

MBM

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Memorandum

To: Chief, Migratory Bird Management
Region 7

From: Karen S Bollinger, Wildlife Biologist / Pilot
John I Hodges, retired - Wildlife Biologist / Pilot

Through: Eric J Taylor, Chief, Waterfowl Management Branch

Subject: Report to the Pacific Flyway Committee on the 1985-2009 Coastal Zone
Yukon-Kuskokwim Delta Goose Survey of geese, swans, and sandhill cranes.

INTRODUCTION AND METHODS

Aerial surveys of geese, tundra swans (*Cygnus columbianus*), and sandhill cranes (*Grus canadensis*) were conducted from 2-10 June 2009, in the coastal zone of the Yukon-Kuskokwim Delta (YKD) for the 25th consecutive year. Goose species surveyed include cackling cackling Canada geese (*Branta hutchinsii minima*), black brant (*Branta bernicla nigracans*), emperor geese (*Chen canagica*), greater white-fronted geese (*Anser albifrons frontalis*), and Taverner's cackling geese (*Branta hutchinsii taverneri*). To simplify terminology, these species will be referenced as cackling Canada geese, black brant, emperor geese, white-fronted geese, and Taverner's Canada geese, respectively, throughout the remainder of this document. A Cessna 206 on amphibious floats was flown using standard Department of Interior survey methodology, similar to previous years. The 108 transects flown comprised 2,551 km linear distance. Sample survey coverage measured 7.9% of the total 12,852 km² study area. This was Karen's fourth year as primary pilot/observer, while it was John's first year as right seat observer. John had previously flown the survey as primary pilot/observer for 4 years, however.

The survey transect design (Fig. 1), initiated in 1998, was designed to obtain optimal distribution data. This is achieved by a four-year rotation design of unique sets of transect lines for each year. The years 1998-2001 comprised the first complete four-year rotation; 2002-2005, the second; and 2009 represents the completion of the third, four-year rotation. Standardized methodology for data collection involves a pilot and right-seat observer recording observations within a 200 m transect on each side of the plane, flying at an altitude of approximately 45 m and a speed of 150 km/hr. Observations were recorded directly into a laptop computer connected to the airplane global positioning system, so that each observation was matched with a latitude/longitude coordinate location.

Spring phenology in 2009 was a few days earlier than normal based on cumulative thaw degree days in Bethel (Stehn, pers. com.). Nesting phenology for geese was a few days later than the 28-year mean. In 2009, average hatch was 25 June for cacklers and white-fronts, and 24 June for emperors and black brant (Fischer et al. 2009).

Population Indices

Population indices used in this report are calculated for the following species or groups of species as follows:

All Geese and Sandhill Cranes

$$\textit{indicated pairs} = 2 \times (\textit{singles} + \textit{pairs}^*)$$

$$\textit{indicated total birds} = 2 \times (\textit{singles} + \textit{pairs}) + \textit{birds in flocks}$$

Tundra Swans

$$\textit{total birds} = \textit{singles} + (2 \times \textit{pairs}) + \textit{birds in flocks}$$

$$\textit{singles and pairs} = \textit{singles} + (2 \times \textit{pairs})$$

$$\textit{nests} = \textit{number of active nests observed}$$

$$*\textit{pairs} = \textit{no. of pairs (for all references)}$$

Stratification Design

Stratification of this survey is based on sampling effort, that is, the distances between transects which are 1, 2, 4, and 8 miles (Fig. 1). There are four primary strata with one small additional stratum in a high-density area. This additional stratum was created to better accommodate historical data for that area which had variable spacing between transects for several years (Fig. 1).

RESULTS

The aerial survey was conducted from 02 – 10 June and ground plots from 06 – 19 June in 2009. Timing of this year's aerial survey was comparable phenologically to previous years and coincided well with the peak incubation dates obtained from the ground plots (Fischer et al. 2009). The effect of different timing of the survey relative to nesting phenology is not completely understood, but it is generally assumed that the relative number of failed breeders increases as the nesting season progresses. Therefore, surveys timed later relative to nesting phenology could result in greater numbers of flocked birds and fewer pairs observed than if the survey had been flown earlier in the nesting season. Differences in nesting success could complicate that correlation because heavy predation increases the number of birds seen in flocks due to failed breeding attempts. In 2009 fox predation was heavy in a few localized areas, but overall not significant. As a result, the proportion of nests that were active was higher than average for all four geese species for the entire area where nest plots are searched (Fischer et al.

2009). In recent years the survey has been flown in fewer days and somewhat earlier in the nesting season than in the earlier, developmental years of the survey. Although there has been some variation in timing of the survey relative to nesting phenology during recent years, we do not think those variations have had a significant impact on results.

Cackling Canada Geese

The cackling Canada goose indices for indicated total birds decreased 20% in 2009 (67,434) from the record high of 84,699 in 2008 (Table 1, Fig. 2). However, the index for indicated pairs totaled 52,368 in both 2008 and 2009. This index is second only to the record high of 52,855 in 2000 (Table 2, Fig. 2). The growth rate for indicated total birds and pairs exhibited exponential growth rates from 1985 through at least 1997 (Fig. 2). However, data from 1998-2009 indicate a stable or only slightly increasing growth rates for both indices, although the data are much more variable over this period (Fig. 2). The estimate of the fall population is based on the 1985-98 correlation between the indicated total index and fall count (App.1). This fall population estimate (160,635) also decreased from the near record high of 193,321 in 2008, second only to that of 199,672 in 1997.

Pacific White-fronted Geese

The indicated total bird index for white-fronted geese (144,678) in 2009 continued to decrease from the record high of 178,515 recorded in 2007 (Table 1, Fig. 3). The indicated pairs index (66,759) in 2009 also decreased and was 9% below the record high of 73,022 recorded in 2008 (Table 2, Fig. 3). 2009 represents the first year since 2004 that both indices have not increased (Tables 1 and 2; Fig. 3 and 4). The log-linear growth rates for the first 11 years of the survey (1985-1995) and last 14 years of the survey (1996-2009) are plotted separately (Fig. 4). Growth rates in recent years have declined and are more variable than early years of the survey (Fig. 4).

