REPLICATE AERIAL SCOTER SURVEYS

OF THE

YUKON FLATS, ALASKA - 2002

FINAL REPORT

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Waterfowl Management
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Abstract: Replicate aerial scoter surveys of the Yukon Flats of Alaska were completed for the third consecutive year in 2002. Four surveys were conducted from 26 May to 18 June, 2002. These surveys were conducted to investigate temporal fluctuations of scoter densities within the Yukon Flats during the breeding season. White-winged scoters and surf scoters accounted for 98.7 and 1.3% of the indicated-total scoters observed during the four surveys, respectively. Observations of indicated-total and indicated-breeding white-winged scoters followed similar trends with high numbers occurring during the second and third surveys (2 and 8 June), respectively.

Key Words: aerial survey, white-winged scoters, scoters, Alaska, Yukon Flats, replicate **March 2003**

INTRODUCTION

Standard waterfowl breeding population surveys have been flown in Alaska for over 46 years (Conant and Groves 2002). Generally, waterfowl breeding population surveys are conducted when a representative sample of the local breeding population can be obtained for the greatest number of duck species. These surveys do not begin until the majority of transient species migrate through the survey area and most late-arriving species are occupying breeding territories in the survey area (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1987). The timing of waterfowl breeding pair surveys is critical to estimating local breeding populations and is dictated by the phenology of the majority of local breeding birds.

The Alaska-Yukon waterfowl breeding population survey (AYWBPS) is conducted in Alaska throughout all major breeding habitats south of the Brooks Range, including the Yukon Flats, and in the Old Crow Flats, Yukon Territories, Canada. For the Yukon Flats, which supports the most scoters in interior Alaska (Lensink 1965, King and Lensink 1971, Bellrose 1980), the AYWBPS is typically conducted within the last week of May. This survey works well for estimating local populations of the majority of waterfowl species but is not timed optimally for scoters which are among the latest migrants to arrive in spring (Lensik 1965). In addition, during climatically late years the Yukon Flats may support a transient population of scoters en route to coastal habitats (Conant and Roetker 1987, Conant and Dau 1990, Conant and Groves 1992). Furthermore, speciation of scoters out to 200 meters from an aerial platform, which is the standard maximum distance for most waterfowl breeding population surveys, can be difficult. Therefore, the use of the AYWBPS to estimate local scoter populations is problematic.

Scoters are among the least studied of North American waterfowl and little is known of their life history, ecology, and distribution (USFWS 1999). Furthermore, scoter populations of interior Alaska are exhibiting a gradual decline (Conant and Groves 2002). Replicate aerial scoter surveys of the Yukon Flats have been conducted for three consecutive years and are designed to assess the

temporal variation (within breeding season) in scoter species distribution on the Yukon Flats. This information is important to understanding the value of the Yukon Flats to local and transient scoter species, as well as designing future surveys to monitor local scoter populations of the Yukon Flats.

STUDY AREA AND METHODS

Study Area and Survey Design

The survey area included contiguous waterfowl habitat in the central portion of the Yukon Flats which is within the AYWBPS area. Survey design consisted of three strata with a total of 14 transects located in areas where previous surveys (Platte and Butler 1992) indicated relatively high scoter densities (Fig. 1). Transects were located in those areas of high density due to the efficiency limitations associated with systematic random sampling for low-density species. Transect width was 400 meters except when large lakes were intersected, in which case the entire lake surface was searched for scoters. This search pattern was chosen over a rigid strip design to minimize between-survey variability associated with resident scoters moving about a lake. In order to maximize survey efficiency and data quality, scoters were the only waterfowl counted during these surveys and were identified to species, which often required a circling maneuver to allow proper aircraft positioning for positive identification. Transects were flown in an amphibious equipped Cessna 206 aircraft at 100-150 feet above ground level and at 90-105 mph ground speed. Aircraft navigation and altitude were maintained with a Global Positioning System (GPS) and radar altimeter, respectively.

Survey Procedures

Observations were recorded directly into laptop computers as sound files using a program developed by John Hodges (USFWS, Region 7, Waterfowl Management - Juneau). Each laptop computer (one for each observer) was linked to the aircraft GPS unit. The program simultaneously recorded observations and their coordinates into linked sound and ASCII files, respectively. A second computer program, also developed by John Hodges, was used on the ground to replay the linked sound files and produce transcribed ASCII files. The transcribed ASCII files were then used for data analysis.

Observations of scoters were recorded according to breeding pair survey protocol (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1987). All observations of lone male scoters (drakes) were recorded as lone drakes (singles). Drakes in flocks were recorded as flocked drakes. A male scoter in close association with a female scoter of the same species was recorded as a pair. Scoters in mixed-sex groupings of three or more of the same species which could not be separated into singles and pairs were recorded as groups (a hen and two drakes were recorded as a pair and a lone drake). Female scoters not accompanied by drakes were not counted.

Following standard waterfowl breeding population survey data protocol (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1987, Smith 1995), all observations of lone drakes, flocked drakes (<5), and pairs (one pair equals two birds) were doubled. Groups of scoters and flocked drakes (>4) were not doubled.

Statistical Methods

Although white-winged scoter (*Melanitta fusca*) densities were used for analyses, those densities are not reported due to the subjective placement of survey transects in high density scoter areas. Due to the nonstandard survey procedure of surveying large lakes that were intersected by the transect yet extended beyond the transect width, density estimates used for analyses were based on design transect areas (400 meters wide) and intercepted lake areas.

Two sample pairwise t-tests were conducted for the entire survey area in order to compare mean differences in white-winged scoter density among time periods (surveys). The samples were paired by transect using densities of indicated-total ((lone drakes + flocked drakes + pairs)* 2 + groups) and indicated-breeding ((lone drakes + flocked drakes + pairs)*2) white-winged scoters and comparisons were made between peak survey density and other survey densities. The Bonferonni multiple comparisons procedure was used to adjust significance levels for all comparisons.

Coefficients of variation (CV) were calculated from white-winged scoter densities using standard statistical techniques described by Smith (1995) to determine the time periods at which spatial distribution was most uniform. Estimates were derived using a stratified analysis for indicated-total and indicated-breeding white-winged scoters.

RESULTS

Four surveys were conducted using an amphibious configured Cessna 206 aircraft on 26 May and 2, 8, 17-18 June 2002. Each replicate consisted of 198.9 km^2 of search area, which required slightly less than eight hours of flight time, including ferry time from and to Fairbanks, AK.

White-winged scoters accounted for 98.7% (4,737/ 4,799) of the indicated-total scoters observed on the four surveys (Table 1). Surf scoters (*Melanitta perspicillata*) accounted for 1.3% (62) of the indicated-total scoters observed on the surveys. No black scoters (*Melanitta nigra*) were observed during the surveys, while white-winged and surf scoters were observed on every survey.

