		
11	>15 ha	approx 10%	(arex	meadow at 1 end	some on shore		Marl yellow/ green	MOSS	402			closed spruce to shore				·		clear	shallow water with deep holes several bays and inlets

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	<u>513</u> £	<u>Z COVER</u>	EME SPECIES	NGENT VEGET 1 END BOT	ATION <u>DISTRIBUTION</u> H SHORE ENTIRE CLUM LINE	AQUATIC BE MARC, ALGAN PS ROCK	D <u>SUBME</u> I SPECI	IGENT_VEG IS %COVER	SHORELIN	UPLAN IE SHRUBS C	<u>D VEGETATION</u> SPRUCE PEN CLOSED	MIXED ASPEN/POPLAR	<u>SNAGS</u>	<u>BEAVER</u> DAM/HOUSE	SLOPE OF SHORE	H20 COLOUR	COMMENTS
 12	med size	1-2m n side	Carex sedge			Marl			rocky		closed to shore	mixed behind spruce				clear	25% shallow water centre is deep
13	med size					Marl	noss	75-80%	rocky	flooded willow 2% north shore	closed to shore	mixed behind spruce	P		steep bas in	clear	shallow at shore, deep spots 50% deep water, spruce islands
14	>15 ha		sedge	some flooded		5% Marl deep			rocky	flooded willow sedge at 1 end	spruce to shore/n&s	mixed, some of shore-most of n slope	on n	1 old	steep I to N	clear	deep lake
15	med size		sedge	meadow 1 end	narrov strip	Marl yellow/ green	moss	50% in dee water	φ		spruce around bas in	mixed behind spruce			mod. all sides	clear	deep pothole no sub, veg, around shore
16	>15 ha	some on shure B floating	eelgrass Bisedge	s flooded NE Lorner	sedge at east shore	Marl	Care botto & mos	< <10% Carex	rocky In N		spruce to shore		lots	some	steep to N		large, 2 islands 1 treed, 1 sedge, N end shallow with deep holes, V side shallow
17	¯<1Š ha	approx 100% last survey	Carex				prese moss Carex	nt L		flooded willow NE and W	spruce around basin						small pothole in sedge basin 50% water 50% sedge, survey 2 shallow with 1 deep hole
18	>15 ha			1 meadow		Marl	some a shore	t	some rock	some willow & flooded sedge	closed to basin flooded shore	mixed behind spruce				clear brown bottom	large, many bays & inlets 107 deep water.1 treed island. Small connected pothole surveyed twice
186	meri s i ze	flooded se east end	dge		1-2m strip	Marl green bottom	moss st follow contour	r ipes shore s			spruce around basin	aspen behind			shallow	clear	missed survey 2 sedge basin, tree island
19	<15 ha		1	meadow to East	thin band	Marl Algae	moss algae			willow to south shore	spruce to shore/open black in N	solid aspen behind spr. in south			moderate slopes	clear lt.brown colour	small and shallow wetland
21	med size	10'i at outside edge	Carex	swampy at 1 end	tussocks around shore				spruce to E edge		sparse fl- ooded all around	aspen on slopes	•	P	steep to N. mod t south	o clear o brown colour	
 211	<15 8 ha		(arex		alt atong shore	Marl yellow bottom			defined by moss		some black at shore/cl behind aspe	aspen at osed shore n			low relief	clear	small and shallow

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APPENDIX 2. Continued.

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APPENDIX 2. Continued.