Pacific white-fronts nesting in Alaska are mainly concentrated on the Yukon Delta, both coastal and interior, with a very small percentage also found in Bristol Bay. Estimates for all Pacific white-fronts nesting in Alaska are determined from results of this survey combined with results from the survey of Bristol Bay and the interior Yukon Delta (Mallek and Groves 2009). These estimates are presented in Appendix 2. Only a small percentage of the Pacific white-fronts nesting in Alaska are found in Bristol Bay, as compared to those found in the Yukon Delta, both coastal and interior. In 2009, the coastal Yukon Delta (YKD) accounted for 79% of the birds; interior Yukon Delta, 20%; and Bristol Bay, only 1%. And although the birds found in Bristol Bay in 2009 at least doubled from counts in 2008, both Yukon Delta counts were down from 2008. As a result, the total for all areas (182,527) decreased from the record high count of 2008 (217,937). Fall estimates of the Alaska Pacific white-front population, based on a correlation between spring and fall counts for the time interval 1985-1998, are presented in Appendix 3. Although the 2009 fall index (536,746) decreased from the record high in 2008 (627,035); the 3-year average in 2009 (589,496) did increase slightly from that in 2008 (580,334) to a new record.

Emperor Geese

The emperor goose index for indicated total birds has declined for the last 3 years from the 2nd highest count of 26,562 recorded in 2006 compared to 20,684 in 2009 (Table 1, Fig. 5.) The indicated pairs index of 13,563 in 2009 decreased from that of 16,110 recorded in 2008 (Table 2, Fig.5). Population growth rates are slightly positive for both indices (Fig. 5).

Black Brant

This survey is not designed for colonial nesting species such as black brant. However, brant data collected does provide useful information on distribution with the highly variable population indices (Table 3, Fig. 6). The indicated pairs index of 8,847 birds decreased from the record high recorded in 2008 (13,132) and was similar to that of 2007 (8,937). The indicated total bird index in 2009 (23,033) was also lower than that recorded in 2008 (29,166), but higher than that of 2007 (19,191) (Table 3, Fig. 6). The variation noted in indicated pairs may reflect differences in survey timing related to black brant nesting phenology, or a difference in counting brant as pairs or flocks between observers. Black brant breeding numbers in major colonies are currently determined through aerial videography but data for 2009 were not available for this report.

Taverner's Canada Geese

This subspecies is found primarily interior to the coastal zone surveyed, but some overlap occurs on the eastern, northern and southern portions of the survey area. For these areas, arbitrary lines have been established to divide cackling Canada geese and Taverner's Canada geese observations for population index estimates. We do not consider the range overlap, and resulting misclassification of subspecies, to substantially affect results. Results for both indices decreased from those of 2008. Both indices are highly variable with slightly positive growth rates (Table 3, Fig. 7).

Tundra Swans

The index for tundra swan singles and pairs for 2009 (20,272) was essentially the same as in 2008 (20,233) (Table 4, Fig. 8). The index for total birds in 2009 (27,897) decreased from that recorded in 2008 (32,184), while the nest index increased from 2008 (Table 4, Fig. 8). All three indices indicate slightly positive growth rates (Fig. 8). The total bird index is highly variable, the singles and pairs less so, and the nest index the least variable of the three (Fig. 8).

Sandhill Cranes

The indicated total bird index for sandhill cranes increased in 2009 (16,188) as compared to 2008 (14,882), while the 2009 index for indicated pairs (13,207) was similar to those recorded in recent years and up only slightly from 2008 (12,944). Both indices indicate slightly declining trends in growth rates (Table 5, Fig. 9).

DISCUSSION

All geese indices for 2009 were lower in comparison to the previous year's indices, except for the cackler pair index which equaled the 2008 index. The cackling Canada geese index showed a decrease from the previous year for the first time since 2004 and the Pacific white-fronted geese index, for the first time since 2005. Indicated pairs indices for both species are less variable. Cackler indicated pairs have remained steady for 3 years, while white-fronts indicated pairs declined for the first year since 2004. The total bird index for swans was also lower in 2009 compared to 2008, while the pairs index was essentially unchanged. The only indices higher in 2009 compared to 2008 were those of sandhill cranes for both total birds and pairs. It appears that numbers of geese, especially white-fronts, have begun to level out in recent years, possibly due to populations reaching carrying capacity. Future plans will include fitting the data to sigmoid curves, rather than just log-linear equations, to help better interpret trends.

Part of the fluctuations in indicated total bird indices may be attributed to factors other than real population changes, such as variation among years in visibility, survey timing, habitat conditions, nest success, and changes in observers.

We encourage managers to evaluate both indicated pairs and total birds in the decision making process. Population trends over time are the most useful information from this survey, rather than annual variation.

ACKNOWLEDGMENTS

We thank the staff of the YKD National Wildlife Refuge for logistical support. Robert Platte was backseat observer for other waterbirds and provided valuable assistance during the survey. Ed Mallek and Deborah Groves provided data for the combined Pacific white-front fall population estimate.

LITERATURE CITED

- Mallek, E. and D.J. Groves. 2009. Alaska-Yukon waterfowl breeding population survey. Unpub. Rept. U.S. Fish and Wildlife Service, Migratory Bird Management. Juneau, AK
- Fischer, J.B., R.A. Stehn and G. Walters. 2009. Nest populations and potential production of geese and eiders on the Yukon-Kuskokwim Delta, Alaska. Unpub. Rept. U.S. Fish and Wildlife Service, Migratory Bird Management. 1011 E. Tudor Road, Anchorage, AK

Table 1. Indicated total^a population indices for cackling Canada, emperor, and white-fronted geese on the Yukon-Kuskokwim Delta, 1985-2009.