White-winged Scoters

Indicated-breeding and indicated-total white-winged scoters followed similar trends throughout the surveys with peak numbers of birds observed on the second and third surveys, respectively (2 June, 8 June, Table 1, Figs. 2 and 3). However, those trends were not consistent for each geographic area (Table 2, Figs. 2 and 3). For indicated-breeding white-winged scoters, the central stratum (n=6) followed the overall trend (peak on the 3rd survey, 8 June) while the west (n=4) and northeast (n=4) strata had peak numbers during the second survey (2 June). Conversely, for indicated-total white-wined scoters, the central stratum peaked on the 3rd survey while the west and northeast strata followed the overall trend and peaked on the second survey.

Paired two sample t-tests (by transect) that compared peak-survey density to the other survey densities, for indicated-breeding and indicated-total birds, revealed significant differences among

most surveys (Table 3). For indicated-breeding white-winged scoters, peak survey density was estimated on the 3rd survey (8 June) which was significantly different than the 1st and 4th survey. Similarly, for indicated-total white-winged scoters, peak survey density was estimated on the 2nd survey (2 June) which was significantly different than the 1st and the 4th survey.

Coefficients of variation (CV) were calculated for indicated-total and indicated-breeding white-winged scoter densities (Table 4). The CVs can be used to estimate the time at which scoter distribution was most uniform. Table 4 lists the CVs for indicated-total and indicated-breeding birds. These statistics indicated that the 2nd survey (2 June) provided the least variable data for indicated-breeding and indicated-total white-winged scoters.

Surf Scoters

Surf scoters were most numerous on the 3rd survey for indicated-breeding birds, and on the 2nd and 3rd survey for indicated-total birds (Table 1).

DISCUSSION

Overall, temporal trends for indicated-breeding and indicated-total white-winged scoters were similar in 2001 and 2002 (Figs. 4 and 5, Mallek 2002). The 2001 and 2002 transect and lake coverage were identical, providing a good comparison between years. A comparison among the 2000, 2001 , and 2002 survey data is a little more difficult due to the fact that only 10 of 14 transects from the 2000 survey (Mallek 2001) were included in the 2001-2002 surveys. Although the within year trends for 2000-2002 were still similar (Figs. 6 and 7).

Since the replicate surveys were conducted approximately one week apart, the actual peak day for indicated-breeding white-winged scoters can not be estimated. Although, there is a difference of five days for peak surveys of indicated-breeding white-winged scoters from 2000-2002 (8 June vs. 13 June). Furthermore, all years indicated a considerable drop in indicated-breeding white-winged scoters after the peak, suggesting that monitoring surveys should be concentrated during the end of the first week to the beginning of the second week of June (Fig. 6).

A comparison of trend for indicated-total white-winged scoters from 2000-2002 indicate minor differences in trends (Fig. 7). In 2000, the largest number of indicated-total white-winged scoters was observed on the first survey (29 May), while in 2001 the peak survey occurred on the third survey (8 June), and in 2002 the peak survey occurred on the second survey (2 June). The 2000 survey was initiated later than designed due to aircraft problems. The late initiation of the 2000 survey probably explains the peak occurrence on the first survey.

The results from the three replicate scoter surveys (2000-2002) on the Yukon Flats of Alaska indicate that the end of the first week to the beginning of the second week in June is the most appropriate time to monitor white-winged scoters. This is illustrated by similarities in peak of indicated-breeding birds and by the low CVs obtained during the peak survey periods. Furthermore, the three years data suggest that the peak occurrence of indicated-breeding birds is short lived and

monitoring surveys should be timed appropriately and consistently if they are to provide a reliable trend estimate.

CONCLUSION

These surveys were designed to estimate the most appropriate time to monitor scoter populations that breed on Yukon Flats of Alaska. While the data indicate that the end of the first week to early in the second week of June provides the highest occurrence of indicated-breeding scoters, some of these birds may still be transient scoters enroute to other breeding grounds. Although the actual number of breeding scoters on the Yukon Flats may be difficult to monitor, the replicate survey data collected over three years suggests that the proportion of transient birds is relatively consistent (similarities in trend among years), at least during the time periods the replicates were surveyed (after 26 May).

ACKNOWLEDGMENTS

I thank Larry Lysne for his help as an observer during these surveys. I also thank Bob Platte (Waterfowl Management-Anchorage) for his help with survey design and map production. Thanks are extended to Arctic NWR for use of their fueling facilities at Fort Yukon.

REFERENCES CITED

Bellrose, F. C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrison, PA

Conant, B., and F. Roetker. 1987. Alaska-Yukon waterfowl breeding population survey: May 14 to June 14, 1987. Unpubl. Rept., U. S. Fish and Wildl. Serv., Juneau, AK. 25pp.

_____, and C. P. Dau. 1990. Alaska-Yukon waterfowl breeding population survey: May 18 to June13, 1990. Unpubl. Rept., U. S. Fish and Wildl. Serv., Juneau, AK. 26pp.

_____, and D. J. Groves.1992. Alaska-Yukon waterfowl breeding population survey: May 24 to June 21, 1992. Unpubl. Rept., U. S. Fish and Wildl. Serv., Juneau, AK. 26pp.

_____, and D. J. Groves. 2002. Alaska-Yukon waterfowl breeding population survey: May 17 to June 9, 2002. Unpubl. Rept., U. S. Fish and Wildl. Serv., Juneau, AK. 32pp.

King, J. G., C. J. Lensink. 1971. An evaluation of Alaska habitat for migratory birds. Unpubl. Rept., U. S. Fish and Wildl. Serv., Washington DC.

Lensink, C. J. 1965. Waterfowl of the Yukon Flats, Alaska. Unpubl. Rept., U. S. Fish and Wildl. Serv. 129pp.

Mallek, E. J. 2001. Replicate aerial scoter surveys of the Yukon Flats, Alaska - 2000. Unpubl. Rept., U. S. Fish and Wildl. Serv., Fairbanks, AK 14pp.

_____, 2002. Replicate aerial scoter surveys of the Yukon Flats, Alaska - 2001. Unpubl. Rept., U.S. Fish and Wildl. Serv., Fairbanks, AK 15pp.

Platte, R. M., and W. I. Butler Jr. 1992. Aerial surveys and mapping of waterbird distribution and abundance for impact assessment of potential oil development on the Yukon Flats National Wildlife Refuge, Alaska. Unpubl. Rept., U. S. Fish and Wildl. Serv., Anchorage AK 122pp.

Smith, G. W. 1995. A critical review of the aerial and ground surveys of breeding waterfowl in North America. Biological Science Report 5, National Biological Service, Washingtion D.C. 252pp.

U. S. Fish and Wildl. Serv. - Canadian Wildl. Serv. 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America. Unpubl. Manual.

U. S. Fish and Wildl. Serv. 1999. Population status and trends of sea ducks in Alaska. Unpubl. Rept. Anchorage, AK 137pp.

