AERIAL SURVEY OF EMPEROR GEESE AND OTHER WATERBIRDS IN SOUTHWESTERN ALASKA, SPRING 2009

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Key Words: Aerial survey, emperor geese, waterbirds, southwest Alaska.

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Abstract: The 29th consecutive spring aerial emperor goose survey was conducted from 1-3 May. The survey area is coastline and estuarine habitats from Jacksmith Bay to Wide Bay, including the north and south sides of the Alaska Peninsula. A total of 91,948 emperor geese were observed, up 41.6% from 2008 and up 43.2% from the long-term average (64,190, 1981-2008). This is the second largest count since the survey began bringing the recent 3-year average management index to 78,144 birds (up 7.2% from the previous 3-yr average of 72,864). Other species of emphasis included Pacific brant and Steller's eider with observed populations of 82,709 and 25,841, respectively. An amphibious Cessna 206 (N234JB) was used, flown at 45m (150 feet) ASL and 200km/hr (110 kts).

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INTRODUCTION

This survey has annually monitored spring distribution, abundance and population trends of emperor geese and other waterbirds at migratory staging areas throughout southwestern Alaska since 1981. The traditional survey route included coastline and estuarine habitats from the Yukon-Kuskokwim Delta (Y-K Delta) south and west along the north side of the Alaska Peninsula to Unimak Island, and the south side of the Alaska Peninsula east to Wide Bay. Coverage along the south side of the Alaska Peninsula emphasizes known emperor goose staging and use areas and omits areas of marginal habitat where birds have not been seen during previous surveys. A 3-year moving average of these population data, collected in accordance with the Pacific Flyway Emperor Goose Management Plan, is used as the index to establish harvest thresholds. These data also assess annual and long-term variation in seasonal migratory phenology and determine trends in distribution and habitat use for emperor geese.

METHODS

The survey was flown from 1-3 May. Generally, survey timing during recent years has been adjusted earlier in response to climatic conditions within the survey area, including earlier break-up of sea ice. However, adverse winds delayed the start of the 2009 survey until 1 May which fortuitously compensated for the late conditions (ice and snow cover) encountered in the northern segments of the survey area.

The survey area includes a maximum of 143 shoreline/estuarine segments identified on

1:500,000 scale aeronautical and 1:63,360 topographical maps (Figure 1) (Mallek and Dau 2000). Segments along the south side of the Alaska Peninsula with marginal habitat, where no emperor geese were observed during initial surveys, have been omitted. General observations of habitat and survey conditions including wind speed and direction, temperature, sky condition, visibility and tide stage were recorded en route.

An amphibious Cessna 206 (N234JB) flown at a ground speed of approximately 200 km/hr (110 kts) and an altitude of 45m (150 feet) ASL was used. The planned route of flight was Jacksmith Bay, in the southern portion of Kuskokwim Bay south to Bechevin Bay on Unimak Island along the north side of the Alaska Peninsula, and then eastward along the south side of the Alaska Peninsula to Wide Bay. The coastal flight path was approximately 100 meters offshore with deviations, normally within 1.6 km (1 mile) of exposed shorelines, to confirm species identification and estimate numbers. In estuaries, a systematic but meandering flight path was followed to ensure complete coverage. Whenever possible, flights were conducted with <20 knots of wind and primary staging areas were flown at or near high tide as this concentrated geese near shorelines. Observations were made from both sides of the aircraft and voice recorded into two laptop computers using remote microphones. Computers received input from the aircraft Global Positioning System (GPS) saving coordinates for each observation. Specialized record and transcribe programs were used to process these data (J. Hodges, MBM-Juneau).

SURVEY CONDITIONS

Climatic conditions this spring were delayed even more so than in 2008, also a late spring. Sea ice coverage was extensive from Cape Pierce to the Walrus Islands to an estimated 10 kilometers southward of Shaiak and Hagemeister islands and 3 kilometers southward of Round Island. Some onshore ice and broken, floating brash was present along the west and south shores of the Nushagak Peninsula but the remainder of Bristol Bay was ice-free. Broken, floating ice was present in approximately 5% of Egegik Bay and 1% of Ugashik Bay with the remainder of Alaska Peninsula estuaries ice-free. Snow cover in coastal lowlands was extensive from the Nushagak Peninsula north and light or absent in all other surveyed areas (Table 1).

