PASQUIA PROJECT

2003 INTERIM REPORT

WESTERN BOREAL FOREST
DUCKS UNLIMITED CANADA

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EXECUTIVE SUMMARY

The Pasquia Project is one of several projects under the auspices of Ducks Unlimited Canada's Western Boreal Program. Pasquia was initiated in 2001 and was selected to represent the southeastern portion of the Boreal Plains Ecozone. Principle components of the project include developing an accurate and enhanced satellite-based earthcover classification; conducting an inventory of waterbird use from spring through to fall, including production; water sampling to measure selected water chemistry parameters as an indication of wetland productivity and to determine a regional water chemistry profile; and the collection of Traditional Ecological Knowledge/Traditional Land Use information. Support for the project including financial and in-kind contributions have been provided by, SaskPower, Saskatchewan Environment and Resource Management, Louisiana Pacific Canada, Manitoba Conservation, Tembec Industries Inc., Ducks Unlimited Canada, Ducks Unlimited Incorporated, North American Waterfowl Management Plan, The Pew Charitable Trust and the United States Department of Agriculture Forest Service.

Waterbird surveys were conducted for the third consecutive year on approximately 300 wetland basins, the Saskatchewan River Delta (SRD) and several large lakes. We observed waterfowl throughout the season, covering breeding, brood and moulting, and staging. Waterfowl breeding pair densities were generated and mallard, bufflehead and blue-winged were the most common breeding duck documented on wetland basins. Mallard, canvasback, and bufflehead were the most abundant breeding ducks in the SRD. Significant numbers of non-breeding waterfowl and associated waterbirds were recorded during spring and fall staging surveys. Ancillary data on other wildlife species of interest were also collected. The water chemistry analysis was undertaken this field season. We randomly selected a range of wetlands across the project area and collected water samples for later analysis. These analyses will include a characterization of pH, conductivity, salinity, nutrients, primary productivity and dominant ions.

Change detection analysis for the Pasquia Project area was undertaken in 2003. Analysis was performed using the 1999 imagery used for the earth cover classification

and additional imagery from 1985. The purpose of the change detection is to identify and map major earth cover changes.

Communications throughout the year consisted of various newspaper articles and speaking opportunities. We presented a range of information including a highlight of our trumpeter swan data at the Ornithological Society Convention and updating DUC staff on the Pasquia project and related boreal work.

ACKNOWLEDGMENTS

We wish to thank Louisiana Pacific Canada, Manitoba Conservation, SaskPower, Saskatchewan Environment, Tembec Industries Inc., the Pew Chartable Trusts, North American Waterfowl Management Plan and the USDA Forest Service Office of International Affairs for providing financial and in-kind support for this project. A number of DUC staff assisted with conducting waterbird surveys including: Mark Kornder, B. Arquilla, D. Atamanchuk, T. Sargeant, W. Price, A. Leach, K. Patton, K. Russell, C. Lindgren and P. Tkachuk. Garth Ball of Manitoba Conservation also assisted with the surveys. DUC staff in Edmonton was invaluable in assisting with data transcription and data entry and Sean Smyth provided GIS technical support for all aspects of the project. We wish to thank Wayne Bell for his work in the collection and ongoing analysis of water samples for the chemistry work. Appreciation is extended to Bob Derksen at Transwest Air, Bob Gladstone at Cranberry Air and Bob Simpson with Dauphin Air Services who provided efficient and safe service.

INTRODUCTION

The Canadian Western Boreal Forest (WBF) expands over 3 million square kilometers, stretching over portions of four provinces and three territories (Figure 1). The WBF is comprised of six Ecozones and supports a population of 12-14 million breeding ducks (Ducks Unlimited 2000). This area has been ranked by Ducks Unlimited as a Level 1 Habitat Priority for wetland conservation in North America (Ducks Unlimited 2001). Populations of several common boreal nesting waterfowl species such as lesser scaup and scoters are declining (Wilkins and Otto 2002, DUC Unpubl Data 2003). As a result, these species have been the focus of considerable discussion (Austin et al. 2000) and currently the emphasis of many research initiatives including that conducted by Ducks Unlimited Canada (Slattery 2002). Industrial activity including petroleum exploration and development, forestry, mining and hydro electricity generation as well as agriculture has greatly expanded in the Western Boreal Forest. The influence of these activities on boreal wetland ecosystems remains largely unknown.

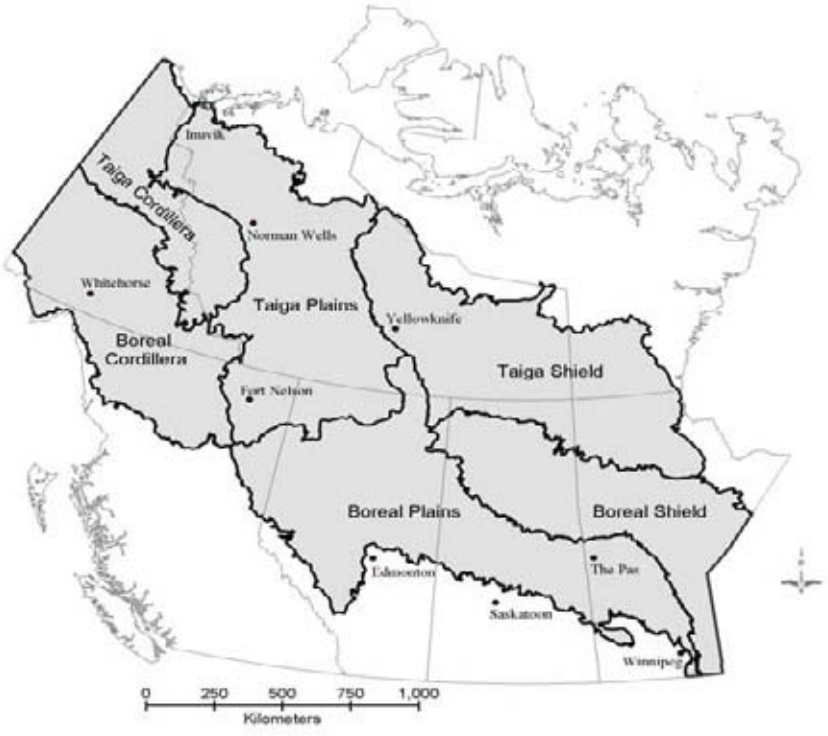

Figure 1. Eco-zone boundaries in the western boreal forest of Canada (Ecological Stratification Working Group 1996).

In 1997, Ducks Unlimited Canada (DUC) established its Western Boreal Forest Initiative in recognition of the need to advance the understanding of boreal wetland systems and value to waterbirds. This initiative has matured into a comprehensive DUC conservation program that includes the collection of science-based information through landscape inventory and research projects and to utilize and share this information to advance boreal wetland conservation. Key wetland conservation initiatives through the program include multi-stakeholder watershed based conservation planning and to assist/influence the establishment of protected areas where boreal wetland habitats are significant. This work is being conducted in partnership arrangements with a variety of stakeholders including governments, First Nations, industries, universities and foundations.

In 2000, DUC identified the need to establish a project in Manitoba and Saskatchewan to complement their previous work in the boreal. Both provinces are well recognized as contributing significantly to all flyways in North America. However, unlike the prairie and parkland regions, limited information is available for these boreal wetlands that historically provide more consistent water conditions and contribute significant breeding, moulting and staging habitat for large numbers of waterbirds.

The Pasquia Project area was selected to represent the southeastern portion of the Boreal Plains Ecozone (Ecological Stratification Working Group 1996) and initiated in 2001. Project components include:

- Accurate and enhanced satellite-based earthcover classification
- Comprehensive waterbird inventory of representative wetland systems
- Water sampling to measure selected water chemistry parameters as an indication of wetland productivity and to determine a regional water chemistry profile
- Develop an understanding of Traditional Ecological Knowledge and Traditional Land Use of wetlands within the project area
- Utilization of this information to advance wetland conservation programs

This is an interim report that provides a synopsis of activities of the Project for the fiscal year of 2003/2004.

PROJECT AREA

The Pasquia Project straddles the Manitoba / Saskatchewan border and is centered west of Reddeer Lake, Manitoba at approximately 53^{o} North (Figure 2). Key communities include The Pas and Swan River, Manitoba and Hudson Bay and Cumberland House, Saskatchewan.

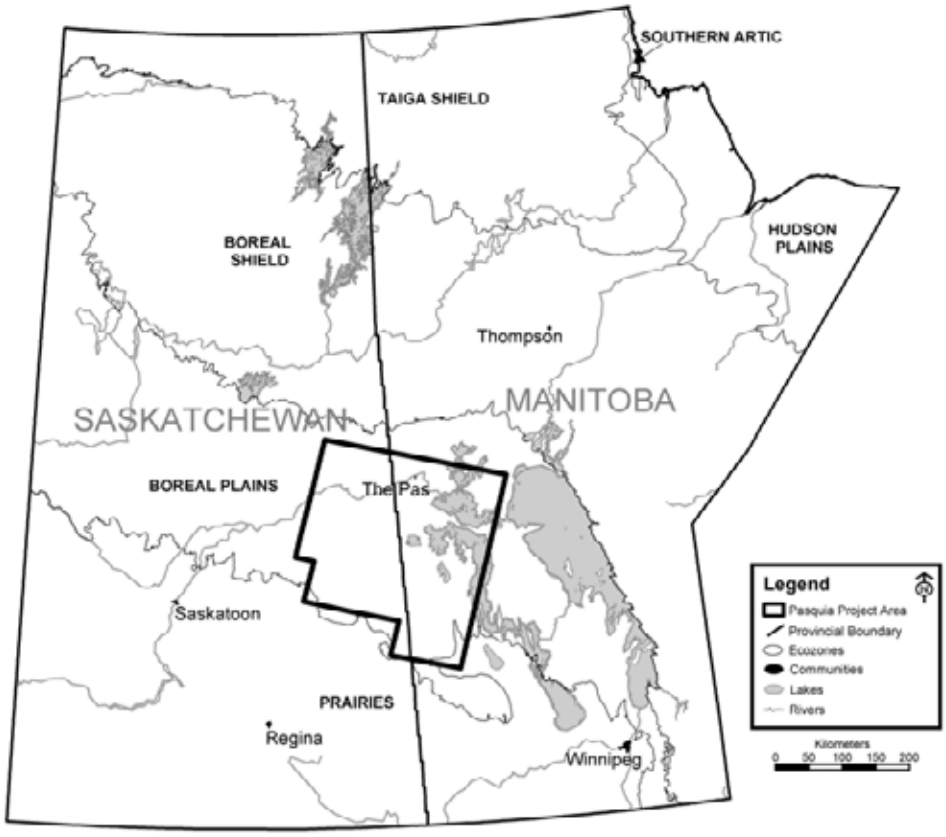

Figure 2. Location of the Pasquia Project in the Boreal Plains of Manitoba and Saskatchewan, 2001-2003.