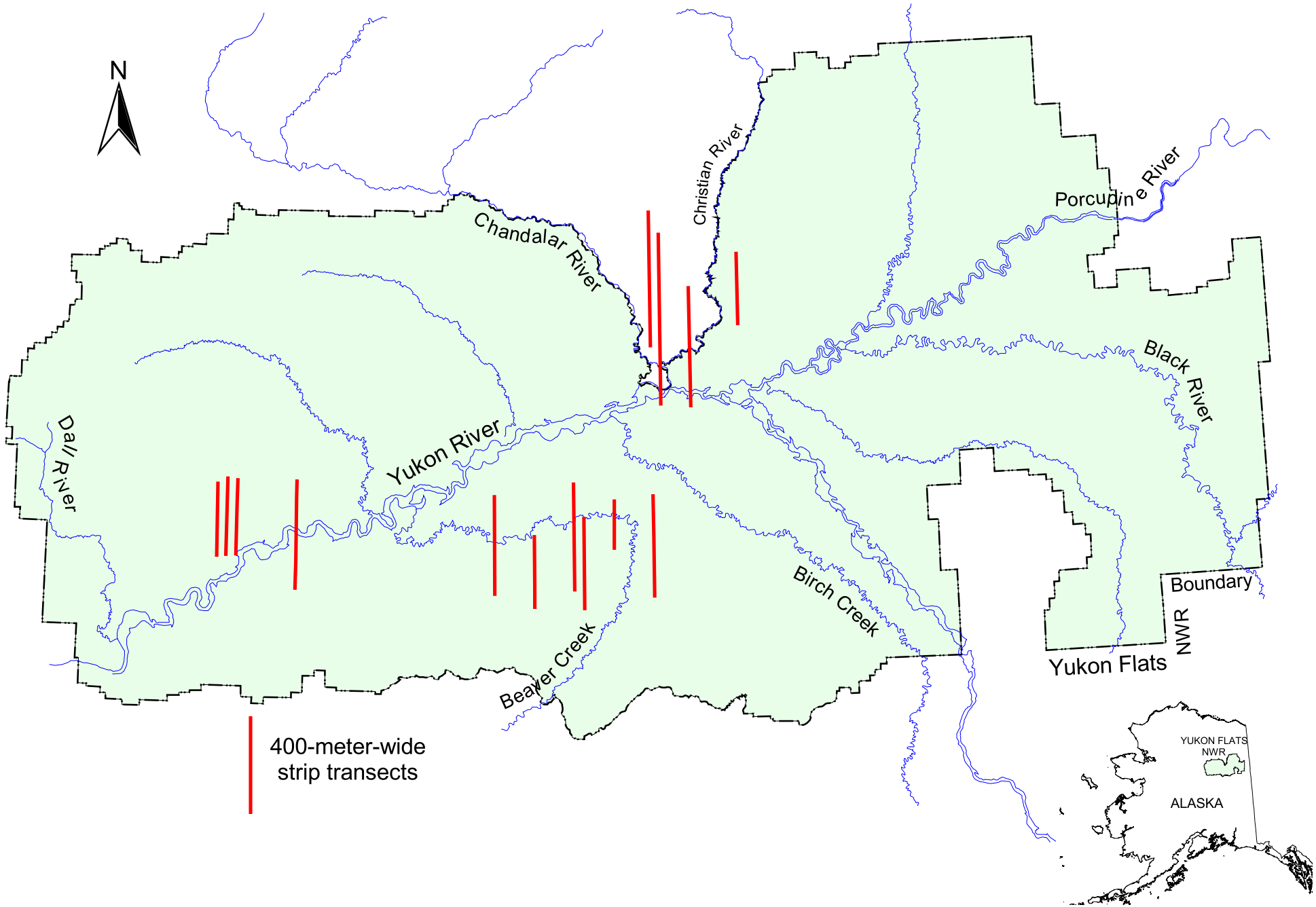


Fig. 1. Map features of the Yukon Flats, Alaska in relation to the year-2002 transect locations (vertical lines) of the replicate aerial scoter surveys.

Table 1. Species composition and group classification of scoters from four replicate aerial surveys on the Yukon Flats of Alaska, 26 May, 2 June, 8 June, 17-18 June, 2002.

Species*	Survey Number	Groups	Flocked drakes**	Singles	Pairs	Indicated-total	Indicated-breeding	% Grand Indicated-total
WWSC	1	184	38	35	127	584	400	
	2	434	149	128	358	1,704	1,270	
	3	193	131	172	396	1,591	1,398	
	4	244	53	74	180	858	614	
WWSC Total		1,055	371	409	1,061	4,737	3,682	98.7%
SUSC	1	0	0	2	0	4	4	
	2	6	0	0	0	6	0	
	3	12	5	1	1	26	14	
	4	16	0	1	4	26	10	
SUSC Total		34	5	4	5	62	28	1.3%
BLSC	1	0	0	0	0	0	0	
	2	0	0	0	0	0	0	
	3	0	0	0	0	0	0	
	4	0	0	0	0	0	0	
BLSC Total		0	0	0	0	0	0	0%
Grand Total		1,089	376	413	1,066	4,799	3,710	

* WWSC = white-winged scoter, SUSC = surf scoter, BLSC = black scoter.

** drakes in flocks < 5.

Table 2. Group classification of white-winged scoters by stratum and survey from four replicate aerial surveys on the Yukon Flats of Alaska, 26 May, 2 June, 8 June, 17-18 June, 2002.

Region*	Survey	Groups	Flocked Drakes**	Singles	Pairs	Indicated-total	Indicated-breeding
Northeast n = 4 W = 0.3116	1	64	11	7	30	160	96
	2	144	19	31	78	400	256
	3	38	19	23	44	210	172
	4	32	6	11	33	132	100
	Total	278	55	72	185	902	624
Central n = 6 W = 0.4256	1	92	10	20	60	272	180
	2	214	102	59	186	908	694
	3	129	101	119	284	1,137	1,008
	4	212	39	45	105	590	378
	Total	647	252	243	635	2,907	2,260
West n = 4 W = 0.2628	1	28	17	8	37	152	124
	2	76	28	38	94	396	320
	3	26	11	30	68	244	218
	4	0	8	18	42	136	136
	Total	130	64	94	241	928	798

* n = number of transects, W = stratum weight determined by area searched per stratum.
** drakes in flocks < 5.