	SIZE	<u>X_COVER</u>	EME SPECIES	R <u>GENT VEGETAT</u> DI 1 END BOTH	<u>ION</u> STRIBUTION SHORE ENTIRE LINE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERG SPECIES	ENT VEG S XCOVER	SHORELIN	UI E SHRUBS	PLAND VEGETATION SPRUCE OPEN CLOSED	MIXED ASPEN/POPLAR	<u>SNAGS</u>	<u>Bea</u> Dam/	<u>VER</u> HOUSE	SLOPE OF SHORE	HZO COLOUR	COMMENTS
22	medi s)ze		Carex serige			some tussocks				no veg rocky- moss	some flooded willow in south	spruce to shore flooded in south	aspen behind spruce	i P		1	<u> </u>	clear slightly turbid	large, deep wetland
40	red size	2'. (arex	some floating		thin strip		Marl. 20% is shallow	mossy	80% at only 1 end	dead,float spr./aspe on shore	ing villow at n SE edge	t spr. to shore in S. flooded at shore	flooded at N bank	P		1 active	steep in N gentle to the S	clear	isolated some deep holes 2 treed islands snow to survey 3
40A	<1.5 ha						Marl,green bottom			spruce to S shore		flooded Live E dead in centre	aspen to N e some falle	P		•	steep to NES	clear	deep water, dark in spots
2.5	med size						Harl in sh- ailow centre strips	moss/ other	5% on marl	rocky, mos defines sh steep bank	s ore	spruce to shore	mixed behind spruce	1			moderate	clear	large, many bays and intets 80-85% deep water. 1 treed isl shallow water on shore
 42	<1.5 ha	705.	Carex in tiasin			·	rock bottom in channel					spruce to basin flooded elsewhe	re	lots	2 old	1 old	no slope	clear	sedge meadow complex channel throughout
<u> </u>	med size	40'.	Carex basin	· · · · · · · · · · · · · · · · · · ·	some on shore	some tussocks				<u> </u>		spruce to basin flooded elsewhe	re	lots		1		clear green	large basin, lots of bays deep water, treed island
46	>15 ha	10". 1 5m	(arex m S shore a	neadow at 1 end	all at edge		Marl	moss tily		····· ··		spruce to shore in N			1 sedge	1 old	low relie	f clear	shallow water,80-85%
 48	med size	<5% em sub veg	(arex		thin strip		Mart/blue green			moss shor	e	spruce to shore		٢		1	slope to to NE	clear	connected to 46 by channel bare slopes, shallow in centre
49	ned size	to SU 301.	(arex s	small neadow	thin strip		Marl	studge/ moss 10% til	/ 100%			spruce to basin dead in centre	aspen far behind sp	lot •.	3 2	.1	slope to N	clear	dams form wetland-50% shallow flooded into spruce PHOTOW1
49A	neci s i ze	40'.	sedg e Carex		thin strip	centre clumps	Marl/green brown bottom	moss/ Illy	50%			closed spruce				1	gentle slope	clear	shallow, bar across vetland
 50	med size	<2";	Carex				moss bottom some algae	floats algae	ing			closed spruce shore	to						shallow pothole basin
51	<1.5 ha	25:.	Larek basin				mari algae	float algae	ing			some around ed	ge some asp	en			slope to N	brown	<pre>small flooded pothole beside road. Snow to survey #3</pre>