The project area is approximately 7.4 million hectares (18 million acres) in the Boreal Plain Ecozone and includes portions of six Ecoregions including the Mid-Boreal Uplands, Mid-Boreal Lowlands, Boreal Transition, Aspen Parkland, Lake Manitoba Plain, and the Interlake Plain (Figure 3). Notable features include the Saskatchewan River Delta (Mid-Boreal Lowlands), the Porcupine Mountains, the Pasquia Hills, the

Duck Mountains (Mid-Boreal Uplands) and portions of Lake Winnipegosis (Interlake Plain).

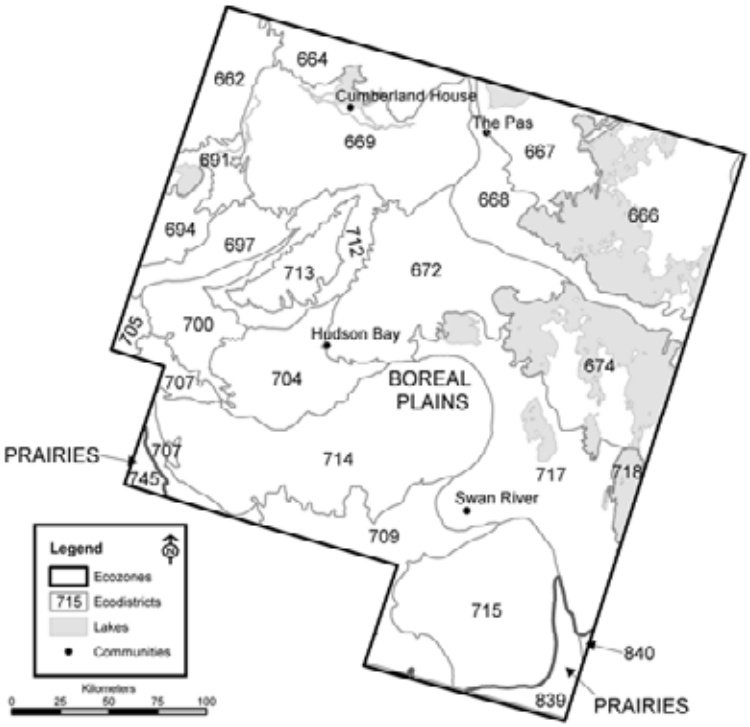

Figure 3. The Pasquia project area and associated ecodistricts.

The size of ecodistricts contained within the Pasquia project area and associated water area statistics are outlined in Table 1. Ecodistricts ranged from less than 140,000 ha to over 880,000 ha with water representing from less than 0.5% (rim of the Pasquia Hills) to over 75% (Lake Winnipegosis region). Wetland statistics for basins ranging from 1-300 ha and basins ranging from 1-3000 ha are presented to outline the density and size of wetlands found in the project area. Table 2 outlines the number of basins and associated hectares surveyed during breeding, brood and staging surveys.

Table 1. Size of ecodistricts contained within the Pasquia project area, amount of water and wetland basins statistics up to 3000 ha.

Ecodistrict*	Ecodistrict Area (ha)	Total Wetlands	Total Wetland Area (ha)	Total # wetlands (1-300ha)	Total wetland area (1-300ha)	Total wetlands (301-3000)	Total wetland area (301-3000ha)
662	193,234	189	3,344	187	2,520	2	654
664	206,859	163	15,114	158	2,670	8	3,547
666	674,931	443	112,325	419	7,653	24	23,597
668	269,086	151	5,199	146	2,100	5	2,798
672	561,137	484	13,861	481	4,762	3	4,084
674	507,362	204	378,150	202	3,383	2	809
700	191,723	320	2,206	320	1,960	0	0
704	314,008	523	2,975	523	2,239	0	0
712	195,943	105	725	105	289	0	0
713	139,856	175	3,291	173	2,446	2	674
714	881,779	3,549	37,131	3,535	24,301	14	9,446
715	536,422	3,806	34,394	3,798	23,803	8	4,973
717	703,526	789	67,816	788	9,529	1	323
Total	**6,306,826**	**13,996**	**676,531**	**13,859**	**87,655**	**140**	**50,905**

***** Wetland statistics not generated for ecodistricts comprising the Saskatchewan River Delta

Table 2. Available wetland hectares within the Pasquia project area, wetlands selected and hectares surveyed; up to 3000 ha.

Ecodistrict	Total # of Available Wetlands (1-300ha)	# of Wetlands Selected for Pair and Brood Surveys	Wetland area (ha) surveyed for Pair and Brood	Total # of Available Wetlands (1-3000ha)	# of Wetlands Selected for Staging Surveys	Wetland area (ha) surveyed during staging
662	187	4	388	189	6	492
664	158	5	45	166	11	2,528
666	419	14	644	443	26	6,938
668	146	3	17	151	3	131
672	481	13	79	484	10	818
674	202	6	33	204	9	1,014
700	320	11	66	320	8	74
704	523	11	29	523	6	240
712	105	2	10	105	1	1
713	173	7	196	175	7	523
714	3,535	127	1,266	3,549	100	5,932
715	3,798	108	775	3,806	81	4,117
717	788	14	615	789	17	1,314

***** Wetland statistics not generated for ecodistricts comprising the Saskatchewan River Delta

2003 ACTIVITIES

Waterbird Survey Methods

Wetland Basin Site Selection -- Since waterbird use is expected to vary by wetland type across the project area a stratification system was established to ensure a representative sample from each "landscape unit". The Ecoregion and Ecodistrict classification framework (Ecological Stratification Working Group 1996) was selected as the landscape unit for stratification purposes. Individual wetland basins were sampled from 13 Ecodistricts within 4 Ecoregions (Mid-Boreal Lowlands, Mid-Boreal Uplands, Boreal Transition and the Interlake Plain).

An unsupervised classification of the Pasquia Project satellite image was imported into ArcView 3.2 (Environmental Systems Research Institute, Inc 1996) and expected classes of wetlands were arbitrarily determined for the selection of the waterbird sampling universe. Sites < 1.0 ha were excluded from the sample universe to reduce risks of misclassification (e.g., terrain shadow, misclassified single and small clusters of pixels, etc.). The total number of wetlands within each Ecodistrict was determined and, using a "proportional allocation protocol (a ratio of wetlands per Ecodistrict to total wetlands on the scene to represent the proportion), individual basins were randomly selected.

For surveys to determine Indicated Breeding Pairs (IBP) and production, wetlands > 300 ha were excluded from the samples due to survey constraints and the expectation that these wetlands will be more important for fall staging. A total of 329 wetlands were selected for IBP and production / brood surveys in 2003 although some basins were dropped during the survey for a variety of reasons including misclassification from the satellite image and some falling in the agriculture zone. For post breeding / staging surveys wetlands >300ha and less than 1000ha were included in the sample universe. A subset of 289 basins was selected for surveys. Figures outlining the location and distribution of basins surveyed are included in Appendix 1 for reader reference.

Line Transects -- Line transect surveys were established for the Saskatchewan River Delta (SRD), Plummer's Marsh, Reddeer Lake, Swan Lake and Pelican Lake (Appendix 2). Given the large size of the SRD (approx. 950,000 ha) it was determined that survey coverage should target approximately 5% of the two ecodistricts that make up the delta (see Table 1). For the remaining basins the survey area covered approximately 10% of the basin water area. This resulted in 31 transects being established for the SRD and 2, 4, 8, 6 transects established for Plummer's Marsh, Reddeer Lake, Swan Lake and Pelican Lake, respectively. Transects were oriented north to south in the SRD and Plummer's Marsh and east to west for the remaining basins to maximize the number of replicates for future statistical analyses. Additional transects were established in Pelican Bay and Overflow Bay in Lake Winnipegosis to capture various water depths in this large lake. (Appendix 2)

Wetland Basin Surveys -- Individual wetland basins functioned as the sample unit when recording waterbird observations. We utilized two Bell 206 helicopters for breeding pair surveys. Surveys were flown at a nominal altitude of 35 m; altitude was occasionally reduced to less than 35 m above ground level (AGL) as required given shoreline complexity, vegetative cover, and/or unconfirmed species or sex. Our ground speeds did not exceed 100 km/h, though we regularly employed slower speeds in areas with reduced visibility. During staging surveys, we utilized a Cessna 185 aircraft. The fixed-wing aircraft flew at approximately 100m AGL with an average airspeed of 150km/h. Flight paths varied depending on the size and shape of the basins in order to attain approximately 100% coverage, (i.e. one central transect, circle from shoreline, multiple transects, etc).

ArcView 3.2 (Environmental Systems Research Institute, Inc 1996) software integrated with a moving map extension (Ducks Unlimited Canada) and global positioning system (GPS) was utilized to ensure that all wetland basins surveyed corresponded with pre-defined coordinates. Each survey crew consisted of a pilot, an observer/navigator seated opposite the pilot and an observer seated in the rear behind the pilot. Observers used micro-cassette tape recorders to record all waterbirds encountered on their respective side of the aircraft. Survey techniques were modified from protocols

developed by the Canadian Wildlife Service (CWS) for application in eastern North America to achieve 100 percent coverage of a given area (Black Duck Joint Venture 1996). A detailed description of survey methodology is provided in the *Western Boreal Forest Program Aerial Waterbird Survey Protocols* (Ducks Unlimited Canada 2002).

We conducted two breeding pair surveys (May 09-12 and May 29-June 01), which were used to estimate indicated breeding pairs for early and late nesting species, respectively. We recorded waterbird species, sex, and social status (lone male, pair etc.) when possible. We also conducted two brood surveys (July 02-08 and July 22-25) to document waterfowl production and brood characteristics including size, age, and species. Finally, we conducted three staging surveys (August 26-30, September 16-21 and September 29-October 03) to evaluate the use of wetland basins by migrating/staging waterbirds. We estimated the number of individuals, and recorded species and sex whenever possible.