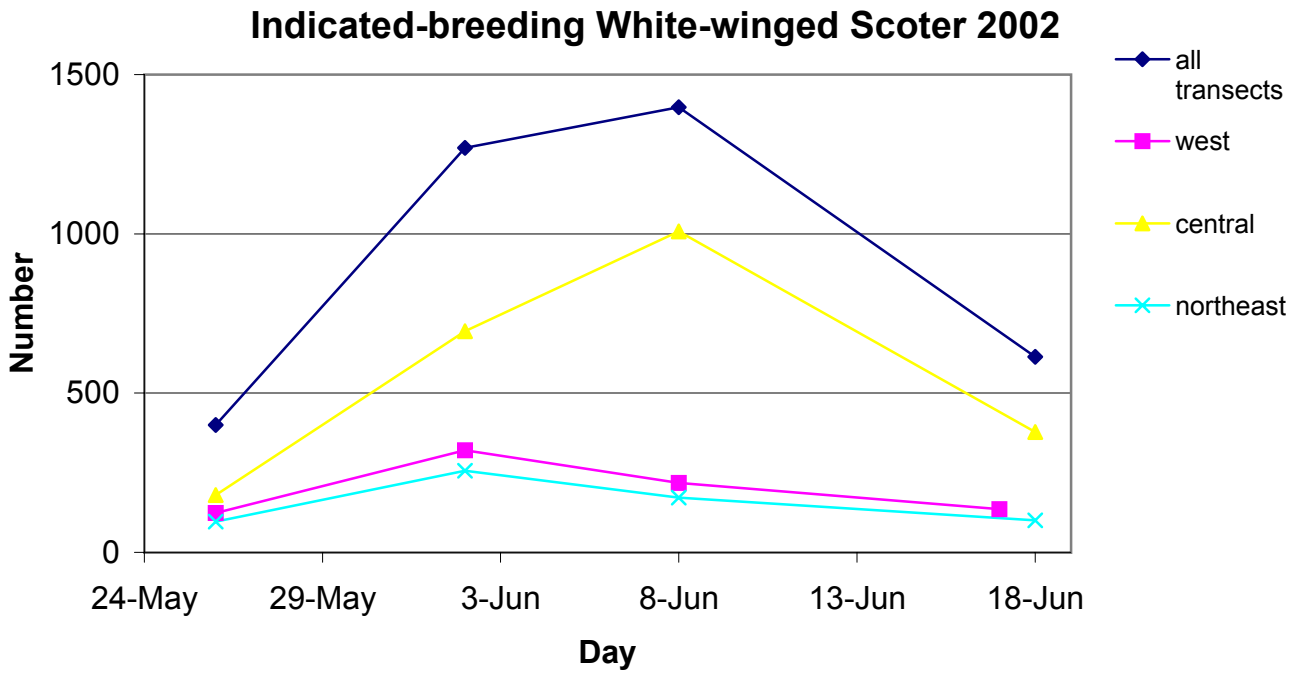
Table 3. P-value results from paired (by transect) two sample t-tests of peak survey density to other survey densities for indicated-breeding and indicated-total white-winged scoters on the Yukon Flats of Alaska, 2002. Density values were based on stratified analyses and P-values were corrected using the Bonferonni multiple comparisons procedure.

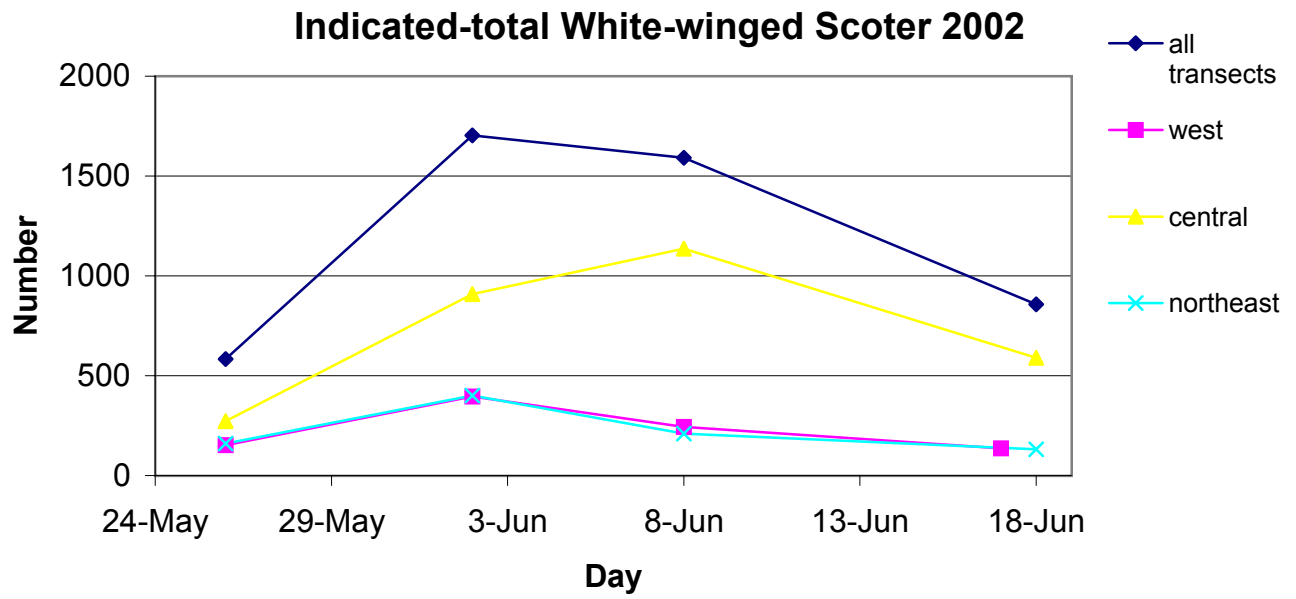
	Peak Survey	Survey 1 to 3	Survey 2 to 3	Survey 4 to 3
Indicated-breeding	3	0.0336	1.0000	0.0255

	Peak Survey	Survey 1 to 2	Survey 3 to 2	Survey 4 to 2
Indicated-total	2	0.0005	1.0000	0.0002

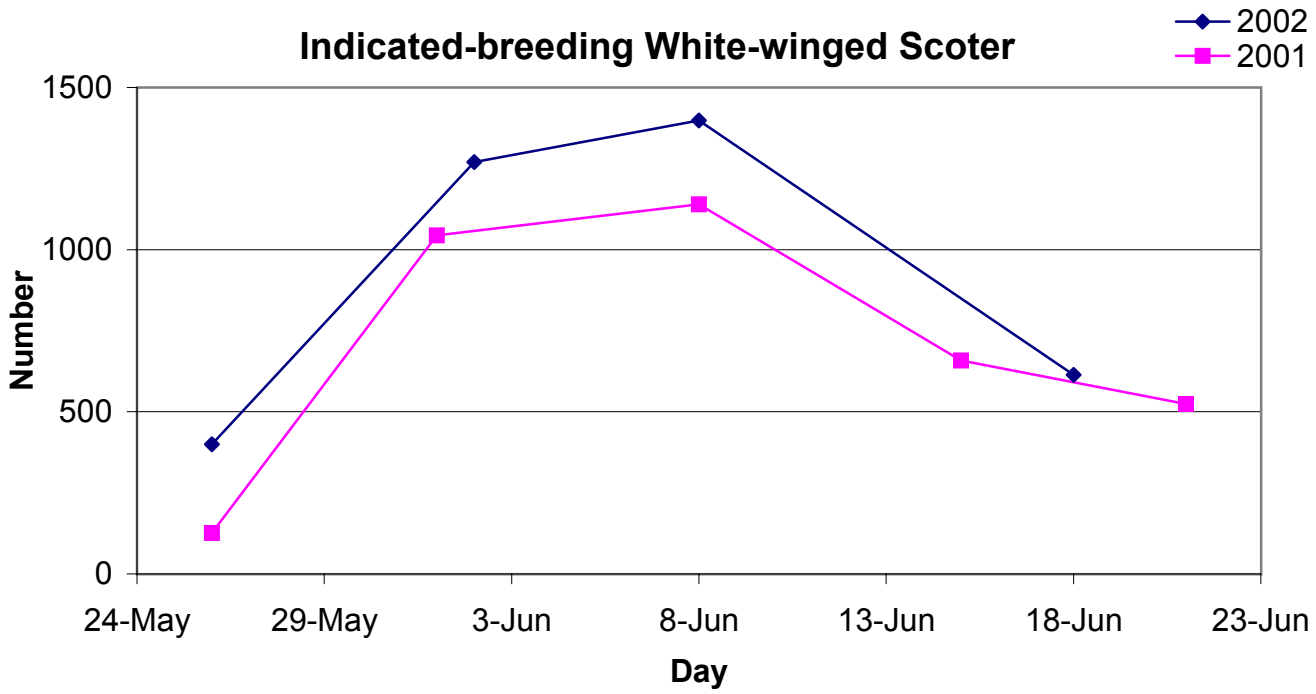
Table 4. Coefficients of variation from density estimates of white-winged scoters on the Yukon Flats of Alaska, 2002. Density estimates were based on sampled transect strips and lake areas using stratified analyses of three surveyed strata (n=14). Strata weights were based on area searched per stratum.