	SIZE	Z COVER	<u>En</u> Species	ERGENT VEGETA D 1 END BOTH	I ION I STRIBUTI SHORE LINE	ON ENTIRE CLUMP	AQUATIC BED MARL, ALGAE S ROCK	<u>SUBHER</u> SPECIES	GENT VEG S XCOVER	SHORELINE	UPLAND VEGETATION SHRUBS SPRUCE OPEN CLOSED	HIXED ASPEN/POPLAR	SNAGS	BEAVER DAM/HOUSE	SLOPE OF SHORE	KSO COLOUR	COMMENTS
52	med size	35% of basin	flooded sedge/spr	·····		sedg	e floating algae			bright orange moss	sparse black a spruce to basi	nt edge				dark vater	large sedge basin, 65% vater
55	med size	<5". Beadow	Carex In south				Mari sludge with moss				spruce to basi dead in meadow	in I		1	slope at N end	clear	W and E sides are deep 70% shallow. Lots of bays
55A	med size	55 B flooded m	Carex meadow SE	•••••••	thin strip	some patche	sand bottom s algae shore		lov X	rocky and moss	spruce to shor	e			_		mostly shallow, little sub. veg 1 tree island with flooded sedge
53	med Size	50% at Wend	Carex flooded			basın	some algae perimeter			little em. or undergrowth	open around basi some in centre	n some asper behind spruce	1				small round wetland. Shallow - seedling spruce in centre
54	med size	small V	sedge	patch on N shore	thin strip		Marl/yellow green shallow			rocky	open to N, mostl to shore	y scattered aspen		1	steep sides ridge N/NE	clear	small pothole, shallow with deep holes. Submerged island in centr
54 A	med 512e	sedge mer in south	ido¥ i		south strip	some tussock	Mart/gravel s 50% shallow			rocky/moss flooded spr.	spruce to shore			2		clear	yellow/green bottom. 5 deep hold many bays,sedge strip to treed island
 58	>13 ha				flooded in S	· · · · · · · · · · · · · · · · · · ·	some floating algae			flooded spr.	closed to shore some floating c	lead	P		steep in N to spruce	clear green	treed island, shallow
58A	med 512e		Carex		v.thin on N	son tussoc	e Marl ks	BOSS			contained by cl spruce to shore	osed			steep to N shallow sho	green re	30% deep water couple of deep holes
60A	med size	40 50%	Carex			sedge Beadow					flooded black s to south	spruce	lots				small, deep vater
£0	>15 ha		Carex	meadow at 1 end			Marl	noss		rocky 1 end	closed to shore some standing de	ad					large, <30% deep water in centre shallow, treed island with sedge
61	med size	Q'.	Carex		shore strip		Marl	none visible			spruce all arou	ind			steep in north		isolated pothole, shallow at S/SE
62	>15 ha	20:	sedge	1 flooded meadow			Marl	moss	10%	rocky shore	spruce to shore	•	P		steep 1/2 N shore	clear	large, shallow with deep spots no sedge in N. 20% shallow
67A	>15 ha	25":	sedge	meado both er	ow shore nds strip		rocky bott. floating alg	lily ae	lovX		spruce to N/Ssł	ore		1		clear	long, marrow, deep water
62A Ext	<1.5 ha	25%	basin				moss bottom shallow	moss	100%		closed N/Sshare open E/W share				low relief	clear tea	flooded sedge wetland, connected to 62A via channels.3 waterbodie

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APPENDIX 2. Continued.

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	<u>512E</u>	Z COVER	<u>EME</u> SPECIES	RGENT V 1 END	VEGETATI D15 BOTH	ION STRIBUTION SHORE ENTIRE LINE	CLUMPS	<u>AQUATIC BED</u> MARL, ALGAE ROCK	<u>SUBMERG</u> SPECIES	<u>ENT VEG</u> XCOVER	SHORELIN	<u>UPL</u> E Shruds	AND VEGETATION SPRUCE MIX OPEN CLOSED ASPEN	<u>S</u> KED I/POPLAR	NAGS	BEAV	<u>ER</u> OUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
63	<1 5 ha	2m 30%	Carex S/E	4	ends	south strip		marl/ other	MOSS	100%	rocky in	N	closed with fallen/ flooded at shore					steep	clear	pothole, deep centre dark green
65	>15 ha	<10".	Larex				<u></u>		none visibl	e	· · · · · · · · · · · · · · · · · · ·	and the second second second second second second second second second second second second second second second	spruce to shore some flooded		P		1	steep to north	turbid	little shoreline dev. Many bays deep with treed island
65A	med size		flooded basin					Marl/moss yellow/black	MOSS	50%			open/flooded in south						clear	50% deep water. Some equisetum piles. Oil slick on water in sedge.
65B	med size	20%	Carex sub	1 end 100% veg		thin strip	tussocks in centre	Mart and moss	titie: Moss	5-10% bottom			spruce to basin flooded/dead stumps		P	1	1	moderat to shall	e ov	75% shallow bottom. Dam caused flooding 100% veg. cover in one bay
67	med size	50%	flooded sedge basin					Vegetation			SORE NOS	5	spruce to basin		_	1	1 old	low,hill to M		50% water in basin
81a	>15 ha		2 (arex meadows				· · · · · ·		l i l y sparse	5% at shore	rocky in spots		spruce to shore old dead on shore				1 old		brown	deep water
81	>15 ha	99". In basin	Carex Equis- etum					algae floating	sub. veg.	100%			sparse spruce			1	1 Large	slope to north		part of a large sedge meadow. Channels-shallow, 10% open water more drainage than vetland.
818	<1 5 ha	30':	fluoded Carex mead	low	4	25m strip		floating algae moss			rocky shore		spruce to basin dead at 1 end of 1 bay	_		2		no		402 water, 302 flooded spruce/ carex shallow, centre ridge with spruce. beaver ponds biun 81A-8.
87A	med size		Carex/moss grass tufts to N/E		1	thin strip		gravel bottom floating algae				willows between sedge & flood.spruce	spruce all around to shore in N e flooded E/W					low	dark brown	round
91	med size	50".	Carex to S.					sludge with sub. veg.	tily at edge		rocky shore		spruce to besin- flooded				2	hill to N		connected to another wetland