Year	Cackling Canada Geese		White-fronted Geese		Emperor Geese	
	Index	SE	Index	SE	Index	SE
1985	13,963	1,605	18,914	1,482	19,805	1,960
1986	13,502	1,013	13,400	1,014	12,430	1,008
1987	19,921	1,390	15,717	1,413	13,035	1,121
1988	24,467	1,507	27,191	2,642	16,392	1,402
1989	25,475	1,567	28,004	2,430	16,855	1,220
1990	31,759	2,166	37,836	4,067	17,347	1,401
1991	28,843	1,688	31,286	2,294	14,888	1,284
1992	44,356	2,632	34,671	2,908	15,416	994
1993	45,749	2,534	39,748	3,020	17,147	1,230
1994	65,021	3,181	56,513	3,730	18,733	1,059
1995	69,888	3,756	77,710	5,483	18,764	1,072
1996	74,574	4,008	78,032	5,339	24,413	2,476
1997	88,018	4,359	83,215	5,738	23,287	1,451
1998	64,601	3,701	87,881	7,874	21,741	1,541
1999	72,173	3,509	95,040	8,876	21,406	1,591
2000	74,992	3,352	91,911	6,591	18,667	949
2001	75,620	3,734	113,603	9,358	27,297	1,473
2002	50,187	2,487	90,407	7,537	19,504	1,326
2003	69,867	3,482	117,951	12,034	21,378	1,746
2004	51,390	2,691	100,622	9,611	21,396	1,097
2005	65,484	3,091	121,017	12,000	19,798	1,190
2006	71,985	3,291	138,067	10,648	26,562	1,697
2007	74,152	3,138	178,515	15,035	24,362	1,508
2008	84,699	3,517	161,979	14,831	22,100	1,038
2009	67,434	2,909	144,678	14,065	20,684	1,092

a--Indicated total = 2 x (singles + pairs) + birds in flocks

Table 2. Indicated pair^a indices for cackling Canada, emperor, and white-fronted geese on the Yukon-Kuskokwim Delta, 1985-2009.

Year	Cackling Canada Geese		White-fronted Geese		Emperor Geese	
	Index	SE	Index	SE	Index	SE
1985	10,313	1,378	9,382	776	9,542	852
1986	10,770	854	6,713	513	7,413	611
1987	14,367	967	7,819	653	9,312	746
1988	16,290	1,009	11,953	890	8,695	829
1989	21,168	1,330	11,982	968	10,737	791
1990	20,330	1,341	11,705	938	9,282	787
1991	22,405	1,290	12,584	902	7,758	590
1992	28,443	1,697	14,077	1,086	9,879	686
1993	33,781	1,828	15,010	1,213	10,183	787
1994	41,200	2,135	20,155	1,432	12,007	712
1995	49,354	2,872	26,985	1,911	12,892	806
1996	39,543	2,371	21,887	1,626	12,433	604
1997	49,254	2,570	27,611	1,521	12,820	741
1998	46,372	2,896	40,872	3,888	15,686	1,136
1999	49,556	2,401	48,207	3,791	16,208	1,285
2000	52,855	2,428	42,558	2,693	12,798	680
2001	49,665	2,451	63,555	5,228	17,112	926
2002	41,982	2,033	51,381	4,491	15,646	1,215
2003	40,993	2,058	51,670	4,797	12,141	869
2004	40,848	2,219	47,928	4,973	14,410	848
2005	44,018	2,220	50,141	4,067	14,490	817
2006	47,500	2,293	71,484	6,104	17,460	936
2007	51,194	2,345	70,670	7,824	14,562	1,004
2008	52,368	2,444	73,022	5,980	16,110	724
2009	52,368	2,328	66,759	6,004	13,563	646

a--Indicated pairs = 2 x (singles + pairs)

Table 3. Black brant and Taverner's Canada geese on the Yukon-Kuskokwim Delta, 1985-2009.

Year	Black Brant		Taverner's Canada Geese	
	Indicated Pairs ^a	Indicated Total ^b	Indicated Pairs ^a	Indicated Total ^b
1985	1,180	5,164	4,285	5,517
1986	2,030	14,007	3,782	5,150
1987	4,652	14,893	3,187	4,059
1988	3,840	22,713	5,191	9,217
1989	4,220	26,231	7,142	8,865
1990	2,989	28,820	6,498	7,819
1991	4,528	27,151	5,454	8,063
1992	6,144	20,026	5,089	8,698
1993	4,446	32,004	6,519	8,643
1994	5,764	31,278	5,536	7,017
1995	5,858	34,401	5,780	6,475
1996	5,620	29,503	3,856	6,644
1997	6,818	30,738	4,466	6,630
1998	8,252	22,127	6,607	8,446
1999	9,492	22,520	7,532	12,532
2000	8,402	26,381	8,232	10,384
2001	5,686	31,242	6,063	7,701
2002	9,208	20,396	5,145	6,204
2003	3,588	20,621	5,426	8,043
2004	7,641	19,238	4,580	7,755
2005	5,634	20,560	3,942	6,385
2006	11,279	19,495	6,523	9,355
2007	8,937	19,191	3,800	7,042
2008	13,132	29,166	5,663	10,209
2009	8,847	23,033	4,245	7,610

a--Indicated singles and pairs = 2 x (singles + pairs)

b--Indicated total = 2 x (singles + pairs) + birds in flocks

Table 4. Tundra swan population indices on the Yukon- Kuskokwim Delta, 1985-2009.

Year	Singles and		
	Pairs ^a	Total Birds ^b	Nests ^c
1985	13,664	30,874	2,471
1986	14,093	24,299	3,093
1987	12,149	24,180	2,177
1988	13,872	24,459	3,159
1989	12,695	33,115	2,613
1990	12,759	30,006	2,802
1991	11,465	18,663	2,442
1992	13,174	19,411	3,009
1993	12,348	20,180	2,818
1994	13,204	18,787	3,086
1995	16,594	23,052	3,560
1996	17,238	23,121	3,975
1997	18,106	28,683	4,034
1998	19,947	33,355	4,964
1999	20,727	27,211	4,601
2000	20,048	28,306	4,494
2001	17,251	24,395	3,147
2002	21,356	31,193	5,713
2003	14,823	23,015	4,646
2004	17,760	27,099	5,301
2005	14,548	23,645	3,360
2006	22,663	31,545	4,224
2007	20,760	30,454	4,074
2008	20,233	32,184	3,649
2009	20,272	27,897	3,808

a--Singles and Pairs = singles + (2 x pairs)

b--Total Birds = singles + (2 x pairs) + birds in flocks

c--Nests = number of active nest observations

Table 5. Sandhill Crane population indices on the YKD, 1987-2009.