Transect Surveys. -- Similar survey protocols were employed during transect surveys except that only individuals within 150m of each side of the aircraft were recorded. More detailed description is provided in the *Western Boreal Forest Program Aerial Waterbird Survey Protocols* (Ducks Unlimited Canada 2002).

Two breeding pair surveys (May 09-12 and May 29-June 01) were conducted to document waterbird abundance for early and late nesting species in the SRD. Breeding pair surveys required the recording of species, sex, and social status for all waterbirds encountered. In addition two spring surveys were also conducted on other selected large wetlands/lakes (e.g., Plummers Marsh, Reddeer Lake, Swan Lake and Pelican Lake) to document spring staging / non-breeding information. Two post breeding/moulting surveys were conducted (July 02-08 and July 22-25) to document the use of the SRD and other selected large wetlands to post breeding and moulting waterfowl and non-waterfowl waterbirds. This survey effort concentrated on documenting total waterbird numbers and, where possible, species. Three post breeding/fall staging surveys were also conducted (Aug 26-30, Sept 16-21 and Sept 29-Oct 03) where the numbers of birds, by species, were recorded.

Data Analyses -- We determined indicated breeding pair (IBP) estimates for each species using modified methods developed by CWS/USFWS (1987). A list of species and scientific names for waterfowl encountered during the 2003 surveys is included in Appendix 3. The IBP totals were derived for duck species by summing the total observed pairs, lone males, and males in groups of 2-4. Data from the early pair survey were used to calculate IBP for mallard, bufflehead, goldeneye, and northern pintail. Indicated breeding pairs for ring-necked duck, scaup, gadwall, scoters, blue-winged teal, canvasback, redhead, ruddy duck, and mergansers were calculated using data from pair survey two. We calculated IBP for northern shoveler, green-winged teal and American wigeon by taking an average of the two surveys.

We estimated the number of unique broods by comparing species, brood size and age of broods seen during each survey. We then censored those from the second survey that could have been repeats from the first survey (Gollop and Marshall 1954, Wishart 1983), based on approximate midpoint age of the subclass and days between surveys. From survey one to two, broods had to be the same species, the same brood size and be within a couple days when comparing approximate midpoint age of subclasses. Brood mortality and movement was not accounted for.

Density and an estimated total number of pairs, broods and staging birds for basin surveys were calculated for each species by ecodistrict. Density was calculated for each species by dividing the sum of birds (or pairs) by the total wetland area surveyed within the ecodistrict. The percent wetland coverage was divided into 100 to obtain the estimation coefficient for each ecodistrict. Multiplying the total observed birds by this coefficient gave an estimate of the total birds for each ecodistrict.

Density and the estimated number of pairs and staging birds for transect surveys were calculated for each species by individual lake and by each of the two ecodistricts which represent the SRD. Density was calculated by dividing the sum of birds (or pairs) by the total area covered by the transect, and the estimated number of total birds were then calculated by multiplying this density by the total water area of the lake/SRD ecodistricts.

Waterbird Survey Preliminary Results

Spring Surveys -- Indicated breeding pair and breeding densities of the most numerous waterfowl species by Ecodistrict derived from individual wetland pair surveys conducted are outlined in Table 3. An average density of 0.839 IBP/hectare is calculated for the wetland area within the project area. Density between ecodistricts ranged between 0.088 IBP/hectare (ecodistrict 662 Mid-boreal Lowland) to 3.221 IBP/hectare (ecodistrict 704 Boreal Transition). We documented 17 different waterfowl species and 1979 IBP on 329 basins. Dabbling ducks represented 48% of all waterfowl observed with divers accounting for 46% and Canada geese with 6%. The three most common breeding ducks observed on individual wetland basins were mallard, bufflehead and blue-winged teal (Table 3). Collectively, these species represent approximately 55% of all breeding ducks. In the majority of ecodistricts, mallard was the most common duck, ranging from densities of 0.028 to 1.131 IBP/hectare of water. The highest densities of bufflehead were documented in ecodistrict 712 (rim of the Pasquia Hills) and blue-winged teal densities were highest in ecodistrict 714 (Porcupine Hills). Related information on IBP densities for the remainder of species is provided in Appendix 4.

Table 3. Indicated breeding pair densities (IBP/hectare) and estimated totals of the top three waterfowl species and all waterfowl for ecodistricts within Pasquia, Spring 2003.*

Ecodistrict	Mallard		Bufflehead		Blue-winged Teal		All Waterfowl	
	Density	Total	Density	Total	Density	Total	Density	Total
662	0.028	71	0.018	45	0.005	13	0.088	221
664	0.245	653	0.111	297	0.067	178	0.823	2198
666	0.050	380	0.022	166	0.022	166	0.132	1010
668	0.057	121	0.115	241	0.057	121	0.459	964
672	0.279	1327	0.228	1085	0.165	784	1.127	5367
674	0.277	936	0.000	0	0.000	0	0.554	1873
700	0.425	833	0.470	922	0.182	357	1.730	3390
704	1.131	2532	0.480	1074	0.343	767	3.221	7211
712	0.287	83	0.669	193	0.000	0	1.052	304
713	0.046	112	0.041	100	0.010	25	0.209	511
714	0.165	4012	0.137	3340	0.055	1325	0.607	14743
715	0.212	5037	0.097	2303	0.079	1873	0.763	18151
717	0.036	341	0.037	356	0.016	155	0.145	1379
Avg/Total	**0.249**	**16438**	**0.187**	**10124**	**0.077**	**5764**	**0.839**	**57321**

*Preliminary analyses for wetlands 1-300ha. Minimal estimate without statistical confidence.

Waterfowl breeding density (including Canada Geese) and estimated total numbers within the SRD derived from pair transect surveys are outlined in Table 4. The estimated breeding waterfowl density is 0.02 pairs/ha with an estimated breeding waterfowl population of just under 20,000 birds. Diving ducks represent approximately 47% of breeding waterfowl followed closely by dabblers (47%) and Canada Geese (6%). Mallard, canvasback, bufflehead and common goldeneye were the most common breeding waterfowl in the SRD. Breeding densities were generally higher in the west delta compared to the east delta. Breeding pair information for waterfowl documented in the SRD is provided in Appendix 5.

Table 4. Breeding pair density and breeding population estimate of waterfowl for the Saskatchewan River Delta (SRD), spring 2003.*

Ecodistrict	All Waterfowl		Diver		Dabbler		Canada Geese	
	Density	Total	Density	Total	Density	Total	Density	Total
SRD East**	0.013	4078	0.006	1809	0.006	1901	0.001	369
SRD West	0.026	15825	0.012	7530	0.012	7530	0.001	747
Avg/Total* **	**0.019**	**19904**	**0.009**	**9338**	**0.009**	**9430**	**0.001**	**1116**

*Preliminary analyses without statistical confidence. Densities are for the total area (i.e. includes land).
** SRD East approximates the ecodistrict boundary.
***Average density/ha for the ecodistrict; total population estimate for the ecodistrict.

Information on spring non-breeding waterfowl for individual wetland basins are outlined in Table 5. Non-breeding waterfowl refers here to certain waterfowl social status groups. These include groups of males of 5 or more birds, lone females, male/female ratios other than pairs, and no-sex-observable birds. Overall, ecodistrict 704 (Boreal Transition) had the highest densities of non-breeding waterfowl. Ring-necked ducks were the most common non-breeding duck observed and densities across ecodistricts ranged from 0 to 1.8 birds/hectare of water surveyed. Canada geese and unidentified divers were the next most common non-breeding waterfowl. Of interest, ring-necked ducks are not listed in the top three breeding species observed yet they are the top non-breeding species documented indicating, perhaps, surveys were conducted too early to adequately estimate the density breeding ring-necked ducks (and perhaps other late nesting species).

Table 5. Non-breeding waterfowl densities (birds/hectare) and estimated totals for two spring surveys in Pasquia, 2003.*

Ecodistrict	Ring-necked Duck		Canada Goose		Unidentified Divers		All Waterfowl	
	Density	Total	Density	Total	Density	Total	Density	Total
662	0.041	104	0.003	6	0.003	6	0.106	266
664	0.222	594	0.044	119	0.067	178	0.934	2494
666	0.093	713	0.020	155	0.003	24	0.152	1165
668	1.836	3856	0.000	0	0.000	0	1.836	3856
672	1.836	8744	0.139	663	0.000	0	2.229	10614
674	0.031	104	0.185	624	0.000	0	0.523	1769
700	0.000	0	0.228	446	0.076	149	0.880	1725
704	0.000	0	0.754	1688	0.069	153	2.673	5984
712	0.000	0	0.000	0	0.000	0	0.000	0
713	0.076	187	0.020	50	0.015	37	0.214	524
714	0.036	883	0.066	1593	0.044	1075	0.403	9790
715	0.121	2887	0.097	2303	0.067	1597	0.410	9766
717	0.124	1177	0.007	62	0.015	139	0.180	1719
Avg/Total	**0.340**	**19250**	**0.120**	**7710**	**0.028**	**3359**	**0.811**	**49673**

*Preliminary analyses for wetlands 1-300ha. Minimal estimate without statistical confidence.

Density and total estimated numbers of spring staging / non-breeding waterbirds within the SRD is outlined in Table 6. For the most part, the estimated number of non-waterfowl waterbird is higher than the waterfowl numbers. Waterfowl accounted for only 40% and 48% of the total waterbirds in survey one and two, respectively. Total waterbird density decreased by almost half in both the east and west delta from survey one to two. The density of waterfowl decreased only marginally. Of particular interest was the significant number of staging tundra swan utilizing the SRD during survey one followed by no observations during survey two indicating a relatively early migration of this species. A listing of the top three non-waterfowl species observed during the spring surveys is located in Appendix 6.