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*	<u>512E</u>	2 COVER	<u>EME</u> SPECIES	RGENT VEGETAL DI 1 END BOIH	<u>ION</u> STRIBUTIO SHORE E LINE	NT I RE	CLUMPS	<u>AQUATIC BED</u> MARL, ALGAE, ROCK	SUBMERGE Species	<u>NT VEG</u> %COVER	SHORELINE	UPLAND SHRUBS	VEGETATION SPRUCE OPEN CLOSED	MIXED ASPEN/POPLAR	<u>SNAGS</u>	BEAVERS DAM/HOUSE	SLOPE OF SHORE	H20 COLOUR	COMMENTS
1	med size	30-35°. 3-4m	Carex	east edge	thin s strip fl	ione looded		sludgy clay algae, dark	·	low%			spruce to shore north/south	2	none		low relief	clear	shallow, T-shaped. Not much shorelead on S, some E/W
	med	20'i in	(arex	meadows						low %		1	flooded black				moderate	clear	shallow
14	size	basin		E/W								1	to S. closed				to north	tea	
- · · - 2	<1.5 ha		flooded sedge	sedge	along 1 shore						<u> </u>		spruce on 1 shore		·····		slope to north	dark brown	V-shaped sedge islands
3	<1.5 ha		serige basin		some			mari, float- ing algae yellow bott.			well defined by moss		open around bas flooded dead bi spruce 1 end	sin Lack	<u>.</u>		, <u>.</u>	clear	semi-flooded sedge/spruce complex isolated pothole in sedge shallow
4	ned size	30°, persists	Carex sedge			basın E side		marl		lovi	mixed willow sedge a shore	flooded e birch W	spruce to basi	in			low relief	brown colour	no trees W end - flooded birch and Carex. Water=20% of basin
5.4	me:1 size		flooded Carex	E/W meadow	serige a shore			N 1					open spruce on sides	3	<58		low to N		10% water.The rest is Carex between SB and 5A. Small
5.B	<1 ha	75%	flooded (arex		sedge a shore		sedge	marl/brown moss	some Pot.?	50%			flooded open sp	pr.	P		lov	clear	connected to 5A. Small marshy meadow
6	<1 ha	>50":	Carex basin						moss	100%			open spruce to	N alder to north			shallow		small, shallow water in sedge black earth, nosnags, rocks
6.A	med size	60°. 40m to spruce	Carex both species			sedge meadow	,		MOSS	90- 100%		some far off shore	some open spars spruce	se			shallow	brown	larger than 6, shallow,isolated in sedge meadow. Black earth, green vegetation
8	>15 ha	smail X	Carex		narrow tussocks a 1 shor	re			moss other	50%	rocky bottom	some willow in tussocks Blong shore	spruce to shore	•	P		slope to shore		large wetland, defined basin surrounded by spruce
	med size	flooded to E	l (arex		thin strip				where shallow	100%			spruce to shore				low relief		small wetland upstream of 8 not much shorelead, deep water

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LOCATION : TESLIN RIVER BASIN DATE : 12-29 MAY 1989 <u>COMMENTS</u> : HELICOPTER SURVEY - BREEDING WATERBIRD POPULATIONS

APPENDIX 2. WETLAND CHARACIERISTICS- NORTHWEST B.C.