Year	Indicated	
	Pairs ^a	Total Birds ^b
1985		
1986		
1987	14,246	15,079
1988	12,777	16,549
1989	13,247	16,719
1990	14,228	18,310
1991	14,358	20,601
1992	13,394	17,185
1993	16,012	19,312
1994	13,832	16,548
1995	16,906	18,182
1996	10,220	16,430
1997	11,446	13,530
1998	17,859	24,458
1999	16,236	18,612
2000	15,886	18,144
2001	14,923	16,211
2002	12,605	13,076
2003	10,779	13,778
2004	12,014	14,608
2005	11,468	14,464
2006	12,778	15,298
2007	12,599	13,138
2008	12,944	14,882
2009	13,207	16,188

a--Indicated Pairs = 2 x (singles + pairs)

b--Indicated Total Birds = 2 x (singles + pairs)
+ birds in flocks

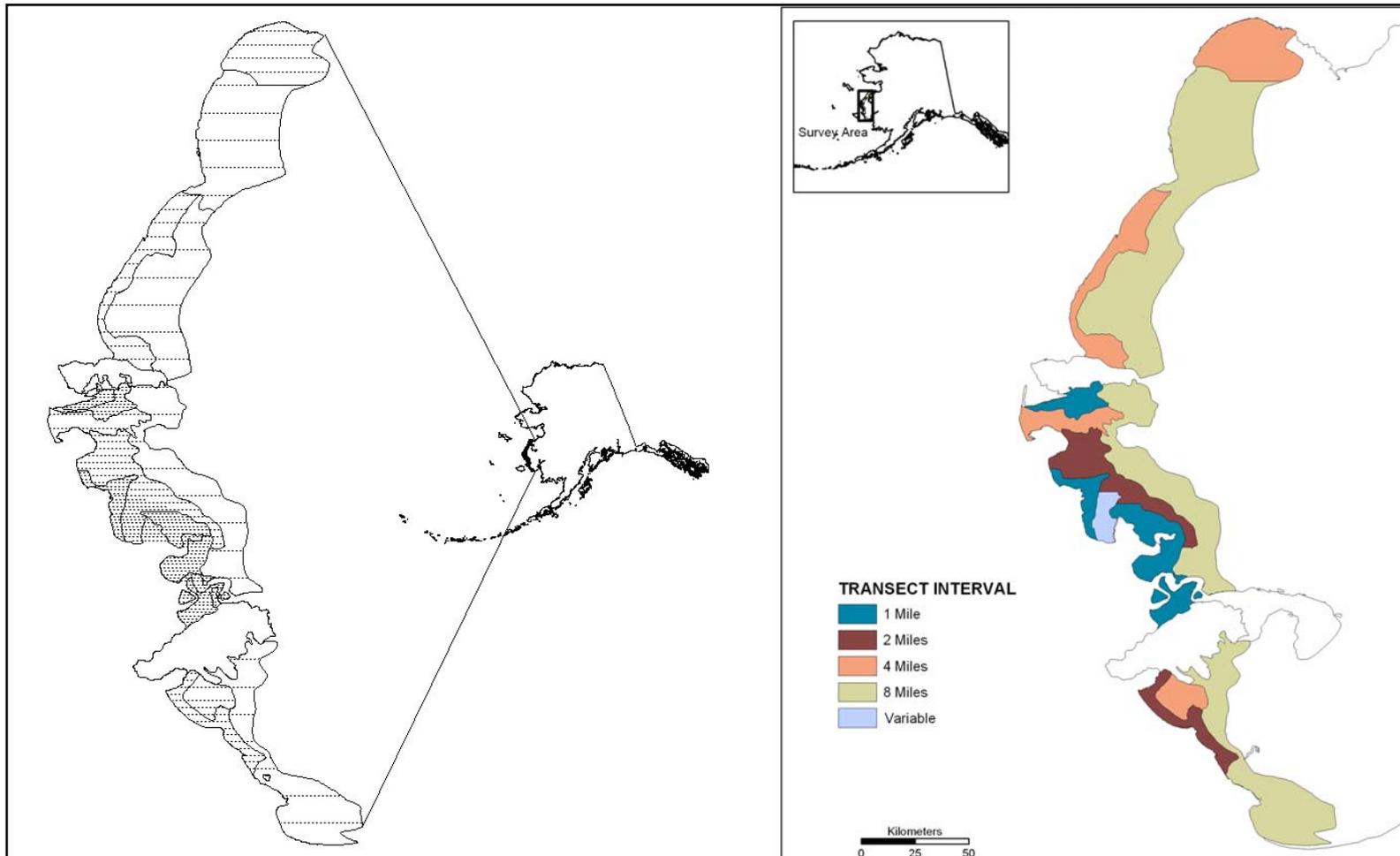


Figure 1. Flight lines (left side) and current 4-strata design (right side) for Yukon Delta aerial surveys.

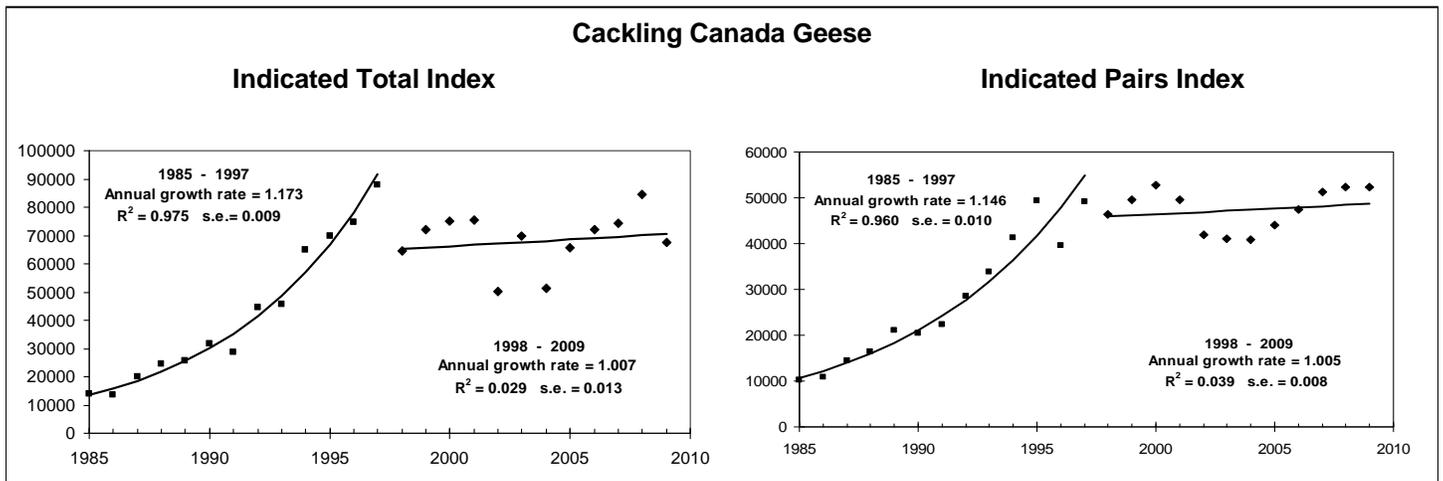


Fig. 2. Population index growth curves and average annual growth rates from log-linear regression for cackling Canada geese, for the first 13 years (1985-1998) and the last 12 years (1998-2009).