Table 6. Spring non-breeding waterfowl and non-waterfowl waterbird densities (birds/hectare) and estimated totals for two surveys on the Saskatchewan River Delta, 2003.*

Lake		May 9-12		May 29-June 1	
		Density	Total	Density	Total
SRD East	Waterfowl	0.045	13638	0.031	9393
	Non-Waterfowl	0.088	26870	0.033	10132
	Total Waterbirds	**0.133**	**40508**	**0.064**	**19525**
SRD West	Waterfowl	0.057	35080	0.050	31210
	Non-Waterfowl	0.063	38855	0.020	12607
	Total Waterbirds	**0.119**	**73935**	**0.071**	**43817**
SRD Total			**114443**		**63342**

*Preliminary analyses without statistical confidence.

Results of spring staging on selected large wetlands/lakes are provided in Table 7. For most part waterfowl densities were higher than non-waterfowl waterbirds. Plummer's Marsh was the exception where waterfowl numbers easily outnumbered non-waterfowl. Specific to Reddeer and Pelican Lake, non-waterfowl numbers increased dramatically from the first to the second survey while waterfowl numbers remained largely unchanged. Double-crested cormorants, western grebes and gulls accounted for most of the waterbirds recorded on Reddeer Lake while on gulls and American White Pelican accounted for most of the waterbirds recorded on Pelican Lake. Appendix 7 lists the top waterfowl and non-waterfowl waterbirds observed in Swan, Reddeer and Pelican Lakes.

Table 7. Spring waterbird densities (birds/hectare) and total estimates for two surveys on selected large wetlands and lakes in Pasquia, 2003.*

Lake		May 9-12		May 29-June 1	
		Density	Total	Density	Total
Plummer's Marsh	Waterfowl	0.067	279	0.108	446
	Non-Waterfowl	0.010	40	0.023	96
	Total Waterbirds	**0.077**	**319**	**0.131**	**542**
Reddeer Lake	Waterfowl	0.037	971	0.038	995
	Non-Waterfowl	0.046	1186	0.210	5453
	Total Waterbirds	**0.083**	**2157**	**0.248**	**6447**
Swan Lake	Waterfowl	0.043	1323	0.054	1648
	Non-Waterfowl	0.110	3372	0.047	1431
	Total Waterbirds	**0.153**	**4695**	**0.100**	**3079**
Pelican Lake	Waterfowl	0.012	195	0.023	366
	Non-Waterfowl	0.056	882	0.534	8394
	Total Waterbirds	**0.068**	**284**	**0.557**	**8760**

*Preliminary analyses without statistical confidence.

Brood/Moulting Surveys -- Table 8 outlines the estimated number of waterfowl broods and density/ha for wetland basins 1-300ha. Densities ranged from 0.046 – 2.741 broods/ha with ecodistrict 704 (Boreal Transition) having the highest densities followed by ecodistricts 700 and 672. Ringed-neck duck (259 broods), Mallard (227) and Bufflehead (181) were the most common duck broods sighted. Together, these three species accounted for 60% of all duck broods observed. Other waterbirds of note included Canada geese (89 broods), red-necked grebes (58) and common loons (52).

Table 8. Waterfowl brood densities (brood/ha) and estimated total broods for two surveys in Pasquia, 2003.*

EcoDistrict	Mallard		Ringed-neck		Bufflehead		All Ducks	
	Density	Total	Density	Total	Density	Total	Density	Total
662	0.018	45	0.013	32	0.000	0	0.046	117
664	0.044	119	0.044	119	0.022	59	0.156	416
666	0.012	95	0.011	83	0.012	95	0.064	487
668	0.057	121	0.172	362	0.000	0	0.230	482
672	0.253	1206	0.038	181	0.063	302	0.659	3136
674	0.123	416	0.000	0	0.123	416	0.431	1457
700	0.197	387	0.076	149	0.182	357	0.759	1487
704	0.685	1534	0.343	767	0.240	537	2.741	6137
712	0.191	55	0.096	28	0.383	111	0.861	249
713	0.010	25	0.031	75	0.000	0	0.066	162
714	0.081	1977	0.141	3417	0.078	1900	0.492	11959
715	0.039	921	0.035	829	0.052	1228	0.212	5037
717	0.024	232	0.020	186	0.002	15	0.073	697
Avg/Total	**0.134**	**7134**	**0.078**	**6227**	**0.089**	**5021**	**0.522**	**31823**

*Preliminary analyses for wetlands 1-300ha. Minimal estimate without statistical confidence.

Post breeding / moulting survey data for the SRD are summarized in Table 9. Waterfowl were more abundant than non-waterfowl waterbirds and densities nearly doubled from the first survey (0.171 waterbirds/ha) to the second survey (0.294 waterbirds/ha), which suggests that birds move into the SRD for their annual post-breeding moult. The east delta, although smaller in total area, had a total higher density than the west delta.

Table 9. Waterbird densities (waterbird/ha) and estimated totals for two moulting surveys in the Saskatchewan River Delta, 2003.*

Ecodistrict		July 2-8		July 22-25	
		Density	Total	Density	Total
SRD East	Waterfowl	0.134	40803	0.318	96738
	Non-Waterfowl	0.044	13453	0.031	9320
	Total Waterbirds	**0.178**	**54256**	**0.349**	**106058**
SRD West	Waterfowl	0.145	89761	0.239	148254
	Non-Waterfowl	0.022	13641	0.027	16496
	Total Waterbirds	**0.167**	**103402**	**0.266**	**164750**
SRD Total		**0.171**	**157658**	**0.294**	**270808**

*Preliminary analyses without statistical confidence.

Fall Staging Surveys -- The results of fall staging surveys for individual wetland basins have been summarized by Ecoregion and are outlined in Table 10. Specific to waterfowl the highest densities were documented in the Mid-Boreal Upland Ecoregion (Duck and Porcupine Mountains), with a peak estimate of 95,000 waterfowl in early October. Non-waterfowl waterbird densities were generally low although densities in the Mid-Boreal Uplands were considerable followed by the Mid-Boreal Lowlands. Based on this preliminary data, the peak fall migration in 2003 was early October in the Mid-Boreal Upland and the Mid-Boreal Lowland Ecoregions. Within the Boreal Transition Ecoregion, highest numbers of waterfowl were documented in late August. Waterfowl numbers peaked in mid-September in the Interlake Plains, having three times the numbers estimated for the other two surveys. Information for individual ecodistricts is included in Appendix 8.

Table 10. Fall staging waterbird densities (waterbirds/ha) and estimated totals for three wetland basin surveys in four Ecoregions in Pasquia, 2003.*

Ecoregion		August 26-30		September 16-21		Sept 29-Oct 03	
		Density	Total	Density	Total	Density	Total
MBL	Waterfowl	0.137	8015	0.407	23849	0.688	40277
	Non-waterfowl	0.060	3523	0.043	2516	0.028	1632
	Total	**0.197**	**11538**	**0.450**	**26365**	**0.715**	**41908**
BT	Waterfowl	0.436	1831	0.251	1056	0.433	1817
	Non-waterfowl	0.019	80	0.010	40	0.006	27
	Total	**0.455**	**1911**	**0.261**	**1096**	**0.439**	**1844**
MBU	Waterfowl	1.022	67401	0.643	42362	0.974	64233
	Non-waterfowl	0.183	12098	0.531	35041	0.480	31642
	Total	**1.206**	**79499**	**1.174**	**77404**	**1.454**	**95875**
IP	Waterfowl	0.249	2451	0.873	8597	0.255	2511
	Non-waterfowl	0.014	142	0.017	165	0.008	82
	Total	**0.263**	**2593**	**0.889**	**8762**	**0.263**	**2593**

MBL = Mid Boreal Lowlands; BT = Boreal Transition; MBU = Mid-Boreal Uplands; IP = Interlake Plain
*Preliminary analyses for wetlands 1-3000ha. Minimal estimate without statistical confidence.

The results of the fall staging surveys conducted in the SRD are provided in Table 11 and depicted in Figures 4 and 5. Peak numbers were documented in mid September when over 650,000 waterbirds were estimated to be utilizing the delta. Waterfowl accounted for over 85% of all waterbirds documented. With the exception of late August

waterfowl densities were greatest in the west delta. Non-waterfowl densities were highest in the west delta with the exception of the end of September when the east delta had higher densities.

Table 11. Fall staging waterbird estimated totals and densities (ha) for the Saskatchewan River Delta, 2003.*

Ecodistrict		August 26-30		Sept 16-21		Sept 29-Oct 3	
		Density	Total	Density	Total	Density	Total
SRD East**	Waterfowl	0.687	209145	0.533	162178	0.462	140568
	Non-Waterfowl	0.080	24452	0.077	23474	0.113	34418
	Total Waterbirds		**233597**		**185652**		**174986**
SRD West	Waterfowl	0.471	292101	0.581	360480	0.655	406040
	Non-Waterfowl	0.093	57976	0.169	105050	0.064	39794
	Total Waterbirds		**350076**		**465529**		**445834**
SRD Total			**583673**		**651182**		**620819**

*Preliminary analyses without statistical confidence.
** SRD East approximates the ecodistrict boundary.

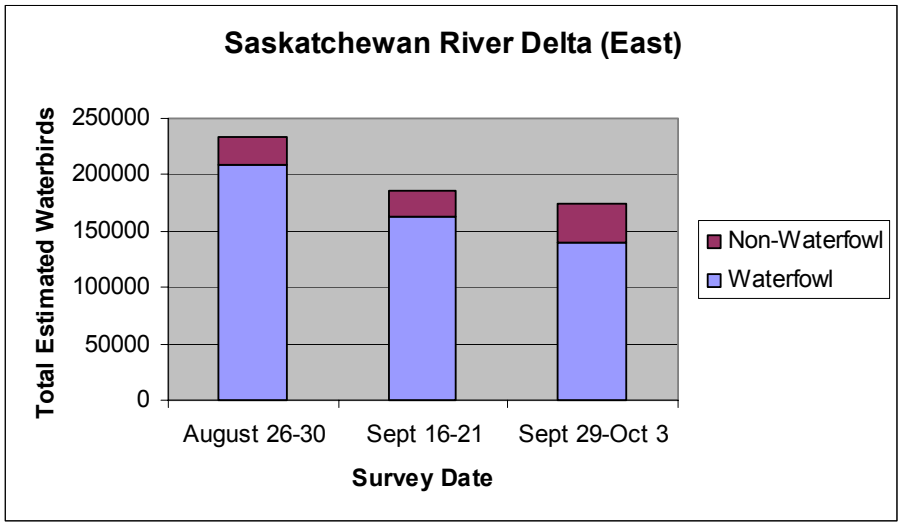

Figure 4. Estimated number of fall staging waterbirds for three surveys in the east Saskatchewan River Delta 2003.