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APPENDIX 2. continued

	<u>\$12E</u>	X COVER	ĘM Species	E <u>RGENT VEGETATION</u> DISTRI 1 END BOTH SHO LIN	BUTION RE ENTIRE CLI E	AQUATIC BED MARL, ALGAE, UMPS ROCK	<u>SUBMERGE</u> Species	E <u>NT VEG</u> XCOVER SH	IOREL INE	UPL. Shrubs	AND VEGETATION SPRUCE OPEN CLOSED	MIXED ASPEN/POPLAR	<u>SNAGS</u>	BEAVERS DAN/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
9	<1.5 ha		sedge Carex		meadow	marl,algae floating		very little			sparse,open spr. thin band	alder behind spruce			flat basin	brown	shallow, in larger flooded basin bottom yellow, lots of orange lichen orange lichen
10	>15 ha	100°.	Carex	sho str	re meadow ip to E	marl,rocky shore	lilies sparse /moss	70% see			spruce surrounds open Ə basin	<u></u>	P	1 1 old	hill to W	clear	large,* 50% shallow,deep centre many bays,channels in sedge. 1 arm no submergent vegetation
10A	15 ha	<u>602 (</u>	aren sedige	N shore	flooded meadow		111y 20-	30%		3	pruce a S shore and to basin	50	ne	f	ət	58	all,S shape.Part of river in sedge meadow.Flow/channels
11	⇒15 ha		Carex sedge	hint edg	a flooded e a S	veg.bottom	sparse Lily	>50%			spruce to shore		P	1 centre	cliff to NE	clear	large pothole.Sparse open meadow across form cliff.Brown bottom. Steep to NE, shallow elsewhere
 11a	mei) size	lou X	flooded to S	1		marl/algae floating#	moss algae	r	ocks Nend	·····	spruce to shore open,flooded @ S				steep to E		isolated,shallow #50% is mart with no veg. Boggy to South
17	215 ha	<1m strip	(arex N end	spar stri	se old p meadow		····		rocky	some willo to shore	w thick closed spr to sh./stand dea	d	00		mod.all aides		large,little shore development
- 18	mei) S128	low	Carex sedge		meadow to N			1	noss to shore		sparse to shore spruce upland	alder behind spr.	P		mod slop N side	e turbid brown	isolated defined basin.Deep water Meadow to N. No em/sub vegetation.
184	<1.5 ha	<60°. tussoo	(arex	ent i shor	re flooded e	can't see bottom		moss/ shore	/Carex s	some willow to north	straggly to N/sma drunken forest	ll mixed to S	no			dark brown	isolated in sedge meadow.Channel from N.Deep in S,shallow to N
 19	med size	10'.	Carex sedge	<1n bar	i 1 small id meadow	MOSS		roci	ks on shore	some willow to east	spr. to shore ex part of N/S ends	cept			mod to W Low E/N	clear brown	well defined basin-2 semi-circles shallow, standing dead spruce
194	<1 5 ha	>60:	sedije meadow		meadow se to E ist	edge mossy Lands	Charra? moss				stunted N/S W side open spr.				low all sides		small in sedge meadow,flow from S.Shallow,channels,defined shore.
 20	<1 5 ha	50'. 3-4m	serige strip			mud/algae green bot.		roci edge	ky e		spruce to basin				upland moderate	clear	water in centre, confined basin small shallow patch, low slope
21	med s12e	small %	sedge a s	jus	it a pre	mucky					spruce confines open to the sout	basin h				brown	water in confined basin,N of tussocky area.Little veg.@ shore
21/	med size	1 - 3m	sedge	sedge alc sho	ong S ore	rocky on S shore		low ro % E	ock lede shore	ge	open to S.Spr. t shore in W/N	0	P		steep a ledge	brown	isolated basin
24	med S120	flooder	l sedge basin	to NV ent end sho	i ire Dre	can't see bottom	sparse Lilies	5%		N	spruce to basin open to E shore		no			brown	isolated basin beside river