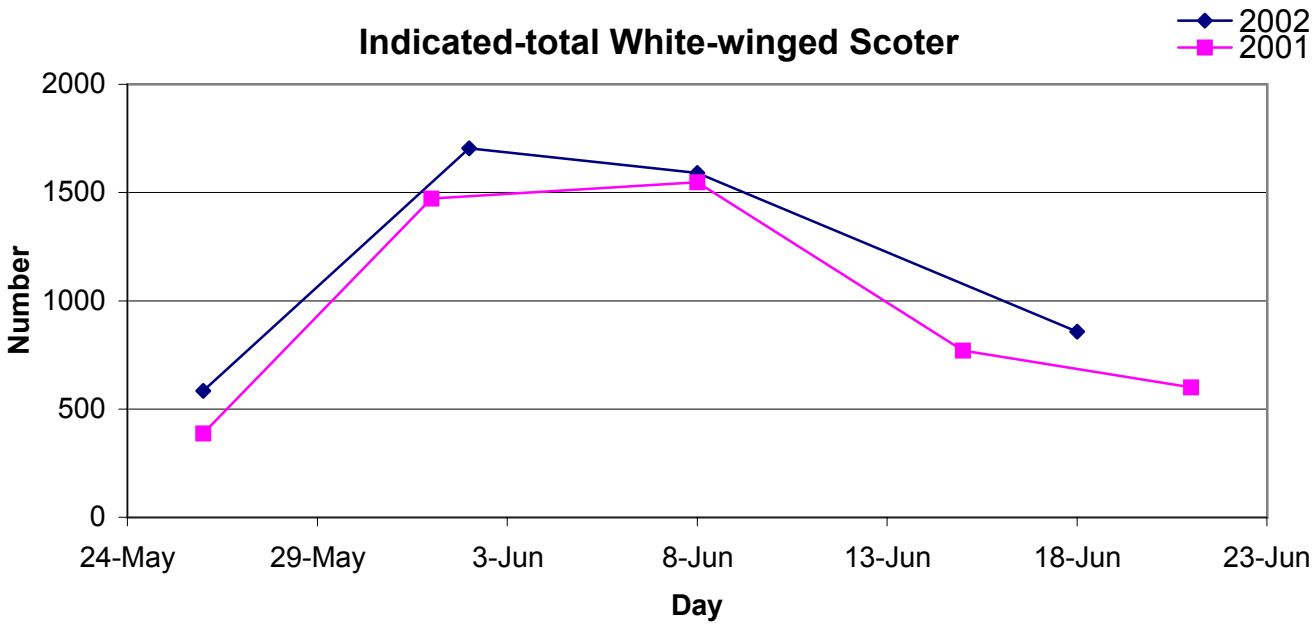
Survey	Date	%CV Indicated-breeding	%CV Indicated-total
1	26 May	19.96	16.07
2	2 June	17.47	13.31
3	8 June	22.90	21.79
4	17-18 June	21.39	24.16