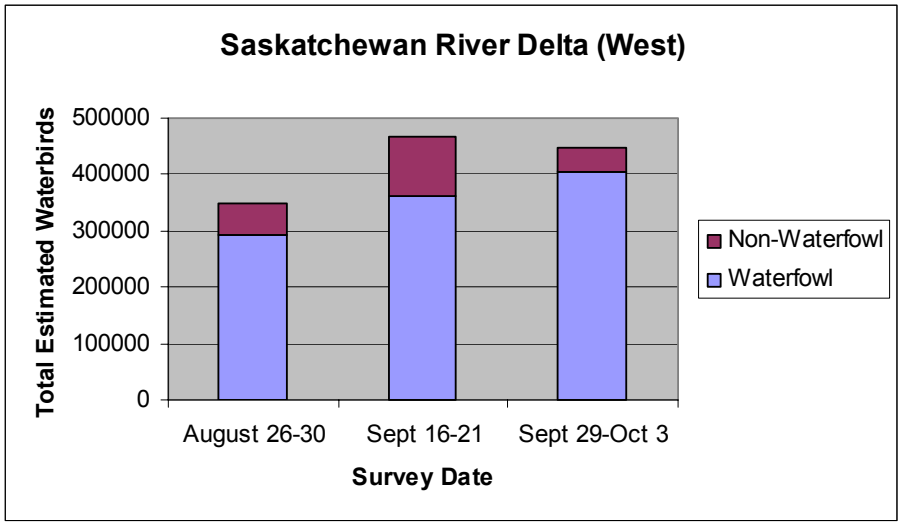

Figure 5. Estimated number of fall staging waterbirds for three surveys in the west Saskatchewan River Delta 2003.

Fall staging numbers for Pelican Lake, Reddeer and Swan Lake are presented in Figures 6 - 8. Waterfowl represented the majority of waterbirds utilizing all three lakes. Non-waterfowl waterbirds were in greatest abundance during the first surveys on Pelican and Swan Lake. Reddeer Lake held more non-waterfowl waterbirds on the last survey. Of note during the last survey on Pelican Lake, Redhead ducks accounted for 78% of waterfowl observations. These were primarily all in one staging group. The second survey was not undertaken on these large lakes due to inclement weather.

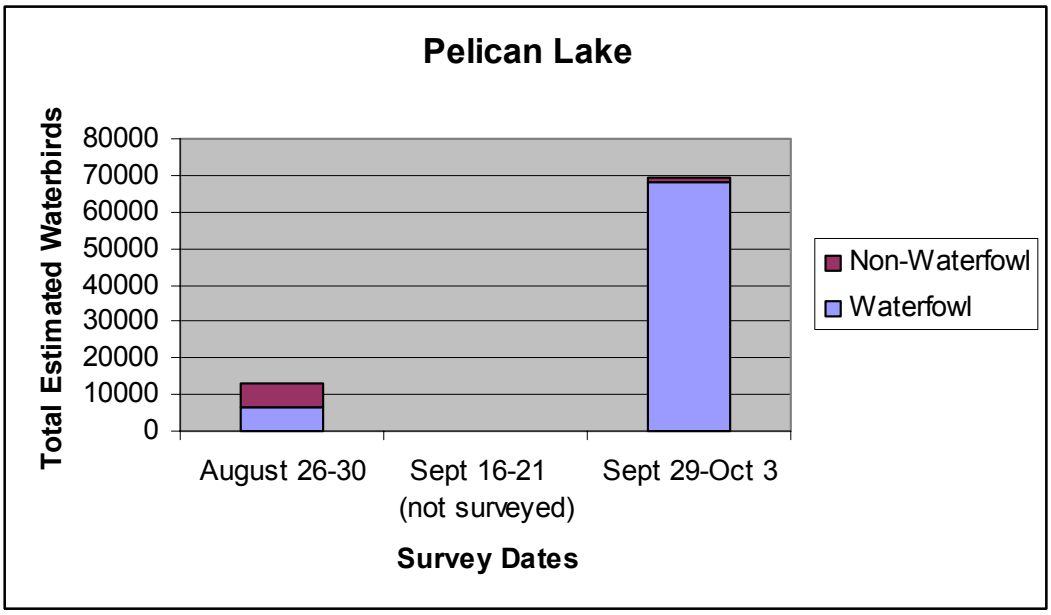

Figure 6. Estimated number of fall staging waterbirds for three surveys in Pelican Lake, 2003.
*Preliminary analyses without statistical confidence.

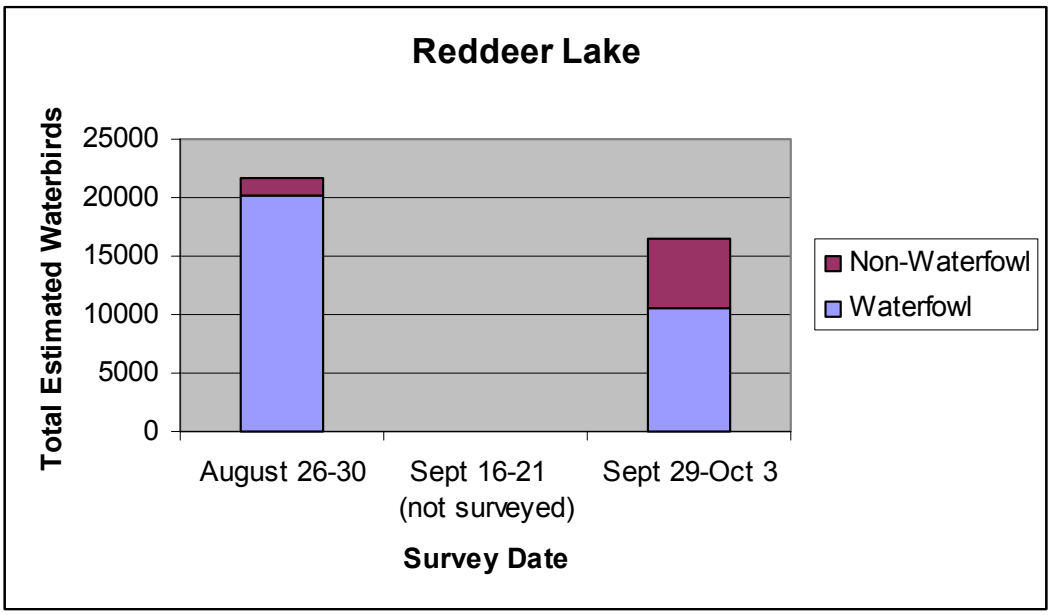

Figure 7. Estimated number of fall staging waterbirds for three surveys in Reddeer Lake, 2003.
*Preliminary analyses without statistical confidence.

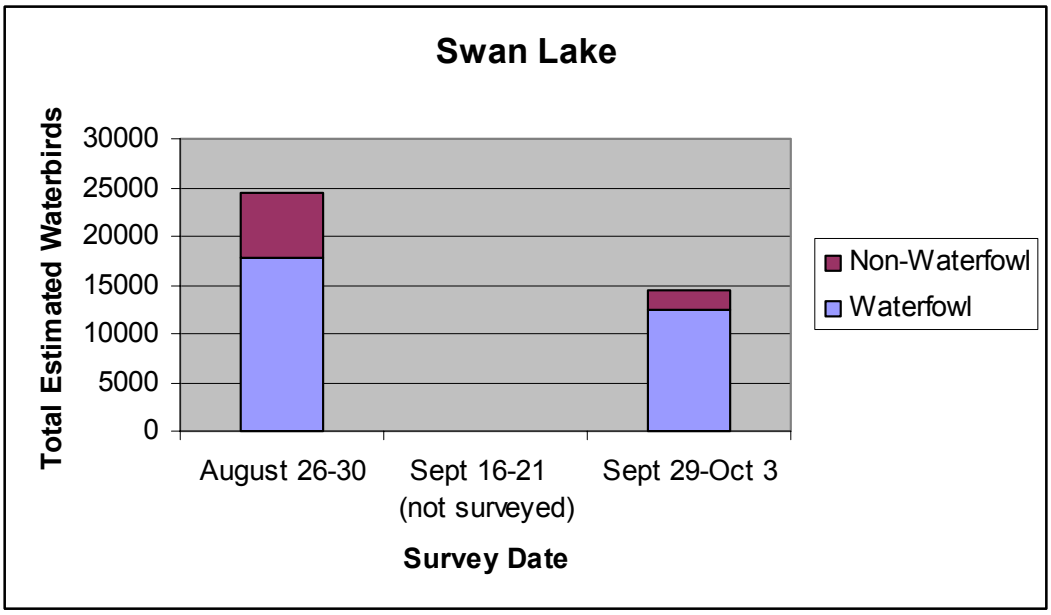

Figure 8. Estimated number of fall staging waterbirds for three surveys in Swan Lake, 2003.
*Preliminary analyses without statistical confidence.

Waterbird Survey Discussion

In 2003, for individual wetland basins, spring waterfowl densities ranged from 0.088 to 3.221 pairs/ha (9 pairs/km^2 to 322 pairs/km^2). The highest densities were documented in the Boreal Transition Ecoregion of Saskatchewan followed by the Mid-boreal Lowlands, Mid-boreal Uplands (Duck Mountains and Porcupine Hills) and Interlake Plain. However, the Mid-boreal Uplands generally had the most observed waterfowl due to the greater amount wetlands present. Dabbling duck densities were greater than diving ducks with mallard, bufflehead and blue-winged teal being the most common breeding waterfowl in the project area. This is similar to what was observed in 2002. Mallard was the most common and along with blue-winged teal made up about 66% of the top three species the last two years. Mallard pair density last year was 0.244 pairs/ha (24 pairs/km^2) compared to 2003 at 0.249 (25 pairs/km^2). The estimated pair total for the project last year was just over 50,000 ducks. The 2003 total was slightly higher at just over 57,000. Other notable breeding waterbirds include Canada geese, common loon and red-necked grebe which were documented in highest density in the Mid-boreal Uplands Ecoregion.