May 1: Jacksmith Bay to Naknek (Segments 14-33). Easterly winds to 25 knots resulted in turbulence in southern Kuskokwim Bay which precluded coverage of segments 15-19 and 26-28, otherwise, ceilings and visibility were unrestricted. Segments 23-25 were omitted due to sea ice and the lack of open water. Extensive ice cover was reported in all estuaries in northern Bristol Bay and southern Kuskokwim Bay. No sea ice was visable in offshore areas of Kuskokwim Bay south to Cape Newenham but there was extensive ice cover from Cape Pierce to Round Island. Estuary ice cover was as follows: Jacksmith Bay open, Carter Bay 70%, Goodnews Bay 75 %, Chagvan Bay 80% and Nanvak Bay 99%. Lowland areas were 80% snow covered north from the Nushagak Peninsula and mostly snow free south to Naknek. Freshwater ponds were ice covered in northern Bristol Bay and mostly open to the south.

May 2: King Salmon to Bechevin Bay (segments 34-69, 80-85). Survey conditions were favorable with northerly winds of 10 kts, clear skies from King Salmon to Cold Bay (segments 34-60) and 8000 feet overcast in the Izembek area (segment 61-85), with temperatures of 45-50^{o}F. Bristol Bay was ice free. Tide conditions were mid-low in Egegik and Ugashik bays, low from Cinder River to Port Moller and Herendeen Bay, mid in Nelson Lagoon, high in Izembek Lagoon and low in all Pacific Ocean side estuaries. Snow in lowland habitats throughout the area was slight to absent. Larger freshwater ponds from Naknek to Port Heiden were mostly ice-free and essentially all lakes to the south were open.

May 3: Cold Bay to Wide Bay (Segments 86-137). Survey conditions were mostly favorable with westerly winds averaging 10 knots, ceilings were clear and temperatures increased from 40-60^{o} F during the day. Turbulence resulted in omission of some fiords and headlands between Pavlof and Stepovak bays but all known emperor goose concentration areas were surveyed. Freshwater ponds were mostly open.

RESULTS/DISCUSSION

A total of 91,948 emperor geese were observed (Table 2). High southerly winds delayed the survey start from 27 April to 1 May. However, considerable sea and estuarine ice in southern Kuskokwim Bay and northern Bristol Bay appeared to delay migration. Most emperor geese were congregated in traditional locations along the north side Alaska Peninsula. Larger than normal numbers along the south side of the Alaska Peninsula suggests delayed migration from that area in conjunction with an accelerated departure from Kodiak Island and other insular wintering sites. Observations from Unalaska, in the eastern Aleutian Islands, suggested the last migrants peaked at 1400 and departed by 15 April, a week later than in 2008 when departure was judged to be a month late (S. Golodoff, pers. comm.). A last, single emperor goose was observed at Unalaska on 23 April. The first emperor goose sighting on the Yukon-Kuskokwim Delta was on 30 April (J. Sedinger, pers. comm.), indicating that some birds went undetected north of the survey area.

Emperor Goose

The 2009 emperor goose count of 91,948 was the highest observed since 1982 and the second highest count since the survey began. This total is 41.6% above the 2008 estimate of 64,944 (Table 2) and 43.2% above the long-term average of 64,190 (1981-2008, 95% CI = 5,789). The current 3-year average management index of 78,144 (Table 3) increased 7.2% from the previous average of 72,864 (2006-2008) (Table 2). Emperor goose migratory phenology was delayed in comparison to recent years and an increased proportion was distributed along the north side of the Alaska Peninsula (95.4% of total birds in 2009; long-term average 91.5%, Table 4). Above average numbers of emperor geese were observed north of Cape Newenham (1,112, approximately 30% above the long-term average) and along the south side of the Alaska Peninsula (5,297, approximately 78% above the long-term average). Long-term (29-year) and 10-year growth rates are illustrated in Figure 3. While the 29-year and 10-year trends differ,

neither is significant.

Pacific Brant

We observed a total of 82,708 brant during the 2009 survey (Table 2), 71,737 (86.7%) of which were in Izembek Lagoon and adjacent areas. The brant total is 63.5% above the 2008 count of 50,591 and 47.1% above the long-term average of 56,208 (1981-2008, 95% CI = 8,783). Increased brant numbers suggests their migratory chronology was advanced in 2009 and that timing of migration to Alaska probably corresponds most closely to climatic conditions south of Alaska. However, the total of 8,493 brant observed in Nanvak (101) and Chagvan (8392) bays north of Cape Newenham is approximately half the recent average number for these areas (i.e. 15,556 [USFWS file data]) suggesting northerly movements were delayed after their arrival to Alaska.. South side Alaska Peninsula numbers in 2009 (2,454) were comparable to recent long-term averages (i.e. 2,616 [USFWS file data]). The first observed arrival of brant on the Yukon-Kuskokwim Delta was reported at the Tutakoke River on 30 April (J. Sedinger, pers. comm.) and small numbers of brant were being reported in estuaries from northern California to British Columbia through the first week of May (USFWS file data).