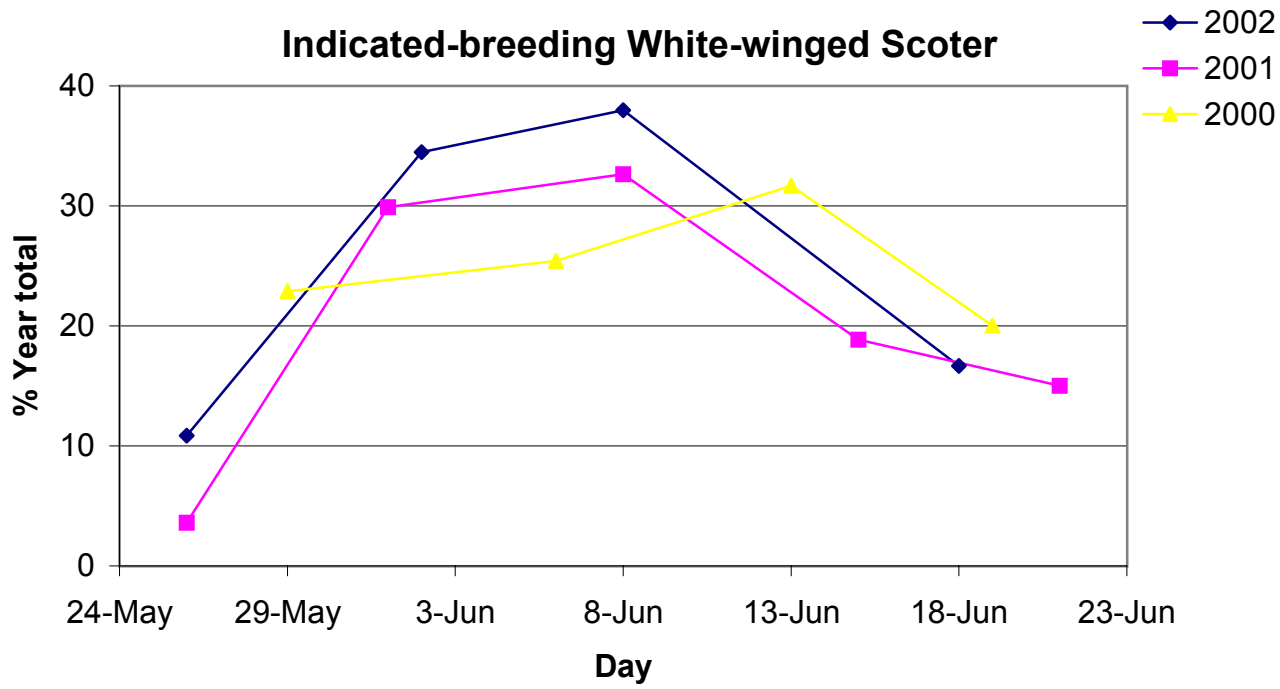


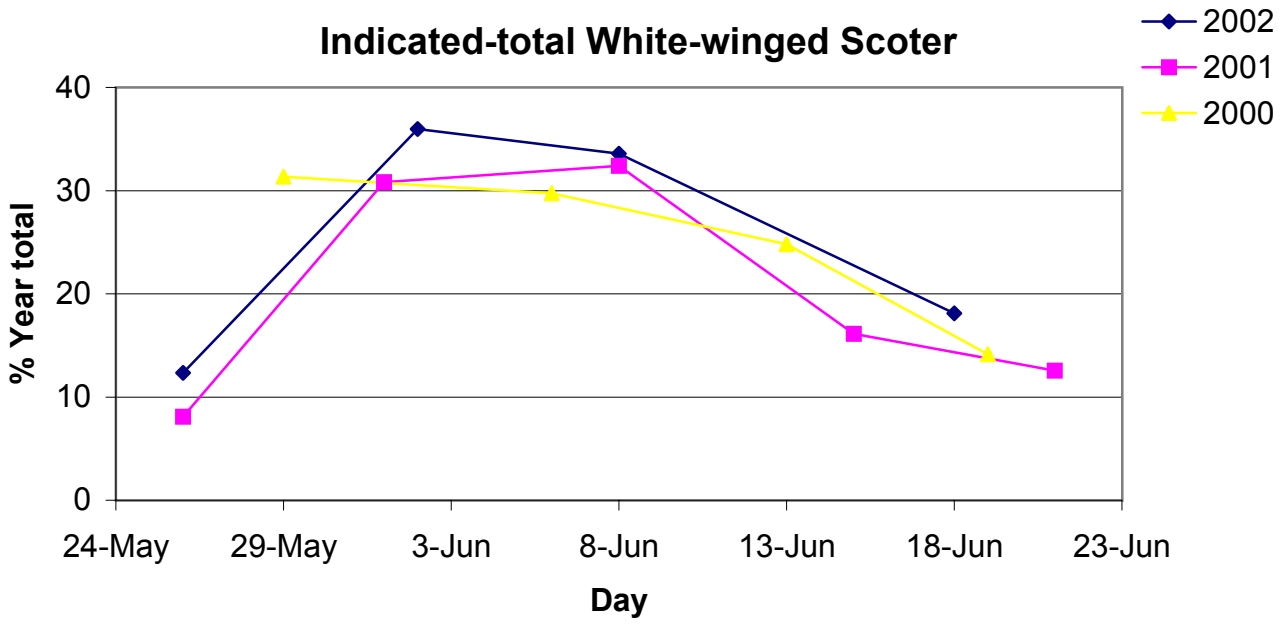
Figures 2 and 3. Numbers of indicated-breeding and indicated-total white-winged scoters observed on four replicate surveys on the Yukon Flats of Alaska, 2002. Data are displayed for each stratum and for all strata. The number of transects per stratum were as follows; west = 4, central = 6, and northeast = 4.



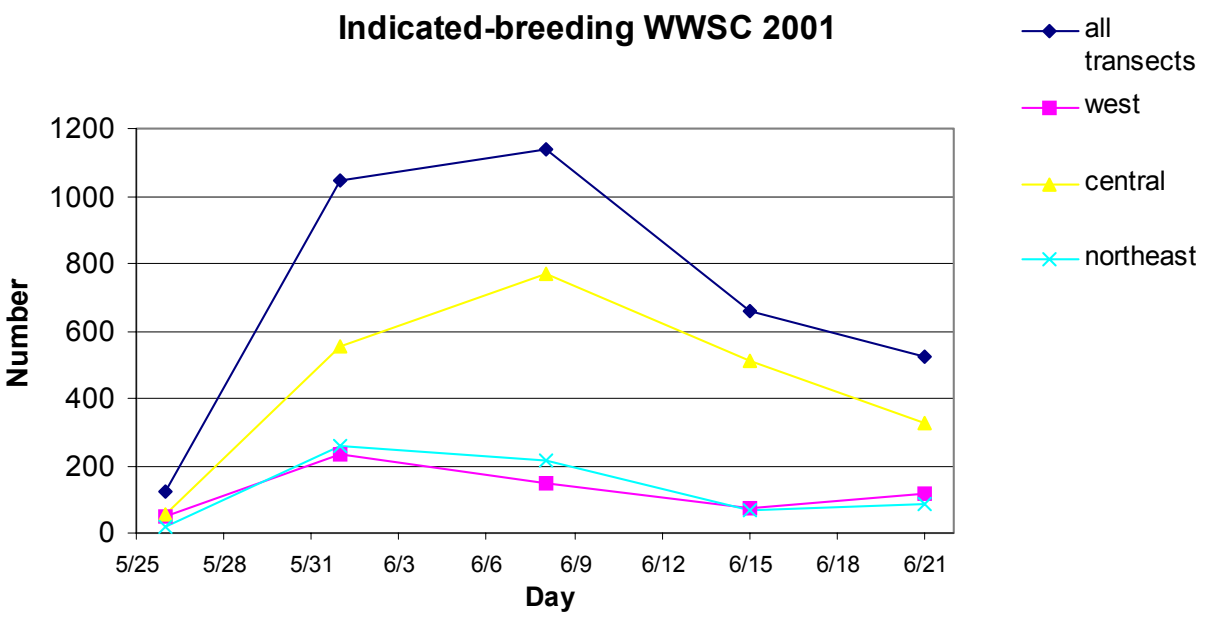


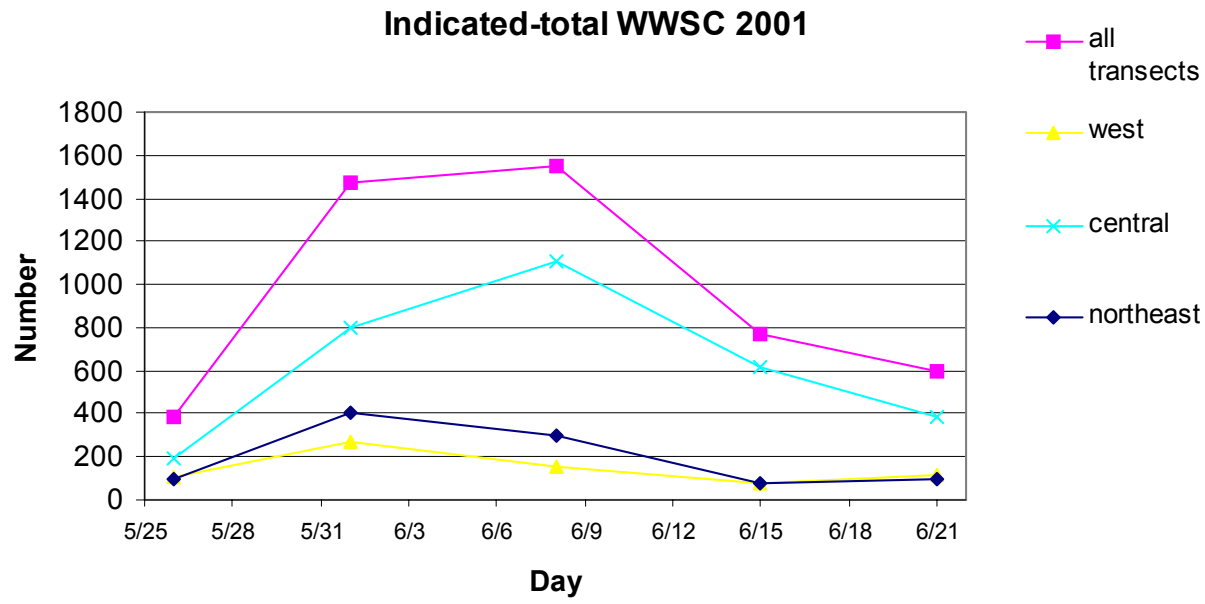
Figures 4 and 5. Numbers of indicated-breeding and indicated-total white-winged scoters observed on replicate surveys on the Yukon Flats of Alaska in 2001 and 2002. Surveys were replicated within year and between years.