In the SRD, breeding duck densities were slightly higher in the west delta with diving ducks slightly outnumbering dabblers. Mallard, canvasback and bufflehead were the most common breeding waterfowl documented. Breeding waterfowl numbers were lower than in 2002. Significant numbers of non-breeding waterbirds were documented with over 100,000 birds estimated in the first of two spring surveys. Estimated numbers for non-breeding waterfowl in 2003 were about 30% of 2002 estimates. The biggest drop

was with dabbling ducks; dropping from just under 45,000 to just under 8,000 birds. Non-breeding waterfowl took similar drops during spring staging. In 2002, spring staging estimates placed over 200,000 waterbirds in the SRD in 2 separate surveys. In 2003, estimates of fewer than 115,000 waterbirds for the first survey and less than 65,000 in the second have been documented. It should be noted that in 2003 the 2 spring staging surveys were flown almost one month earlier, perhaps accounting for some variance. These spring numbers are seemingly confirmed by personal communications with local people as well as observations made by the authors.

The large and shallow Reddeer and Swan Lakes once again appear to be of significant value to spring staging non-waterfowl species. Although the non-waterfowl numbers are not large, it is believed these lakes are of more importance in their fall staging values. These basins continue to display their regional importance to western grebes and canvasbacks.

Waterfowl production surveys documented brood densities ranging from 0.046 broods/ha (5 broods/km^2) to 2.741 broods/ha (274 broods/km^2) depending on ecodistrict. The Boreal Transition Ecoregion had the highest density of broods, followed by the Mid-boreal Uplands, the Mid-boreal Lowlands. The Boreal Transition generally had the highest densities of other broods including Canada Geese, Red-necked Grebes and Common Loons. The Mid-boreal Uplands however had the most of the aforementioned broods documented, largely due to the greater number of wetlands present.

In the SRD, where moulting surveys were conducted overall waterbird numbers ranged from just less than 160,000 waterbirds in survey one to 270,000 waterbirds in survey two. Waterfowl made up the majority of this number with non-waterfowl waterbirds never amounting to more than 0.045 birds/ha (5 birds/km^2). On large lakes, waterfowl numbers were higher than non-waterfowl waterbirds with the exception of Swan Lake where it was very close to equal. An interesting trend showed waterfowl numbers slightly decrease from survey one to two whereas non-waterfowl waterbirds increased. Swan Lake had the highest waterbird total estimate with over 26,000 in the first survey in early July.

Fall staging surveys conducted on individual wetland basins documented the highest density of waterfowl in the Mid-boreal Uplands Ecoregion, perhaps a result of the farming activities that occur nearby. In 2002, the Boreal Transition Ecoregion had some of the highest densities. Both of these ecoregions are impacted by farming operations. The significance of the SRD for fall staging was well documented with peak use occurring in the middle of September with waterfowl representing 80% of the waterbirds documented. Estimated total numbers for the fall were greater than in 2002 with both the late August and late September surveys documenting over twice as many waterbirds using the SRD. In both 2002 and 2003, peak use was in mid September.

Due to inclement weather, the second fall survey was not conducted on the large lakes. From the two surveys conducted, waterbird numbers were higher in early fall on Reddeer Lake and Swan Lake. Conversely, Pelican Lake had a sharp increase in use from 13,000 to almost 70,000 waterbirds. Notable about the third survey on Pelican Lake is that all but about 700 waterbirds are waterfowl and that 78% of those waterfowl are redhead ducks.

Ancillary Data

The collection of information on additional species of interest including bald eagle and osprey (individual observations and nest sites), colonial nesting sites (great-blue heron, gull, double crested cormorant, American white pelican), big game animals continued in 2003. Similar to previous years, as such observations were made during the various surveys each point was logged in a GPS and the associated information recorded in a hand held tape recorder and later transcribed.

In early 2004 we commenced organizing and compiling over 1500 observation points logged during surveys conducted from 2001-2003. An initial spatial database in the form of GIS shapefiles has been developed and once finalized will be distributed to the project partners for future conservation planning and management purposes. This will include distribution to the Conservation Data Center for Manitoba and Saskatchewan.

Earthcover Inventory Change Detection

Following the completion and delivery of the earthcover inventory product in 2003, work proceeded with the earthcover change detection. Analysis was performed using the 1999 imagery used for the earth cover classification and additional imagery from 1985.

The purpose of the change detection is to identify and map major earth cover changes, including fires, forest harvest, regeneration following fire, regeneration following forest harvest, wetland vegetation cover, wetland condition, and anthropogenic changes including urban development, roads, and power lines.

The results of this work determined that most of the Pasquia Project area remained unchanged from 1985-1999 with less than 10% of the area influenced by detectable earth cover change. The greatest earth cover change documented within the Pasquia Project was the change in wetland condition as a result of the drier conditions of the late 1990's compared to the mid 1980's. This resulted in a change in wetland coverage in some regions of the project area as a result of the establishment of vegetation communities including emergent and submergent vegetation as a result of low water conditions.

Timber harvest was the second largest change detected between 1985 and 1999 and represents the greatest anthropogenic influence on the terrestrial cover types. Other land use activities including road development and the conversion of forestland to agriculture represent a minor change in comparison.

Fire represents the greatest natural disturbance to the terrestrial cover types between 1985 and 1999 and regeneration following fire (pre-1985 fires) is significant resulting in the return of forest cover to these disturbed areas. Regeneration following timber harvest is also notable.

An overview of the detected earthcover change between 1985 and 1999 is outlined in Figure 9. and an image of the Pasquia Project depicting this change is provided in Figure 10. The final change detection report will be delivered to the project partners in mid 2004.

Traditional Ecological Knowledge/Traditional Land Use

As noted in the 2002 Annual Report, undertaking a Traditional Ecological Knowledge/Traditional Land Use (TEK/TLU) project has proven to be challenging. In recognition of the unique nature of this important work DUC acquired the services of a full time Traditional Land-Use Coordinator working out of the Western Boreal Office in Edmonton.

In the fall of 2003 meetings were held with representatives of several agencies including Manitoba Conservation, Swampy Cree Tribal Council, University of Manitoba, University of Winnipeg and the Manitoba Model Forest. The purpose of these meetings were to introduce these agencies to the Pasquia Project and our TEK/TLU Coordinator, outline our interest in working with aboriginal communities and identify key contacts for a potential TEK/TLU related project.

Based on these meetings it was determined that the best opportunity for such a project was to work with the Swampy Cree Tribal Council (SCTC) who expressed an interest at the time in discussing such a project further. In addition, the Manitoba Model Forest indicated an interest in working on a project with DU and SCTC. These meetings resulted in meaningful dialogue, however, did not result in any follow-up activities within the Pasquia Project.

Although a TEK/TLU project has not been undertaken to date we remain interested in pursuing such a project should the SCTC or individual First Nation decide to become involved.

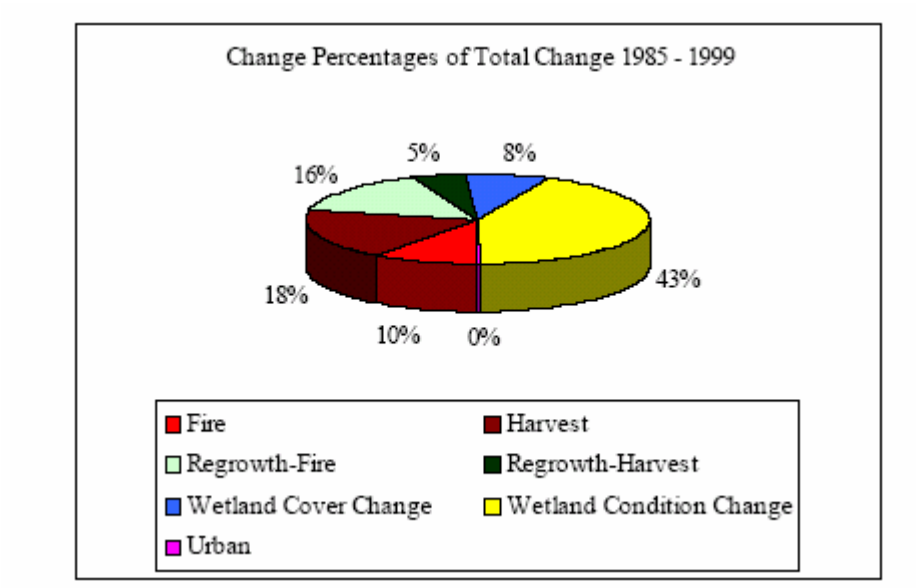

Figure 9. Percentage of total change of each change class.