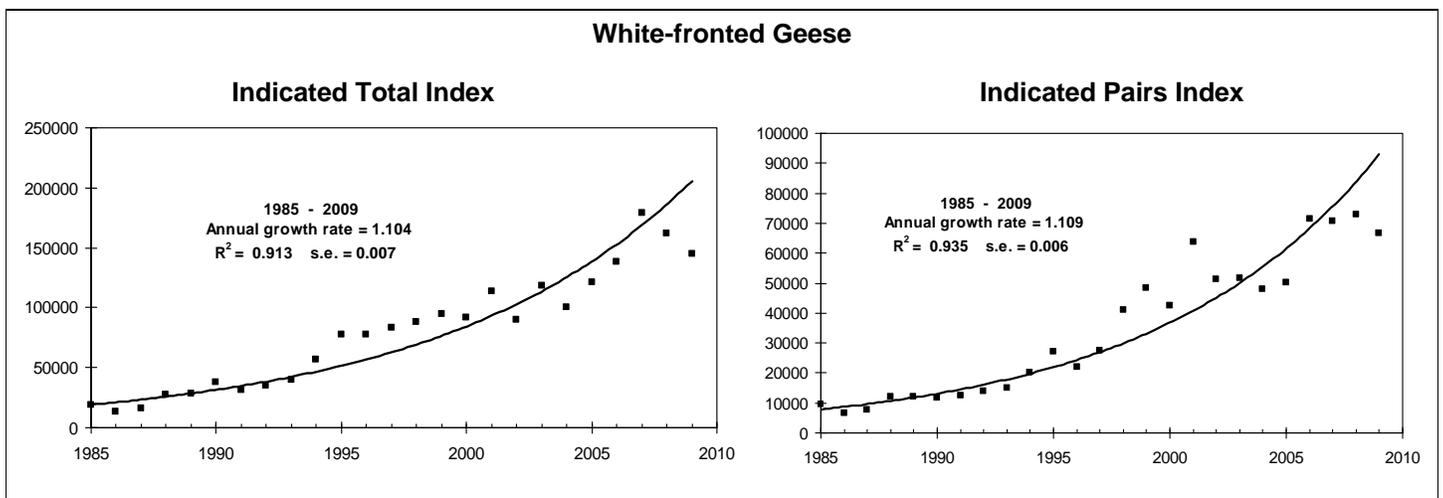


Fig. 3. Population index growth curves and average annual growth rates from log-linear regression for white-fronted geese, 1985-2009.

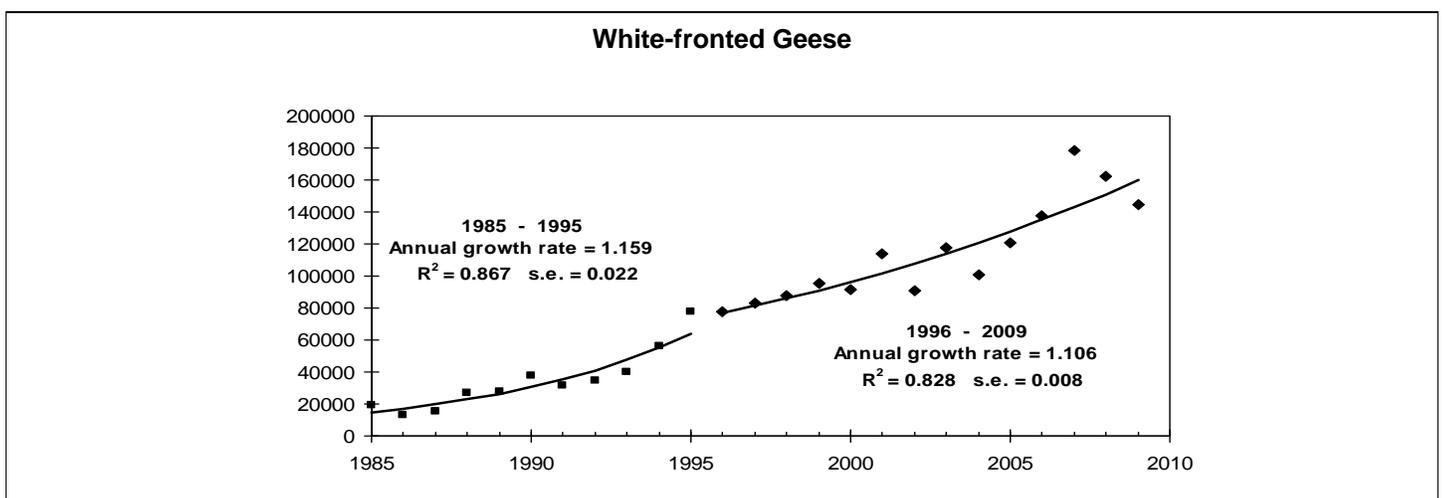


Fig. 4. Indicated total population index growth curves and average annual growth rates from log-linear regression for white-fronted geese based on the first 11 years (1985-1995) and the last 14 years (1996-2009).