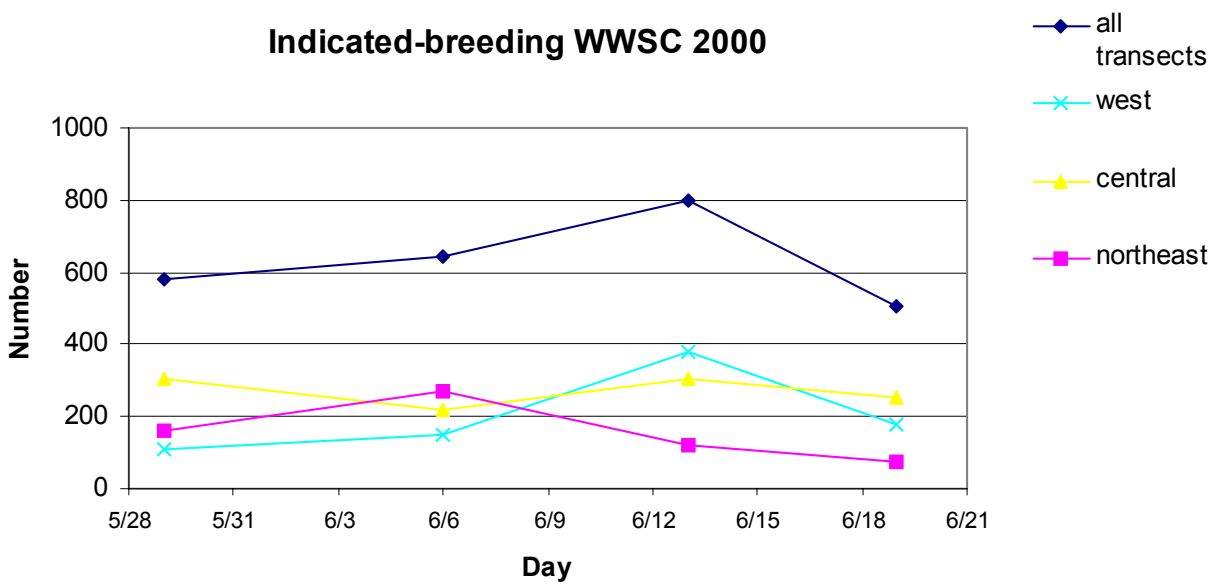


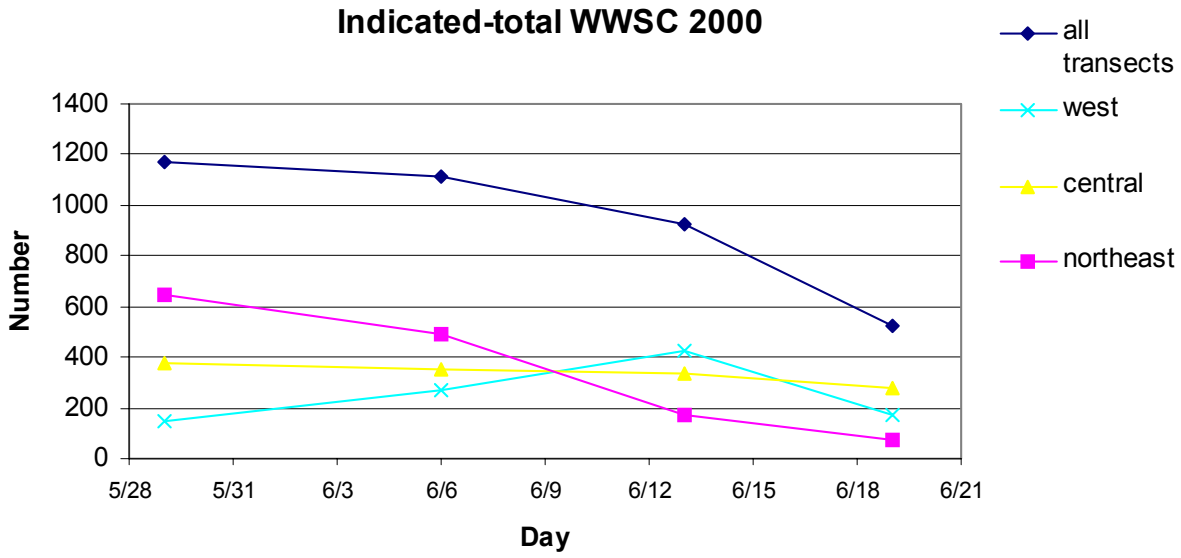
Figures 6 and 7. Percent-total per year of indicated-breeding and indicated-total white-winged scoters observed on replicate surveys on the Yukon Flats of Alaska in 2000 - 2002. Surveys were replicated within year but not between all years. The 2001 and 2002 survey transects were identical (n=14), while the 2000 survey included 10 of 14 transects flown in 2001-2002 and 4 different transects.





Appendix 1. Numbers of indicated-breeding and indicated-total white-winged scoters observed on five replicate surveys of the Yukon Flats of Alaska, 2001. Data are displayed for each stratum and for all strata. The number of transects per stratum were as follows; west = 4, central = 6, and northeast = 4.





Appendix 2. Numbers of indicated-breeding and indicated-total white-winged scoters observed on four replicate surveys of the Yukon Flats, Alaska 2000. Data are displayed for each stratum and for all strata. The number of transects per stratum were as follows; west = 8, central = 2, northeast = 4.

Appendix 3. Species composition and group classification of scoters from five replicate aerial surveys on the Yukon Flats of Alaska, 26 May - 21 June, 2001.