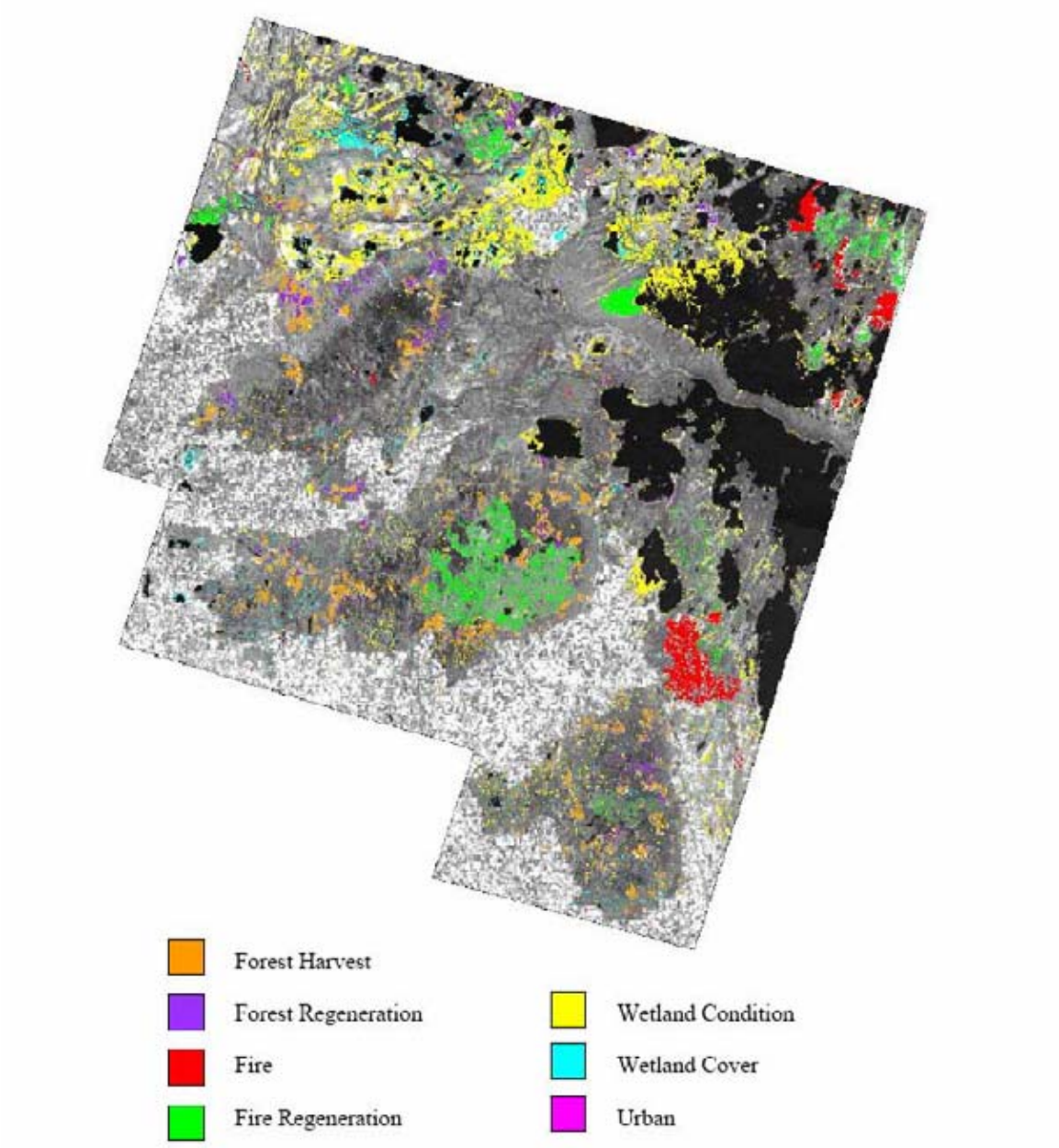

Figure 10. Pasquia Project change detection results by class.

Water Chemistry

During the summer of 2003 surface water was collected on 200 wetland basins and analysis undertaken to measure selected water chemistry parameters. The purpose of this work is to establish a base understanding of relative wetland productivity and to determine a regional water chemistry profile for the project area. A total of 150 basins were sampled from the Pasquia and Porcupine Hills, the Duck Mountains and surrounding areas and 50 basins within the Saskatchewan River Delta (Figure 11).

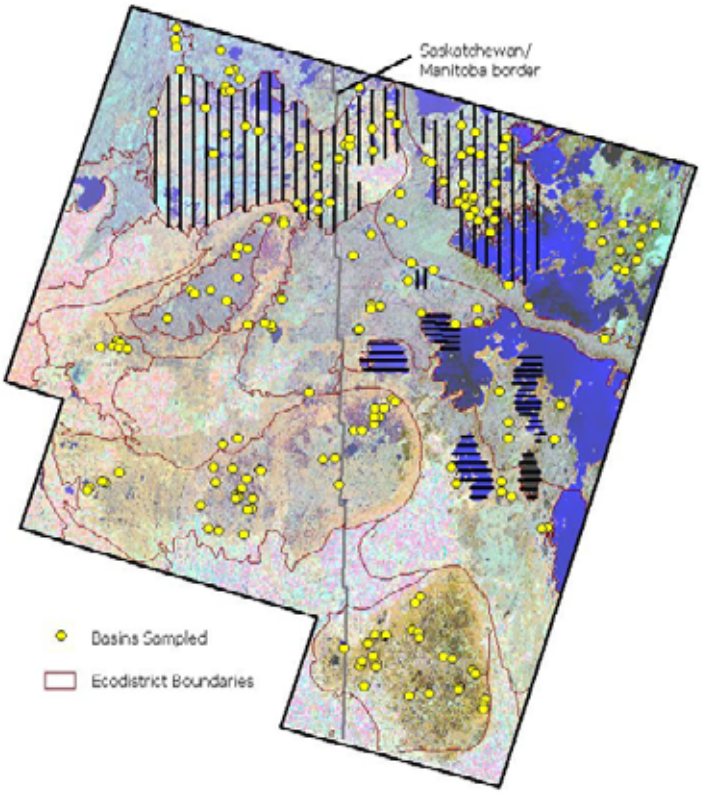

Figure 11. Basins sampled for water chemistry in the Pasquia Project.

Analysis has included a characterization of pH, conductivity, salinity, nutrients and dominant ion composition. This analysis will assist in defining linkages between uplands and wetlands; groundwater to wetland linkages; wetland productivity and waterbird use, and, the range of variability of wetland productivity within the project area.

Collection and analysis of samples for isotopes will assist in determining the relative importance of ground water versus surface water inputs to wetland systems. This in turn will allow development of hypotheses on the effects of various land-use practices on wetland water quality and productivity. Collectively, interpretation of these data will provide an indication in determining how surficial or landscape features (hydrology, relief, till deposits) are linked with regional geology, and how this may affect wetland productivity.

The water sampling and analysis is being conducted by Wayne Bell, graduate student from the University of Alberta, and the following is a synopsis of his progress report. To date test results have been received for some of chemical parameters including chlorophyll a (chl.a), total phosphorus (TP), and total nitrogen (TN) which are general measures of primary productivity. Total dissolved phosphorus (TDP), soluble reactive phosphorus (SRP), total dissolved nitrogen (TDN), dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), and sulfate (SO4), chloride (Cl) are measures of dissolved nutrients. Calcium (Ca), Magnesium (Mg), sodium (Na), and potassium (K), silica, pH, alkalinity, turbidity, and isotopes are all measures of weathering products. One

hundred ponds will be selected for isotope samples and an effort will be made to select basins that represent all possible kinds of flowpaths within the area.

Conductivity is a measure of total dissolved solids within the wetland; therefore it can be used a good indicator of groundwater influence. The conductivities from the Pasquia Project ranged from approximately 97-34900 us/cm; fresher water on the lower end to very saline. General acidity of the wetlands was measured with pH. The general pH of the Pasquia project was generally very basic ranging from 6.96 to 10.08.

Work is ongoing on the analysis of water chemistry data and a final report will be distributed in the fall of 2004.

Communication

Communication remains an important component of the Western Boreal Program. In September 2003 DU launched its National vision for Canada's Boreal Forest at the World Forestry Congress in Quebec City. This vision document outlines DU's commitment to boreal conservation and profiles a number of projects, including Pasquia. The Pasquia Project was also profiled at the Society of Canadian Ornithologists Conference in Saskatoon in October when a poster on breeding trumpeter swans was presented. In late fall 2003 the various progress and annual reports were posted on the Western Boreal Website to broaden the exposure of project activities. All of these can be viewed at http://www.borealforest.ca.

In early winter a presentation on the progress of the project was presented in Prince Albert Saskatchewan to project partners and other agencies interested in boreal conservation. Communication about the Pasquia Project and the partnership continued within the DU organization with several updates provided throughout the fiscal year including staff not working on the boreal program.

In April 2004, we were invited to make a presentation on DU's interest and program in the boreal forest at a wildlife conference in Prince Albert Saskatchewan sponsored by the Integrated Resource Management students at the Saskatchewan Institute of Applied Science and Technology. The presentation focused primarily on the Pasquia Project

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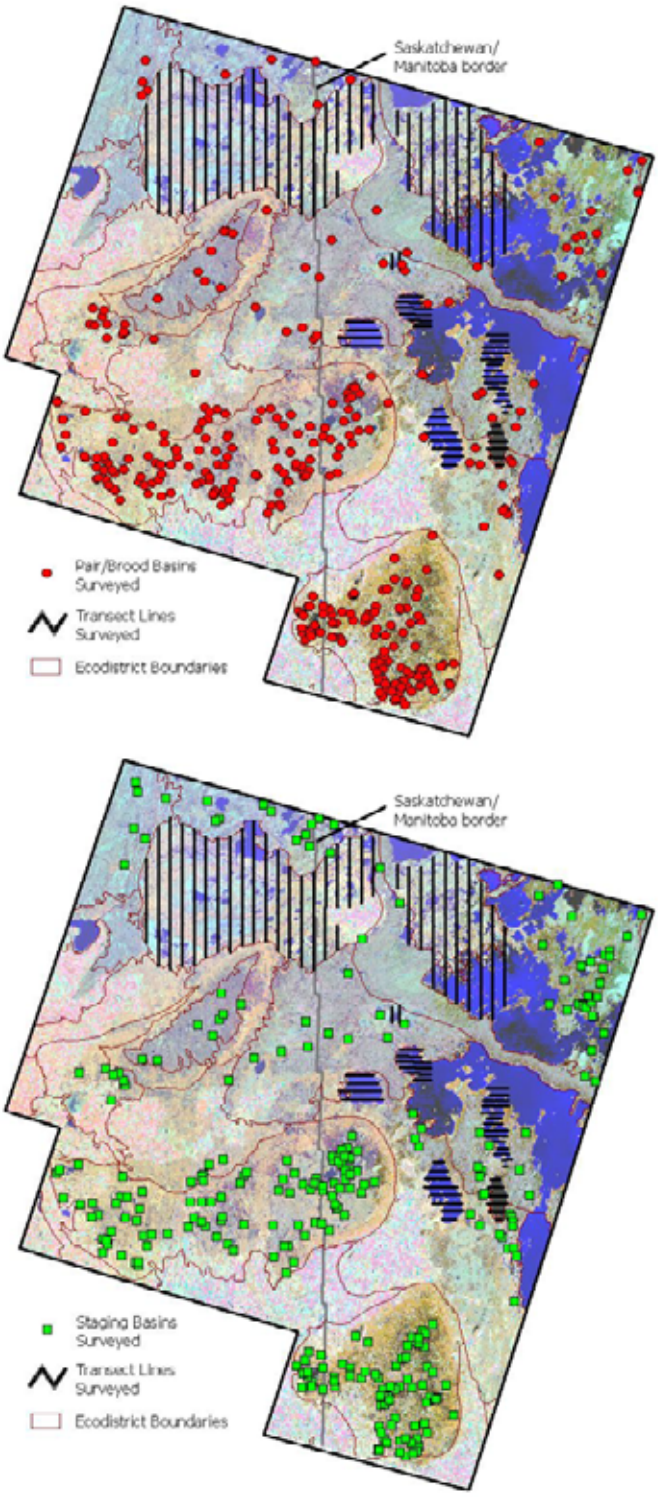
APPENDICES