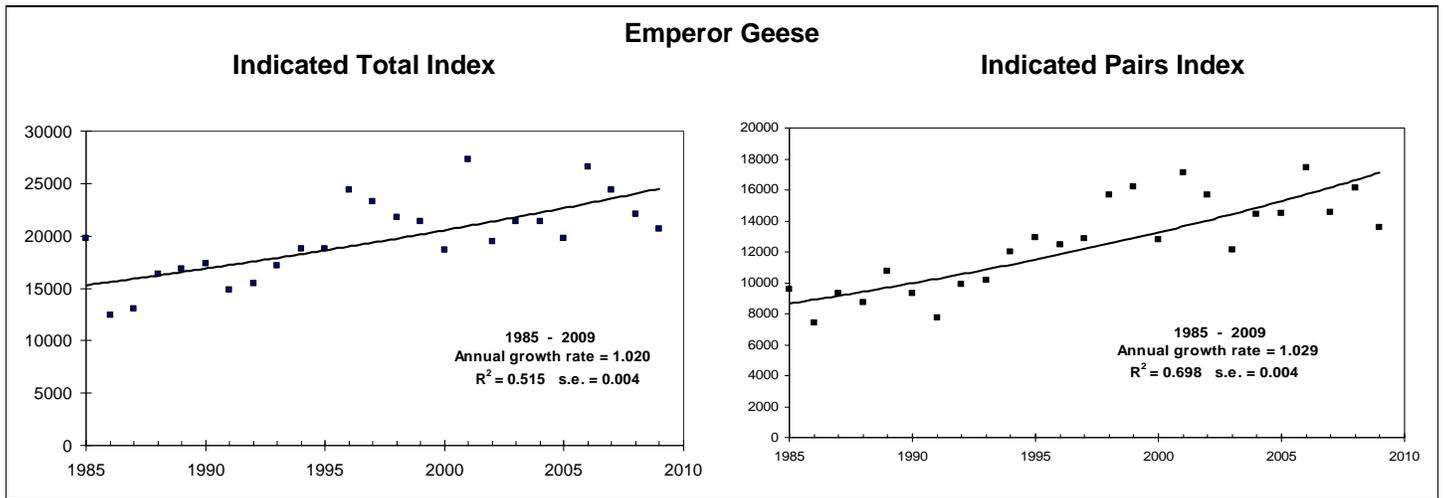


Fig. 5. Population index growth curves and average annual growth rates from log-linear regression for emperor geese, 1985-2009.

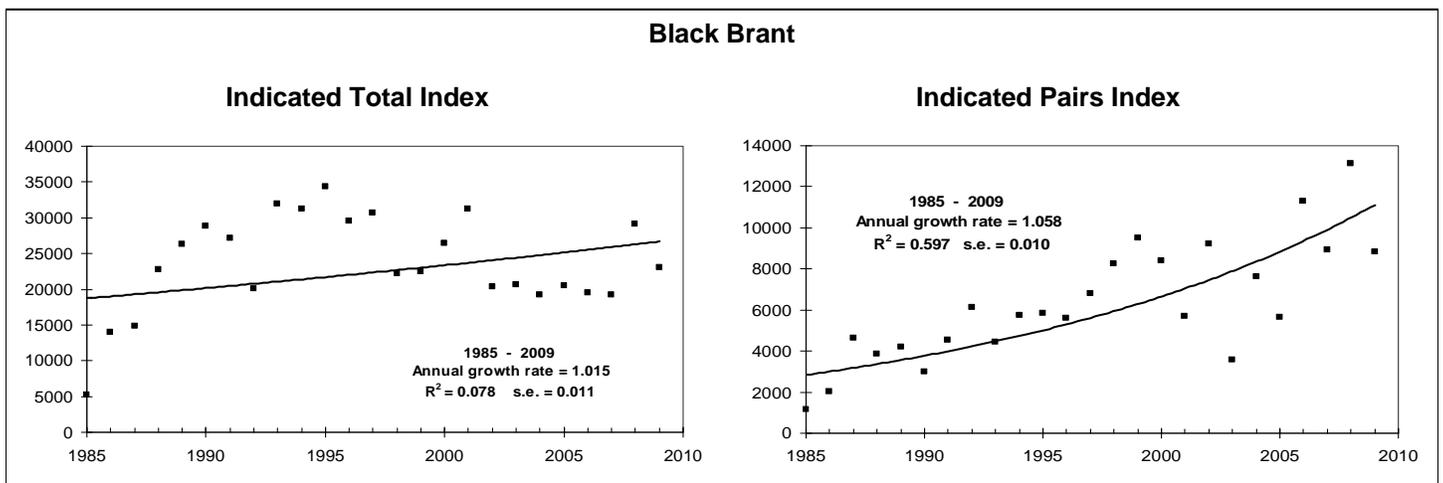


Fig. 6. Population index growth curves and average annual growth rates from log-linear regression for black brant, 1985-2009.

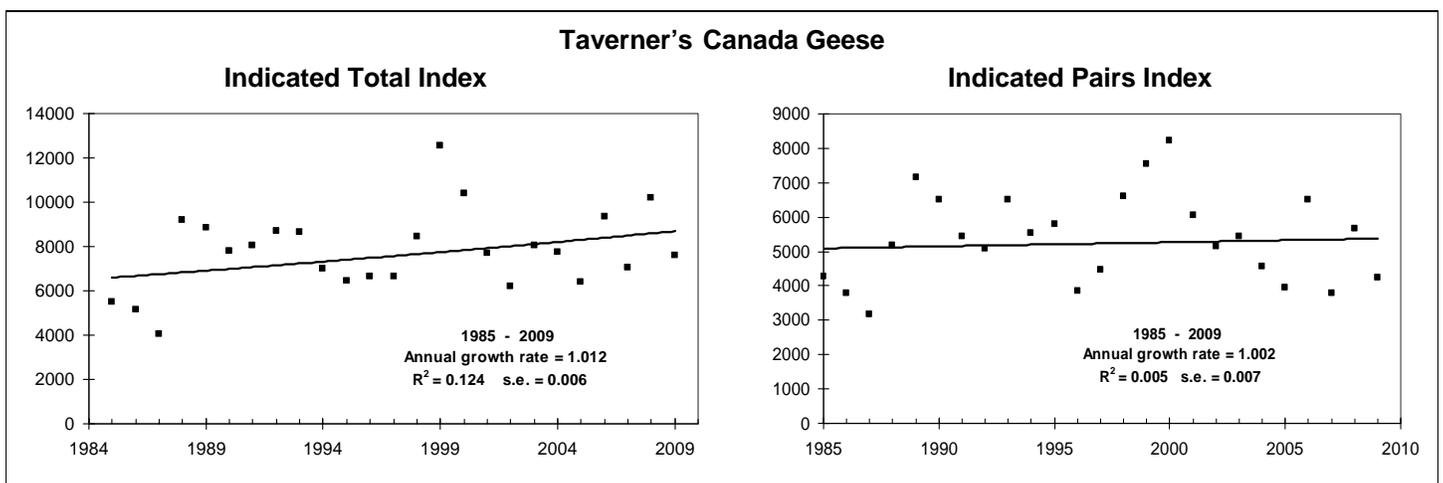


Fig. 7. Population index growth curves and average annual growth rates from log-linear regression for Taverner's Canada geese, 1985-2009.