Species*	Survey Number	Groups	Flocked drakes**	Singles	Pairs	Indicated-total	Indicated-breeding	% Grand Indicated-total
WWSC	1	261	21	6	36	387	126	
	2	428	63	60	399	1472	1044	
	3	407	66	95	409	1547	1140	
	4	112	16	77	236	770	658	
	5	76	52	39	171	600	524	
WWSC Total		1284	218	277	1251	4776	3492	91.3%
SUSC	1	19	8	9	14	81	62	
	2	32	16	14	33	158	126	
	3	10	18	13	12	96	86	
	4	17	0	2	6	33	16	
	5	0	6	1	5	24	24	
SUSC Total		78	48	39	70	392	314	8.2%
BLSC	1	0	0	0	0	0	0	
	2	0	2	2	3	14	14	
	3	0	2	0	0	4	4	
	4	0	0	0	0	0	0	
	5	0	0	0	0	0	0	
BLSC Total		0	4	2	3	18	18	0.5%
Grand Total		1362	270	318	1324			

* WWSC = white-winged scoter, SUSC = surf scoter, BLSC = black scoter.

** drakes in flocks < 5.

Appendix 4. Group classification of white-winged scoters by stratum and survey from five replicate aerial surveys on the Yukon Flats of Alaska, 26 May - 21 June, 2001.

Region*	Survey	Groups	Flocked Drakes**	Singles	Pairs	Indicated-total	Indicated-breeding
Northeast n = 4 W = 0.3116	1	74	3	1	5	92	18
	2	146	14	19	96	404	258
	3	76	14	17	78	294	218
	4	10	5	9	21	80	70
	5	16	13	7	22	100	184
Central n = 6 W = 0.4256	1	135	10	2	17	193	158
	2	243	32	27	217	795	552
	3	331	40	62	284	1103	772
	4	102	9	59	188	614	512
	5	60	20	21	121	384	324
West n = 4 W = 0.2628	1	52	8	3	14	102	50
	2	39	17	14	86	273	234
	3	0	12	16	47	150	150
	4	0	2	9	27	76	76
	5	0	19	11	28	116	116

* n = number of transects, W = stratum weight determined by area searched per stratum..
** drakes in flocks < 5.

Appendix 5. P-value results from paired (by transect) two sample t-tests of peak survey density to other survey densities for indicated-total and indicated-breeding white-winged scoters on the Yukon Flats of Alaska, 2001. Density values were based on stratified analyses and P-values were corrected using the Bonferonni multiple comparisons procedure.

	Peak Survey	Survey 1 to 3	Survey 2 to 3	Survey 4 to 3	Survey 5 to 3
Indicated-total	3	0.012	1.000	0.050	0.010
Indicated-breeding	3	0.002	1.000	0.083	0.007

Appendix 6. Coefficients of variation from density estimates of white-winged and surf scoters on the Yukon Flats of Alaska, 2001. Density estimates were based on sampled transect strips and lake areas using stratified analyses of three surveyed strata (n=14). Strata weights were based on area searched per stratum.

Species*	Survey	Date	%CV Indicated-Total	%CV Indicated-Breeding
WWSC	1	26 May	17.39	24.22
	2	1 June	14.59	16.61
	3	8 June	15.38	12.93
	4	15 June	26.82	36.02
	5	21 June	15.79	13.95
SUSC	1	26 May	28.42	33.62
	2	1 June	23.99	31.41
	3	8 June	29.69	34.67
	4	15 June	33.75	49.62
	5	21 June	51.83	78.44

* WWSC = white-winged scoter, SUSC = surf scoter.

Appendix 7. Species composition and group classification of scoters from five replicate aerial surveys on the Yukon Flats of Alaska, 29 May - 26 June, 2000.

Species*	Survey Number	Groups	Flocked drakes	Singles	Pairs	Indicated-total	Indicated-breeding	% Grand Indicated-total
WWSC	1	593	43	29	217	1171	578	
	2	469	10	63	248	1111	642	
	3	127	17	59	324	927	800	
	4	22	6	24	223	528	506	
	5**	33	33	17	26	185	152	
WWSC Total		1244	109	192	1038	3922	2678	95.4%
SUSC	1	0	5	3	0	16	16	
	2	15	6	4	3	41	26	
	3	0	0	4	12	32	32	
	4	0	0	1	19	40	40	
	5**	0	0	1	1	4	4	
SUSC Total		15	11	13	35	133	118	3.2%
BLSC	1	0	0	0	3	6	6	
	2	15	11	1	5	49	34	
	3	0	0	0	0	0	0	
	4	0	0	1	0	2	2	
	5**	0	0	0	0	0	0	
BLSC Total		15	11	2	8	57	42	1.4%
Grand Total		1274	131	207	1081	4112	2838	

* WWSC = white-winged scoter, SUSC = surf scoter, BLSC = black scoter.

** Survey 5 was only conducted in the west stratum due to increasing winds.

Appendix 8. Group classification of white-winged scoters by stratum and survey from five replicate aerial surveys on the Yukon Flats of Alaska, 29 May - 26 June, 2000.

Region*	Survey	Groups	Flocked Drakes	Singles	Pairs	Indicated-total	Indicated-breeding
Northeast n = 4 W = 0.3597	1	482	17	8	56	644	162
	2	216	5	28	103	488	272
	3	52	0	14	45	170	118
	4	0	3	4	31	76	76
Central n = 2 W = 0.1307	1	72	17	13	123	378	306
	2	134	2	20	87	352	218
	3	31	4	17	130	333	302
	4	22	3	16	108	276	254
West n = 8 W = 0.5096	1	39	9	8	38	149	110
	2	119	3	15	58	271	152
	3	44	13	28	149	424	380
	4	0	0	4	84	176	176
	5**	33	33	17	26	185	152

* n = number of transects, W = stratum weight determined by transect lengths.

** Survey 5 was only conducted in the west stratum due to increasing winds.

Appendix 9. ANOVA results relating indicated-total and indicated-breeding white-winged scoter densities (by transect) to survey timing and strata from four surveys conducted on the Yukon Flats of Alaska, 2000.

Analysis of Variance

N: 56 transects

Dependent Variable: Indicated-total R^2: 0.7206

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Survey Time	140.0689	3	46.6896	3.6148	0.0203
Survey Strata	1067.9350	2	533.9675	41.3412	0.0000
Time*Strata	290.9247	6	48.4875	3.7540	0.0042
Error	568.3092	44	12.9161		

Analysis of Variance

N: 56 transects

Dependent Variable: Indicated-breeding R^2: 0.7694

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Survey Time	18.7680	3	6.2560	1.0893	0.3636
Survey Strata	717.1379	2	358.5689	62.4335	0.0000
Time*Strata	93.9814	6	15.6636	2.7273	0.0243
Error	252.7014	44			

Appendix 10. Coefficients of variation for density estimates of white-winged scoters on the Yukon Flats of Alaska, 2000. Coefficients of variation are from surrogate density estimates, based on transect lengths, using stratified analysis of three surveyed strata (n=14).

Survey	Date	CV Indicated-Total	CV Indicated-Breeding
1	29 May	28.01	11.54
2	6 June	8.99	20.44
3	13 June	11.52	5.73
4	19 June	16.42	16.57
5*	26 June	25.93	16.49

*Survey 5 was only conducted in the west stratum (n=8) due to increasing winds.