

Table 1. Analysis of variance evaluating the effect of plot type, year, and plot type x year interaction on the number of Tundra Swan adults, pairs, nests, broods, and young present in reference and development plots in the Mackenzie Delta region, 2001-2003. Tests were carried out on both untransformed and log transformed data. Places where the results of the two tests differed are highlighted in bold and the results that better met the assumptions of the ANOVA are underlined.

Survey	Effect of plot type (df = 1, 46)				Effect of year (df = 2, 82)				Effect of plot type X year (df = 2, 82)			
	Untransformed		Transformed		Untransformed		Transformed		Untransformed		Transformed	
	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>
June												
Total adults	1.80	0.19	0.67	0.42	0.39	0.68	0.27	0.76	0.82	0.44	1.65	0.20
Indicated pairs	0.14	0.71	0.07	0.79	0.11	0.90	0.51	0.61	0.99	0.37	1.36	0.26
Nests	0.13	0.72	0.27	0.60	2.40	0.10	1.61	0.21	2.46	0.09	1.35	0.26
Adults in flocks	2.24	0.14	1.90	0.17	0.34	0.71	0.09	0.91	0.69	0.50	0.91	0.41
August												
Total adults	3.40	0.07	0.12	0.73	0.87	0.42	1.05	0.35	0.98	0.38	1.08	0.34
Indicated pairs	0.41	0.52	0.46	0.50	1.55	0.22	1.42	0.25	0.16	0.85	0.20	0.82
Broods	1.96	0.17	1.72	0.20	<u>2.84</u>	<u>0.06</u>	4.38	0.02	2.05	0.14	0.59	0.55
Total young	1.25	0.27	1.08	0.30	<u>2.37</u>	<u>0.10</u>	<u>3.56</u>	<u>0.03</u>	2.24	0.11	0.25	0.78
Adults in flocks ^a	5.01	0.03	0.75	0.39	0.55	0.58	0.21	0.81	1.04	0.36	0.45	0.64

^a The assumption of equality of variances was moderately violated for both untransformed and transformed data for this variable.

Table 2. Estimated numbers and densities of adult Tundra Swans in survey plots in the Mackenzie Delta, June 2001-2003.

Plot type	Year	Number of plots	Area surveyed (km ²)	Swans observed	Median swans per plot	Range	Mean swans per plot (swans ± SE)	Density (swans ± SE/km ²)	% Flocked non-breeders
Reference	2001	20	500	299	14	2-38	15.0 ± 1.9	0.60 ± 0.07	8.4
	2002	26	650	392	13	1-47	15.1 ± 2.3	0.60 ± 0.09	8.4
	2003	27	675	570	12	1-165	21.1 ± 6.2	0.84 ± 0.25	32.3
	2001-03				14	1-165	17.3 ± 2.5	0.69 ± 0.10	19.2
Development	2001	20	500	499	18	3-187	25.0 ± 8.8	1.00 ± 0.35	49.7
	2002	20	500	726	16	3-233	36.3 ± 13.3	1.45 ± 0.53	61.7
	2003	21	525	642	13	1-306	30.6 ± 14.1	1.22 ± 0.56	54.0
	2001-03				15	1-306	30.6 ± 7.0	1.22 ± 0.28	55.9
Total	2001	40	1000	798	15	2-187	20.0 ± 4.5	0.80 ± 0.18	34.2
	2002	46	1150	1118	14	1-233	24.3 ± 6.1	0.97 ± 0.24	43.0
	2003	48	1200	1212	13	1-306	25.3 ± 7.0	1.01 ± 0.28	43.8
	2001-03				14	1-306	23.3 ± 3.5	0.93 ± 0.14	41.1

Table 3. Numbers and densities of indicated pairs of Tundra Swans in survey plots in the Mackenzie Delta Region, June 2001-2003.

Plot type	Year	Number of plots	Indicated pairs observed	Area surveyed (km ²)	Median pairs per plot	Range	Mean pairs per plot (pairs ± SE)	Density (pairs ± SE /km ²)
Reference	2001	20	137	500	7	1-19	6.9 ± 0.86	0.27 ± 0.03
	2002	26	179.5	650	6	1-24	6.9 ± 1.06	0.28 ± 0.04
	2003	27	193	675	6	1-30	7.1 ± 1.19	0.29 ± 0.05
	2001-03				6	1-30	7.0 ± 0.62	0.28 ± 0.02
Development	2001	20	125.5	500	6	2-13	6.3 ± 0.72	0.25 ± 0.03
	2002	20	139	500	7	2-17	7.0 ± 0.99	0.28 ± 0.04
	2003	21	147.5	525	5	1-20	7.0 ± 1.13	0.28 ± 0.05
	2001-03				6	1-20	6.8 ± 0.55	0.27 ± 0.02
Total	2001	40	262.5	1000	7	1-19	6.6 ± 0.56	0.26 ± 0.02
	2002	46	318.5	1150	6	1-24	6.9 ± 0.73	0.28 ± 0.03
	2003	48	340.5	1200	6	1-30	7.1 ± 0.83	0.28 ± 0.03
	2001-03				6	1-30	6.9 ± 0.42	0.28 ± 0.02

Table 4. Numbers and densities of flocked adult Tundra Swans occurring in survey plots in the Mackenzie Delta Region, June 2001-2003.