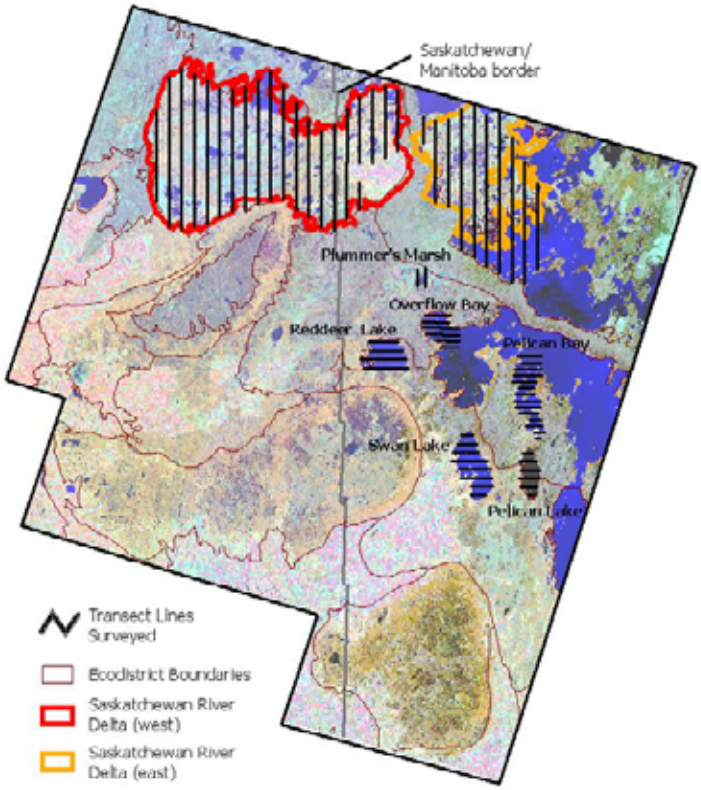
Appendix 1:

Wetland basins selected for spring and fall surveys in 2003.



Appendix 2:

Wetland complexes (SRD) and lakes selected for line transect surveys, 2003.



Appendix 3:

List of species and scientific name for waterfowl encountered in the Pasquia Project, 2003.

Common Name	Species Name
American Green-winged Teal	*Anas crecca*
American Wigeon	*Anas americana*
Blue-winged Teal	*Anas discors*
Bufflehead	*Bucephala albeola*
Canvasback	*Aythya valisineria*
Common Goldeneye	*Bucephala clangula*
Common Merganser	*Mergus merganser*
Gadwall	*Anas strepera*
Hooded Merganser	*Lophodytes cucullatus*
Lesser Scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Anas clypeata*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Ruddy Duck	*Oxyura jamaicensis*
White-winged Scoter	*Melanitta fusca*
Wood Duck	*Aix sponsa*
Goldeneye or Bufflehead	*n/a*
Scaup or Ring-necked Duck	*n/a*
Unidentified Dabbler	*n/a*
Unidentified Diver	*n/a*
Unidentified Teal	*n/a*
American Coot	*Fulica americana*
American White Pelican	*Pelecanus erythrorhynchos*
Canada Goose	*Branta canadensis*
Common Loon	*Gavia immer*
Double Crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Red-necked Grebe	*Podiceps grisegena*
Sandhill Crane	*Grus canadensis*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Western Grebe	*Archmophorus occidentalis*

Appendix 4:

Indicated breeding pair values for waterfowl surveyed on wetland basins in the Pasquia Project, 2003.

Species	Survey Interval	IBP	IBP/ha
Mallard	1	554	0.133
Bufflehead	1	378	0.091
Blue-winged Teal	2	197	0.047
Ring-necked Duck	2	189	0.045
Common Goldeneye	1	156	0.037
American Wigeon	avg	78	0.019
American Green-winged Teal	avg	74	0.018
Canada Goose		115	0.028
Unidentified Scaup	2	103	0.025
Northern Shoveler	avg	22	0.005
Gadwall	2	30	0.007
Common Merganser	1	25	0.006
Canvasback	1	23	0.006
Hooded Merganser	1	19	0.005
Redhead	1	10	0.002
Ruddy Duck	2	5	0.001
Wood Duck	1	1	0.000

Appendix 5:

Total number of indicated breeding waterfowl for the Saskatchewan River Delta, 2003.

SRD East			SRD West	
Species	**Total IBP**		**Species**	**Total IBP**
Mallard	36		Mallard	233
Canvasback	28		Bufflehead	115
Canada Goose	20		Canvasback	107
Ring-necked Duck	19		Common Goldeneye	76
Redhead	18		Northern Shoveler	48
Northern Pintail	17		Lesser Scaup	47
Blue-winged Teal	15		Canada Goose	39
Northern Shoveler	14		Blue-winged Teal	32
Bufflehead	13		Northern Pintail	31
Gadwall	13		American Wigeon	27
Lesser Scaup	11		Redhead	27
American Wigeon	8		Gadwall	19
Common Goldeneye	5		Ruddy Duck	10
Ruddy Duck	4		Ring-necked Duck	9
American Green-winged Teal	0		American Green-winged Teal	3
Common Merganser	0		Common Merganser	2
White-winged Scoter	0		White-winged Scoter	1

Appendix 6:

Top three non-waterfowl waterbirds documented in the Saskatchewan River Delta, spring 2003.

Rank	May 9-12		Rank	May 29-June 1	
	SRD West	SRD East		SRD West	SRD East
1	tundra swan	tundra swan	1	American coot	small shorebird
2	small shorebird	white-headed gull	2	unidentified gull	black tern
3	American coot	small shorebird	3	white-headed gull	white-headed gull

Appendix 7:

Top three waterfowl and non-waterfowl waterbirds documented on large lakes surveyed in the spring, Pasquia Project 2003.

May 9-12	Rank	Reddeer Lake	Swan Lake	Pelican Lake
Waterfowl	1	Ring-Necked Duck	Lesser Scaup	Unidentified Duck
	2	Lesser Scaup	Unidentified Duck	Common Goldeneye
	3	Unidentified Duck	Mallard	Canvasback
Non-Waterfowl	1	White Headed Gull	White Headed Gull	Double Crested Cormorant
	2	Western grebe	Western grebe	White Headed Gull
	3	Double Crested Cormorant	Double Crested Cormorant	Western Grebe
May 29-June 1				
Waterfowl	1	Unidentified Duck	Canvasback	Mallard
	2	Common Goldeneye	Common Goldeneye	Common Goldeneye
	3	Canvasback	Unidentified duck	Canada Goose
Non-Waterfowl	1	Double Crested Cormorant	Western Grebe	White Headed Gull
	2	Western Grebe	American White Pelican	American White Pelican
	3	White Headed Gull	White Headed Gull	Double Crested Cormorant

Appendix 8:

Fall staging waterbird densities/ha and estimated totals for wetland basins surveyed, Pasquia Project, 2003.*

Ecodistrict		August 26-30		September 16-21		Sept 29-Oct 03	
		Density	Total	Density	Total	Density	Total
662	Waterfowl	0.059	187	0.279	884	0.144	458
	Non-waterfowl	0.006	19	0.033	103	0.008	26
	Total	**0.065**	**207**	**0.311**	**988**	**0.153**	**484**
664	Waterfowl	0.286	1778	0.896	5573	1.231	7654
	Non-waterfowl	0.104	649	0.030	184	0.083	517
	Total	**0.390**	**2428**	**0.926**	**5758**	**1.314**	**8171**
666	Waterfowl	0.109	3396	0.280	8748	0.708	22117
	Non-waterfowl	0.059	1842	0.052	1613	0.016	514
	Total	**0.168**	**5239**	**0.332**	**10360**	**0.724**	**22630**
668	Waterfowl	0.015	75	1.088	5327	0.000	0
	Non-waterfowl	0.000	0	0.000	0	0.000	0
	Total	**0.015**	**75**	**1.088**	**5327**	**0.000**	**0**
672	Waterfowl	0.119	1049	0.424	3752	0.103	908
	Non-waterfowl	0.020	173	0.023	205	0.004	32
	Total	**0.138**	**1222**	**0.447**	**3957**	**0.106**	**941**
674	Waterfowl	0.026	107	0.019	79	0.019	79
	Non-waterfowl	0.025	103	0.043	182	0.001	4
	Total	**0.050**	**211**	**0.062**	**260**	**0.020**	**83**
700	Waterfowl	1.436	2815	0.827	1620	1.748	3426
	Non-waterfowl	0.054	106	0.000	0	0.000	0
	Total	**1.491**	**2921**	**0.827**	**1620**	**1.748**	**3426**
704	Waterfowl	0.129	289	0.075	168	0.029	65
	Non-waterfowl	0.008	19	0.012	28	0.008	19
	Total	**0.137**	**307**	**0.087**	**196**	**0.037**	**84**
713	Waterfowl	0.000	0	0.222	692	1.277	3983
	Non-waterfowl	0.031	95	0.038	119	0.006	18
	Total	**0.031**	**95**	**0.260**	**811**	**1.282**	**4001**
714	Waterfowl	0.794	26795	0.247	8329	0.713	24065
	Non-waterfowl	0.193	6514	0.103	3465	0.103	3482
	Total	**0.987**	**33309**	**0.349**	**11793**	**0.816**	**27546**
715	Waterfowl	1.481	42619	1.266	36434	1.312	37755
	Non-waterfowl	0.189	5444	1.212	34875	1.083	31164
	Total	**1.670**	**48063**	**2.478**	**71309**	**2.395**	**68919**
717	Waterfowl	0.249	2451	0.873	8597	0.255	2511
	Non-waterfowl	0.014	142	0.017	165	0.008	82
	Total	**0.263**	**2593**	**0.889**	**8762**	**0.263**	**2593**

*Preliminary analyses for wetlands 1-3000ha. Minimal estimate without statistical confidence.