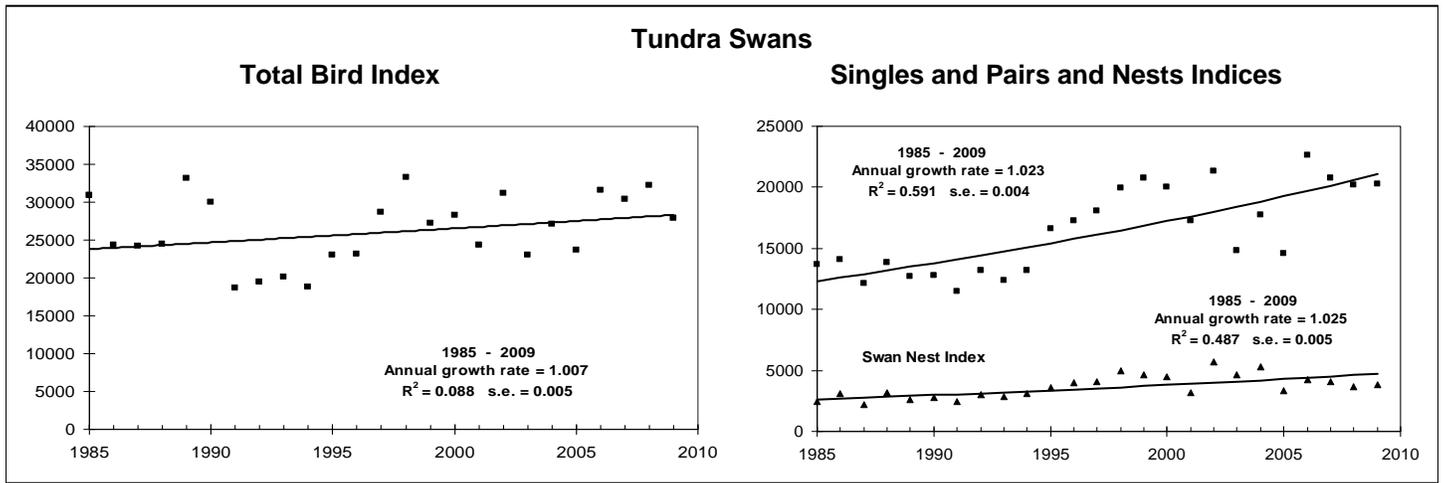


Fig. 8. Population index growth curves and average annual growth rates from log-linear regression for tundra swan, 1985-2009.

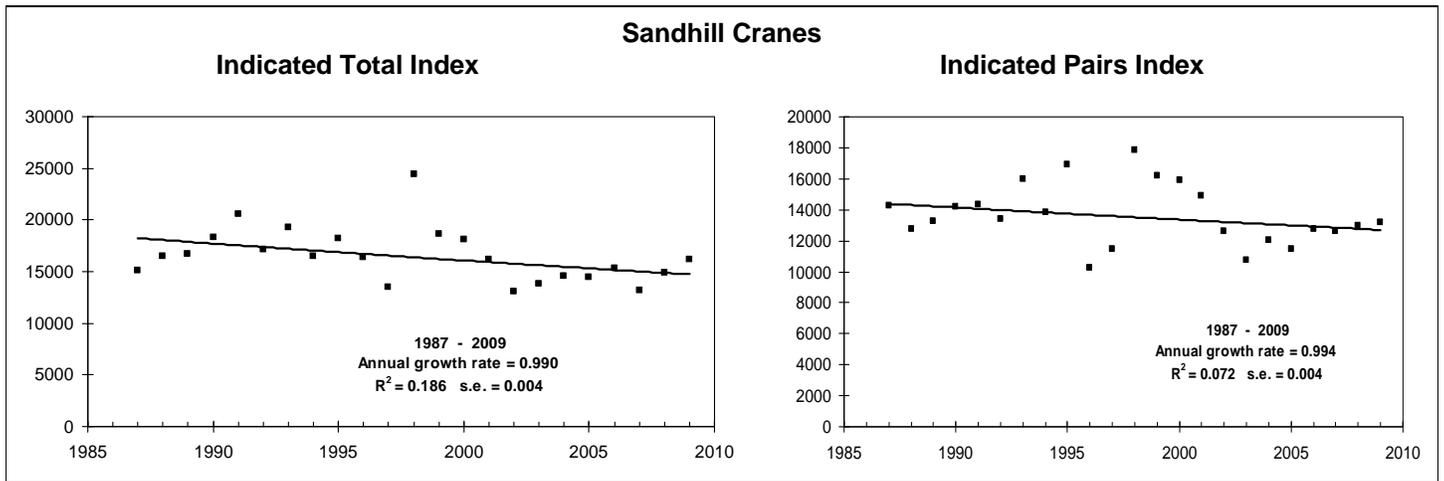
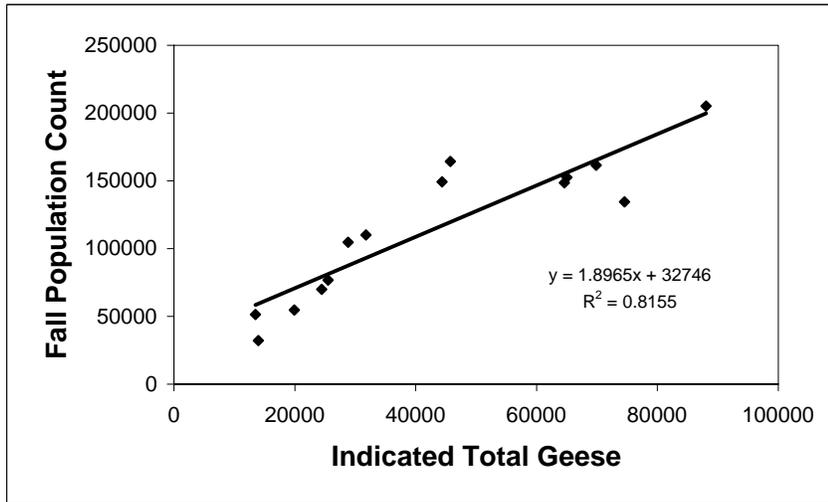


Fig. 9. Population index growth curves and average annual growth rates from log-linear regression for sandhill cranes, 1987-2009.