Plot type	Year	Number of plots	Flocked adults observed	Area surveyed (km ²)	Median flocked adults per plot	Range	Mean flocked adults per plot (swans ± SE)	Density (swans ± SE /km ²)
Reference	2001	20	25	500	0	0-16	1.3 ± 0.81	0.05 ± 0.03
	2002	26	33	650	0	0-15	1.3 ± 0.67	0.05 ± 0.03
	2003	27	184	675	0	0-154	6.8 ± 5.69	0.27 ± 0.23
	2001-03				0	0-154	3.3 ± 2.13	0.13 ± 0.09
Development	2001	20	248	500	0	0-177	12.4 ± 8.82	0.50 ± 0.35
	2002	20	448	500	0	0-200	22.4 ± 12.66	0.90 ± 0.51
	2003	21	347	525	0	0-294	16.5 ± 13.99	0.66 ± 0.56
	2001-03				0	0-294	17.1 ± 6.89	0.68 ± 0.28
Total	2001	40	273	1000	0	0-177	6.8 ± 4.46	0.27 ± 0.18
	2002	46	481	1150	0	0-200	10.5 ± 5.66	0.42 ± 0.23
	2003	48	531	1200	0	0-294	11.1 ± 6.86	0.44 ± 0.27
	2001-03				0	0-294	9.6 ± 3.38	0.38 ± 0.14

Table 5. Estimated numbers and densities of Tundra Swan nests in survey plots in the Mackenzie Delta Region, June 2001-2003.

Plot type	Year	Number of plots	Total nests	Median	Range	Mean nests per plot (nests \pm SE)	Nest density (nests \pm SE/km ²)
Reference	2001	20	43	2	0-10	2.2 \pm 0.53	0.09 \pm 0.02
	2002	26	72	2	0-15	2.8 \pm 0.61	0.11 \pm 0.02
	2003	27	68	2	0-11	2.5 \pm 0.48	0.10 \pm 0.02
	2001-03		183	2	0-15	2.5 \pm 0.31	0.10 \pm 0.01
Development	2001	20	43	2	0-9	2.2 \pm 0.46	0.09 \pm 0.02
	2002	20	54	2	0-10	2.7 \pm 0.57	0.11 \pm 0.02
	2003	21	76	3	0-11	3.6 \pm 0.73	0.14 \pm 0.03
	2001-03		173	2	0-11	2.8 \pm 0.35	0.11 \pm 0.01
Total	2001	40	86	2	0-10	2.2 \pm 0.35	0.09 \pm 0.01
	2002	46	126	2	0-15	2.7 \pm 0.42	0.11 \pm 0.02
	2003	48	144	2	0-11	3.0 \pm 0.42	0.12 \pm 0.02
	2001-03		356	2	0-15	2.7 \pm 0.23	0.11 \pm 0.01

Table 6. Estimated numbers and densities of adult Tundra Swans in survey plots in the Mackenzie Delta Region, August 2001-2003.

Plot Type	Year	Number of Plots	Swans Observed	Area (km ²)	Median swans per plot	Range	Mean swans per plot (± SE)	Density (swans ± SE / km ²)	% Flocked Non-Breeders
Reference	2001	20	254	500	11	1-52	12.7 ± 2.5	0.51 ± 0.10	35.4
	2002	26	356	650	13	0-51	13.7 ± 2.3	0.55 ± 0.09	26.7
	2003	27	349	675	11	0-58	12.9 ± 2.4	0.52 ± 0.10	30.4
	2001-03				12	0-58	13.1 ± 1.4	0.53 ± 0.05	30.3
Development	2001	20	475	500	8	0-156	23.8 ± 8.8	0.95 ± 0.35	63.8
	2002	20	680	500	7	0-183	34.0 ± 12.5	1.36 ± 0.50	74.1
	2003	21	610	525	8	2-196	29.0 ± 11.4	1.16 ± 0.46	72.8
	2001-03				8	0-196	28.9 ± 6.3	1.16 ± 0.25	70.9
Total	2001	40	729	1000	9	0-156	18.2 ± 4.6	0.73 ± 0.18	53.9
	2002	46	1036	1150	12	0-183	22.5 ± 5.7	0.90 ± 0.23	57.8
	2003	48	959	1200	10	0-196	20.0 ± 5.2	0.80 ± 0.21	57.4
	2001-03				10	0-196	20.3 ± 3.0	0.81 ± 0.12	56.6

Table 7. Numbers and densities of indicated pairs of Tundra Swan in survey plots in the Mackenzie Delta region, August 2001-2003.