APPENDIX	2.	cont	Inued
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	<u>SIZE</u>		ĘH	ERGENT VEGET	ATION		AQUATIC BED	SUBMERGE	NT VEG		UPLAN	VEGETATION		SNAGS	BEAVER	SLOPE OF	H20	CONKENTS
		X COVER	SPECIES	1 END BOT	DISTRIBUTION H SHORE ENTIRE LINE	CLUMPS	MARL, ALGAE, ROCK	SPECIES	COVER	SHOREL INE	SHRUBS	SPRUCE OPEN CLOSED	HIXED ASPEN/POPLAR		DAM/HOU	SE SHORE	COLOUR	
26	med size	flooded SW	Carex meadow		sedge shore	tussocks on edge	· · · · · · · · · · · · · · · · · · ·	sparse lily	952			spruce to bas some in sedge	in	no	3	shore shallo	,	1 deep spot
26A	med size	>60% 30m edge	sedge	open to N		sedge tussocks	basın is sedge	lily/ other sparse	100%		· · · · · · · · · · · · · · · · · · ·	black spr. to spruce to N/ basin	5		1	shallo slope shore	r brown I	channel into and out of water evidence of geese feeding-green stems/shoots on shore
30	med size	<1'.					brown clay rock		<1%	villow on shore		standing dead around basin		P		mod al sides		old burn area, shallow pothole little shoreline development dead spruce/pine on N shore
31	<1 ha	flooded	sedge				clay	NOSS	small X	flooded willow		flooded dead throughout		lots	۲ ۲ اه	esker d to N	dark brown	beaver bog;shallow, not much water
	ned		sedge		thin meadow		mossy			rocky	willow on	spruce to sho	re			mod to	clear	waterbody in E edge of meadow
32	512e				str1p		bottom			shore	shore	to south				east	brown	large, shallow
34	>15 hai	very tow	Carex		v. thin Ə edge		rock throughout		little seen			spruce to sho stunted	re			eod.	dark brown	large,shallow-deep in centre often waves during surveys
35	<1 ha	>50': sedge	flooded meadow		<u> </u>		marl	MOS S	lovz			spruce to bas standing dea	in d	P	P	P		beaver bog, shallow, flooded sedge and channels
38	med size		(arex sedge		S,W meadow sides to W		rocks a shoreline	centre moss/ other	lovž	mixed sede willow/spi on N,E she	ge r. ore	spruce to sho 80% open/ spr bog to south	re uce	no		2 mod to north	b clear brown botto	large, shallow, surrounded by open spruce. Narrow band of a sedge between 38 & 38A
38A	med size		(arex		mostly in \$		marl		low%	moss defin shoreline	ned	spruce to sho	re				clear	shallow,many bays
388	med S128	•	Carex basin				algae/other submergents	moss algae	<2%	MOS S	shrub birch/ willow shore	open stunted sparse spruce	,				clear	flooded sedge basin-same as 38A-yellow bottom.Little spruce
 40	med size	50.	sedge bas in	(are	x flooded sedge										1 old 2 Wend	slope i N sprud	o dark e	lots of sedge, oil on water in sedge also
41	neri S120	2 · 5m	sedge Carex	open S meadow	ent ire shore		dark moss/su brown bottom	b				surrounded by spr./dead N s	hore		0	1 (d	clear	isolated,outlet dammed,shallow small island
47	med s12e	low%	(arex	small meadow	E V shore		dark brown bottom	Lilies @ S sho	70% re			N spr. to sho some dead in	re sedge	lots		1	dark	shallow with channels Lilies sparse through wetland

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APPENDIX 2. continued

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•	51 <u>2€</u>	X COVER	EMERGENT VEGETATION SPECIES DISTRIBUTION 1 END BOTH SHORE ENTIRE CLUMPS LINE	<u>AQUATIC BED</u> MARL,ALGAE, ROCK	<u>SUBMERGENT VEG</u> SPECIES %COVER	SHORELINE	<u>UPLAN</u> Shrubs	I <u>D VEGETATION</u> SPRUCE MIXED OPEN CLOSED ASPEN/POPLAR	<u>SHAGS</u>	<u>BEAVERS</u> DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
47A	<1 ha	10m to 5 2m to N	S Carex i sedge	moss	sparse 50% tity	NOSS		open black à shore poplar spruce to basin beyond spr.				dark brown	smail isolated pond in sedge meadow
478	<1.5 ha	>50%	Carex meadow	vegetation		Carex	flooded to S	scattered dead/ poplar beyond spruce to shore spruce		1 old	slope to north	0	waterbody at the base of hill flat elsewhere.flooded meadows
50	med 5126	f Looded sedge	extensive basın	sedge	. <u> </u>	sedge	shrub along river	scattered open spruce	nû		flat	clear	riparian. 3 waterbodies.S mostly sedge, middle sep.by hill/willow @ shore-watercress?