APPENDIX 1. Cackling Canada goose fall count, indicated total bird spring index, estimated fall population from the 1985-98 spring/fall correlation (see graph) and 3-year moving average of the estimated fall population.



Year	Fall Count	Indicated Total Bird Index ^a	Fall Estimate ^b	3-year Average
1985	32,100	13,963	59,227	
1986	51,400	13,502	58,353	
1987	54,800	19,921	70,526	62,702
1988	69,900	24,467	79,148	69,342
1989	76,800	25,475	81,059	76,911
1990	110,200	31,759	92,977	84,395
1991	104,600	28,843	87,447	87,161
1992	149,300	44,356	116,867	99,097
1993	164,300	45,749	119,509	107,941
1994	152,500	65,021	156,058	130,811
1995	161,400	69,888	165,289	146,952
1996	134,600	74,574	174,176	165,174
1997	205,100	88,018	199,672	179,712
1998	148,600	64,601	155,262	176,370
1999		72,173	169,622	174,852
2000		74,992	174,968	166,617
2001		75,620	176,159	173,583
2002		50,187	127,926	159,684
2003		69,867	165,249	156,445
2004		51,390	130,207	141,127
2005		65,484	156,936	150,797
2006		71,985	169,266	152,136
2007		74,152	173,375	166,526
2008		84,669	193,321	178,654
2009		67,434	160,635	175,777

a--Indicated total based on new stratification

b--fall estimate based on indicated total bird index

APPENDIX 2. Indices of Pacific white-fronted geese as indicated breeding birds (2 x singles + paired) and indicated total geese from June aerial surveys of Y-K Delta and Bristol Bay Lowlands (Bollinger and Eldridge 2009; Mallek and Groves 2009).

Year	Y-K Delta		Y-K Interior		Bristol Bay		Y-K Total		All PF W-fronts	
	Singles + Pairs	Total Geese	Singles + Pairs	Total Geese	Singles + Pairs	Total Geese	Singles + Pairs	Total Geese	Singles + Pairs	Total Geese
1985	9,382	18,914	5,698	12,082	1,219	5,050	15,080	30,996	16,299	36,046
1986	6,713	13,400	5,894	10,019	1,915	4,266	12,607	23,419	14,522	27,685
1987	7,819	15,717	4,715	7,564	1,045	3,657	12,534	23,281	13,579	26,938
1988	11,953	27,191	9,037	14,145	522	3,918	20,990	41,336	21,512	45,254
1989	11,982	28,004	5,108	16,307	1,045	5,398	17,090	44,311	18,135	49,709
1990	11,705	37,836	8,841	18,468	871	2,003	20,546	56,304	21,417	58,307
1991	12,584	31,286	6,287	13,262	1,741	4,527	18,871	44,548	20,612	49,075
1992	14,077	34,671	6,287	16,110	522	7,052	20,364	50,781	20,886	57,833
1993	15,010	39,748	8,055	22,790	697	1,306	23,065	62,538	23,762	63,844
1994	20,155	56,513	6,680	12,966	871	4,092	26,835	69,479	27,706	73,571
1995	26,985	77,710	7,859	10,215	1,393	2,612	34,844	87,925	36,237	90,537
1996	21,887	78,032	15,914	36,543	697	4,353	37,801	114,575	38,498	118,928
1997	27,611	83,215	15,521	30,452	871	3,657	43,132	113,667	44,003	117,324
1998	40,872	87,881	16,307	34,381	1,567	1,915	57,179	122,262	58,746	124,177
1999	48,207	95,040	10,806	27,800	1,393	3,483	59,013	122,840	60,406	126,323
2000	42,558	91,911	8,841	16,798	871	1,654	51,399	108,709	52,270	110,363
2001	63,555	113,603	10,806	24,460	348	6,095	74,361	138,063	74,709	144,158
2002	51,381	90,407	14,146	17,387	1,219	5,311	65,527	107,794	66,746	113,105
2003	51,670	117,951	11,002	17,387	522	2,177	62,672	135,338	63,194	137,515
2004	47,928	100,622	9,234	16,601	1,045	1,828	57,162	117,223	58,207	119,051
2005	50,141	121,017	10,216	18,566	174	6,530	60,357	139,583	60,531	146,113
2006	71,484	138,067	13,360	28,979	3,309	4,702	84,844	167,046	88,153	171,748
2007	70,670	178,515	16,503	28,488	697	2,177	87,173	207,003	87,870	209,180
2008	73,022	161,979	20,040	54,913	522	1,045	93,062	216,892	93,584	217,937
2009	66,759	144,678	17,486	32,712	1,045	5,137	84,245	177,390	85,290	182,527

APPENDIX 3. Derivation of the annual fall population index for Pacific white-fronted geese from the relationship between June total indicated geese from the Y-K Delta and Bristol Bay to previous reliable fall surveys (1985-98).

Year	Total Indicated Birds ¹	Fall Survey	New Fall Index ²	3-Year Average
1985	36,046	93,800	163,249	
1986	27,685	107,100	141,930	
1987	26,938	130,600	140,026	148,402
1988	45,254	161,500	186,728	156,228
1989	49,709	218,800	198,087	174,947
1990	58,307	240,800	220,010	201,608
1991	49,075	236,500	196,470	204,856
1992	57,833	230,900	218,802	211,761
1993	63,844	295,100	234,128	216,467
1994	73,571	324,800	258,930	237,287
1995	90,537	277,500	302,190	265,083
1996	118,928	344,100	374,582	311,901
1997	117,324	319,000	370,492	349,088
1998	124,177	413,100	387,966	377,680
1999	126,323		393,437	383,965
2000	110,363		352,743	378,048
2001	144,158		438,913	395,031
2002	113,105		359,734	383,797
2003	137,515		421,975	406,874
2004	119,051		374,895	385,535
2005	146,113		443,898	413,589
2006	171,748		509,262	442,685
2007	209,180		604,706	519,289
2008	217,937		627,035	580,334
2009	182,527		536,746	589,496

¹ TIB = 2 x (pairs + singles) + group birds Y-K Delta and Bristol Bay

² Fall Population Index = (TIB x 2.5498) + 71,339