Plot type	Year	Number of plots	Indicated pairs observed	Area (km ²)	Median pairs per plot	Range	Mean pairs per plot (pairs ± SE)	Density (pairs ± SE / km ²)
Reference	2001	20	82	500	4	1-12	4.1 ± 0.64	0.16 ± 0.03
	2002	26	130.5	650	5	0-15	5.0 ± 0.74	0.20 ± 0.03
	2003	27	121.5	675	5	0-11	4.5 ± 0.63	0.18 ± 0.03
	2001-03		334	1825	5	0-15	4.6 ± 0.39	0.18 ± 0.02
Development	2001	20	86	500	4	0-12	4.3 ± 0.73	0.17 ± 0.03
	2002	20	88	500	3	0-12	4.4 ± 0.82	0.18 ± 0.03
	2003	21	83	525	4	0-13	4.0 ± 0.69	0.16 ± 0.03
	2001-03		257	1525	4	0-13	4.2 ± 0.43	0.17 ± 0.02
Total	2001	40	168	1000	4	0-12	4.2 ± 0.48	0.17 ± 0.02
	2002	46	218.5	1150	4	0-15	4.8 ± 0.55	0.19 ± 0.02
	2003	48	204.5	1200	4	0-13	4.3 ± 0.46	0.17 ± 0.02
	2001-03		591	3350	4	0-15	4.4 ± 0.29	0.18 ± 0.01

Table 8. Numbers and densities of flocked adult Tundra Swans occurring in survey plots in the Mackenzie Delta region, August 2001-2003.

Plot type	Year	Number of plots	Flocked adults observed	Area (km ²)	Median flocked adults per plot	Range	Mean flocked adults per plot (swans ± SE)	Density (swans ± SE / km ²)
Reference	2001	20	90	500	0	0-29	4.5 ± 1.73	0.18 ± 0.07
	2002	26	95	650	0	0-21	3.7 ± 1.03	0.15 ± 0.04
	2003	27	106	675	0	0-40	3.9 ± 1.62	0.16 ± 0.07
	2001-03				0	0-40	4.0 ± 0.84	0.16 ± 0.03
Development	2001	20	303	500	0	0-140	15.2 ± 8.04	0.61 ± 0.32
	2002	20	504	500	0	0-161	25.2 ± 11.63	1.01 ± 0.47
	2003	21	444	525	0	0-184	21.1 ± 10.57	0.85 ± 0.42
	2001-03				0	0-184	20.5 ± 5.82	0.82 ± 0.23
Total	2001	40	393	1000	0	0-140	9.8 ± 4.15	0.39 ± 0.17
	2002	46	599	1150	0	0-161	13.0 ± 5.26	0.52 ± 0.21
	2003	48	550	1200	0	0-184	11.5 ± 4.81	0.46 ± 0.19
	2001-03				0	0-184	11.5 ± 2.77	0.46 ± 0.11

Table 9. The number of adult and young Tundra Swans in reference and development survey plots in the Mackenzie Delta region, August, 2001-2003.

Plot type	Year	Number of plots	Young observed	Adults + young observed	Area (km ²)	% young	Median young per plot	Range	Mean young per plot (young ± SE)	Density (young ± SE / km ²)
Reference	2001	20	24	278	500	8.6	0	0-7	1.2 ± 0.50	0.05 ± 0.02
	2002	26	87	443	650	19.6	1	0-15	3.3 ± 0.95	0.13 ± 0.04
	2003	27	61	410	675	14.9	1	0-9	2.3 ± 0.50	0.09 ± 0.02
	2001-03					15.2	0	0-15	2.4 ± 0.42	0.09 ± 0.02
Development	2001	20	28	503	500	5.6	0	0-13	1.4 ± 0.75	0.06 ± 0.03
	2002	20	32	712	500	4.5	1	0-10	1.6 ± 0.55	0.06 ± 0.02
	2003	21	38	648	525	5.9	0	0-9	1.8 ± 0.60	0.07 ± 0.02
	2001-03					5.3	0	0-13	1.6 ± 0.36	0.06 ± 0.01
Total	2001	40	52	781	1000	6.7	0	0-13	1.3 ± 0.45	0.05 ± 0.02
	2002	46	119	1155	1150	10.3	1	0-15	2.6 ± 0.60	0.10 ± 0.02
	2003	48	99	1058	1200	9.4	1	0-9	2.1 ± 0.38	0.08 ± 0.02
	2001-03					9.0	0	0-15	2.0 ± 0.28	0.08 ± 0.01

Table 10. Estimated productivity of Tundra Swans in reference and development survey plots in the Mackenzie Delta region, 2001-2003.