Steller's Eider

We observed 25,841 Steller's eiders (Table 2), a 56.1% decrease from the 2008 count of 58,841 and 48.0% below the long-term average of 49,719. Most Steller's eiders (20,679, 80.0% of the total) were observed from Port Heiden to Izembek Lagoon.

Steller's eider flock composition was recorded by the right seat observer and all flocks observed (n=64) were of equal ratios (i.e. adult males and brown-plumaged birds). Equal sex ratio flocks usually make up over 95% of observations. Later migrating flocks are occasionally predominated by brown-plumaged birds and as none such flocks were observed, migratory chronology may have been delayed in 2009.

CONCLUSIONS

The spring 2009 emperor goose population estimate of 91,948 is 43.2% above the long-term survey average of 64,190 (1981-2008). The current 3-year average population of 78,144 (2007-2009) is 7.2% above the previous 3-year average of 72,864 (2006-08). The current index is approaching the management threshold of 80,000 geese in spring and the highest 3-year average since 1984 (83,672).

We believe the primary factors affecting recent growth of the emperor goose population is above average productivity since 2006. Increased productivity did not correlate with lower than expected survey counts in the spring of 2007 and 2008. We believe factors including survey weather conditions, migration timing, survey timing, and emperor goose movements between surveys periods may have reduced the counts. Emperor goose productivity, based on 2006-2008 fall photographic age-ratio counts along the Alaska

Peninsula, estimated juvenile composition at an average of 26% (34% above the long-term average; 19%, 1985-2008 [USFWS file data]). This is an encouraging trend since productivity estimated age-ratios have been well below average for 11 of the past 13 years.

Cumulative impacts of illegal and incidental harvest and natural mortality of emperor geese have approached or exceed recruitment of breeding adults into the population (Wolfe and Paige 2002). It is hoped that decreased rates of harvest has occurred and also helped facilitate the recent increase in population size. No legal harvest of emperor geese has been allowed since 1986 and the few data on harvest are largely subjective and are, at best, under estimates due to incomplete surveys of Alaska and Chukotka use areas.

Emperor geese have exhibited their capability to respond positively when reproductive conditions are favorable and if adequate management procedures are initiated, a rapid increase in overall population size could be expected. Stopping all hunting take and increasing productivity by reducing predation of nests and goslings are the most viable options available to facilitate a positive population response.

Following are what we view as the primary problems limiting recovery of the population and realistic management options to control and monitor these factors are:

1) ***Problem:*** Illegal hunting in spring, summer, fall and winter. Comprehensive harvest surveys are needed in Alaska and Russia to assess temporal and spatial distribution of harvest. ***Management option:*** Eliminate or greatly reduce harvest.

2) ***Problem:*** Predation during nesting and brood rearing as indicated by low productivity in recent years and chronic low survival of juveniles from pre-fledging through winter (Schmutz et al. 1997). ***Management option:*** Predator management of foxes and gulls on the Y-K Delta should be initiated and monitored for effectiveness in increasing recruitment of breeding birds into the population (Bowman et al.1997). Monitoring of age and season specific survival rates should be continued.

3) ***Problem:*** Wintering ecology of emperor geese is poorly understood and survival of juveniles is low. ***Management option:*** Marking and satellite tracking studies of emperor geese have suggested the importance of further research to quantify mortality factors and determine if manageable options exist to reduce them.

We suggest that the existing spring emperor goose survey be continued to monitor population size and trend as required by the species management plan. On average, the majority of the emperor goose population arrives in the survey area by mid-April departs for breeding areas in early May. A short duration survey window is faced by the survey crew resulting from the migratory chronology of the species and the challenging climatic

conditions in the survey area (i.e. finding 3-5 consecutive survey days in the 3 week period). Nevertheless, we further suggest that, as conditions allow, continued consideration be given to obtaining replicate surveys of primary, high density staging sites. Replicate surveys would 1) help qualify the accuracy of the population index and 2) provide a useful measure of timing and duration of use of staging sites.

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Figure 1. Map of emperor goose aerial survey segments 1-36 in southwest Alaska, 1992-2009.