Plot Type	Year	Number of Plots	Indicated Pairs in June	Pairs on Nests	Number of Broods	Density of Broods per plot	Mean Brood Size \pm SE	Proportion of indicated pairs nesting	Proportion of nesting pairs with broods	Proportion of indicated pairs with broods
Reference	2001	20	137	43	11	0.02 ± 0.01	2.2 ± 0.18 (n=11)	0.31	0.26	0.08
	2002	26	179.5	72	37	0.06 ± 0.02	2.4 ± 0.17 (n=37)	0.40	0.51	0.21
	2003	27	193	68	35	0.05 ± 0.01	1.7 ± 0.13 (n=35)	0.35	0.51	0.18
	2001-03					0.05 ± 0.01	2.1 ± 0.10 (n=83)	0.36	0.45	0.16
Development	2001	20	125.5	43	11	0.02 ± 0.01	2.5 ± 0.25 (n=11)	0.34	0.26	0.09
	2002	20	139	54	13	0.03 ± 0.01	2.5 ± 0.33 (n=13)	0.39	0.24	0.09
	2003	21	147.5	76	19	0.04 ± 0.01	2.0 ± 0.21 (n=21)	0.52	0.25	0.13
	2001-03					0.03 ± 0.01	2.3 ± 0.15 (n=45)	0.42	0.25	0.10
Total	2001	40	262.5	86	22	0.02 ± 0.01	2.4 ± 0.2 (n=22)	0.33	0.26	0.08
	2002	46	318.5	126	50	0.04 ± 0.01	2.4 ± 0.2 (n=50)	0.40	0.40	0.16
	2003	48	340.5	144	54	0.05 ± 0.01	1.9 ± 0.1 (n=56)	0.42	0.38	0.16
	2001-03					0.04 ± 0.00	2.1 ± 0.08 (n=128)	0.39	0.35	0.14

Table 11. Potential causes of variation in reproductive effort and success of Tundra Swans at reference and development plots in the Mackenzie Delta region, 2001-2003, evaluated through three-dimensional contingency tables.

Maximum Likelihood Analysis of Variance				
Demographic parameter	Source of variation	Degrees of freedom	χ^2	<i>P</i>
Nesting effort - proportion of indicated pairs nesting	Plot Type	1	3.17	0.08
	Year	2	6.64	0.04
	Plot type x year	2	5.30	0.07
Nest success - proportion of nesting pairs successful in producing a brood	Plot Type	1	10.52	0.001
	Year	2	3.66	0.16
	Plot type x year	2	4.42	0.11
Productivity - proportion of indicated pairs producing a brood	Plot Type	1	3.70	0.05
	Year	2	6.64	0.04
	Plot type x year	2	3.32	0.19

Table 12. Precision of untransformed and transformed (log+1) counts of total adults, indicated pairs, nests, flocked adults, broods, and young Tundra Swans in reference and development plots in the Mackenzie Delta region, 2001-2003.

Month/Variable	Reference						Development					
	Untransformed Data			Transformed Data			Untransformed Data			Transformed Data		
	Mean Swans per plot	Standard Error	CV	Mean Swans per plot	Standard Error	CV	Mean Swans per plot	Standard Error	CV	Mean Swans per plot	Standard Error	CV
June												
Total adults	17.27	2.49	0.14	2.59	0.09	0.03	30.61	7.04	0.23	2.82	0.13	0.04
Indicated pairs	6.98	0.62	0.09	1.90	0.07	0.04	6.75	0.55	0.08	1.90	0.07	0.04
Nests	2.51	0.31	0.12	1.02	0.08	0.08	2.84	0.35	0.12	1.13	0.08	0.07
Adults in flocks	3.32	2.13	0.64	0.43	0.11	0.26	17.10	6.89	0.40	0.86	0.21	0.24
August												
Total adults	13.14	1.37	0.10	2.28	0.11	0.05	28.93	6.28	0.22	2.43	0.17	0.07
Indicated pairs	4.58	0.39	0.09	1.52	0.08	0.05	4.21	0.43	0.10	1.43	0.09	0.06
Broods	1.14	0.18	0.16	0.55	0.07	0.13	0.70	0.15	0.21	0.38	0.07	0.17
Total young	2.36	0.42	0.18	0.77	0.11	0.14	1.61	0.36	0.23	0.58	0.10	0.17
Adults in flocks	3.99	0.84	0.21	0.91	0.13	0.14	20.51	5.82	0.28	1.26	0.22	0.18