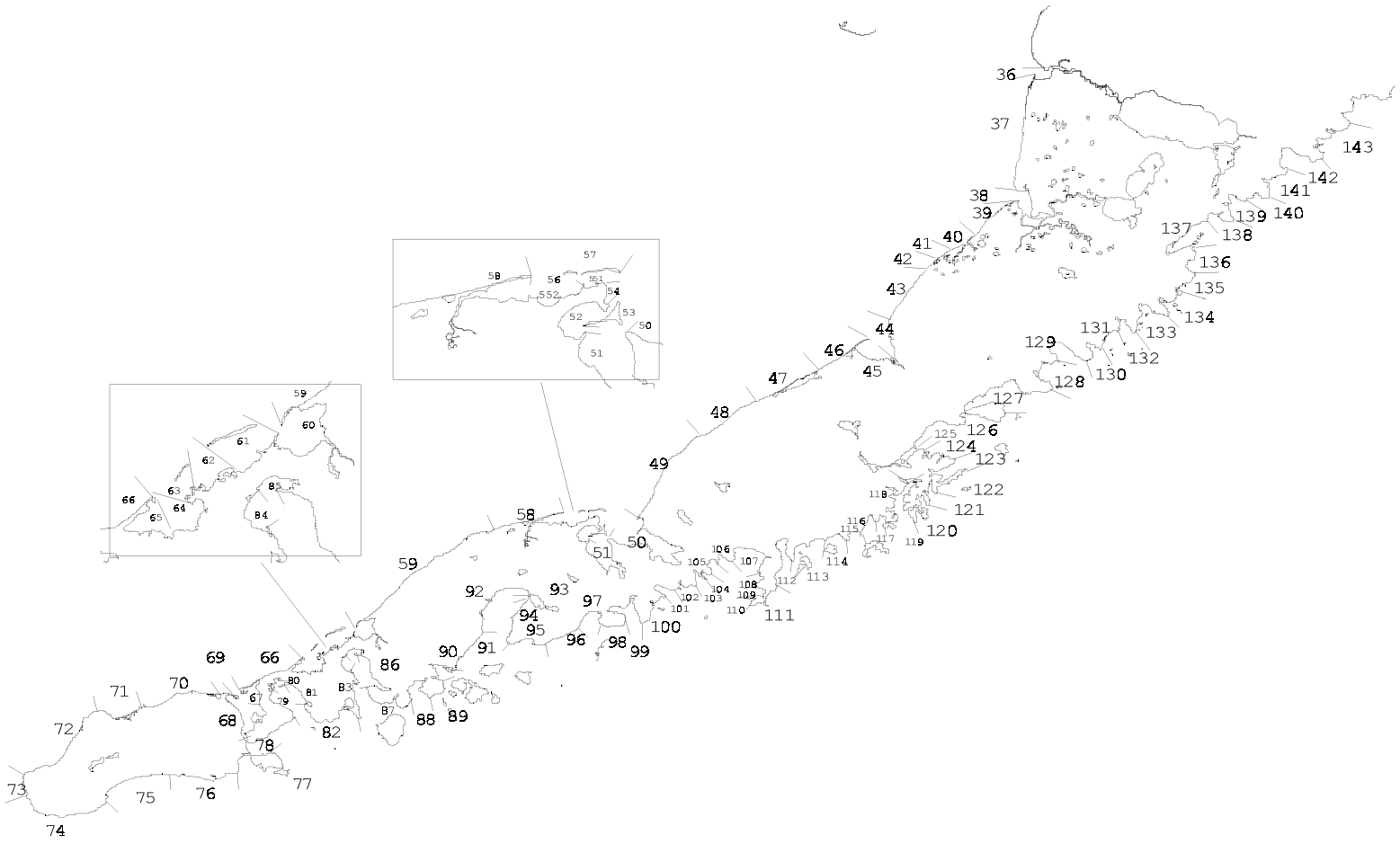

Figure 2. Map of emperor goose aerial survey segments 36-143 in southwest Alaska, 1992-2009.

Table 1. Snow and ice conditions during the spring emperor goose survey in southwest Alaska, 1 May 2009.

AREA	SNOW COVER[1]	MARINE ICE COVER[2]
Kokechik Bay	-	-
Hooper Bay	-	-
Hazen Bay	-	-
Carter Bay	80	70
Goodnews Bay	80	75
Chagvan Bay	80	80
Nanvak Bay	80	99
Relative Phenology[3]	Late	Late

[1] Percent snow cover on near-shore freshwater marshes.
[2] Percent of marine ice cover in estuary.
[3] Subjective habitat conditions (early, average, late).

Table 2. Waterbird and mammal observations by survey segment, southwest Alaska 1-3 May 2009.

SPECIES	14	15	20	22	29	30	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
American Wigeon					2				2												
Arctic Tern										9	112	53	90		160			3		50	11
Bald Eagle adult										1	2		1	1	1				1	2	1
Bald Eagle Nest																					
Bald Eagle juvinile																					
Black-bellied Plover										206											
Beluga Whale							10	2	6		6										
Black Brant (Pacific Brant)			8392	101																	
Black-legged Kittiwake																					
Black Oystercatcher																					
Black Scoter					10		292			191	262	479	1186	1346	15			71	325	125	1258
Brown Bear																	1				
Bufflehead									22			2									
Canada Goose							2			46	4										
Common Eider																					30
Common Loon																					
Common Murre																					
Common Raven																	1				
Cormorant spp.			1		2								5								
Double-crested Cormorant									1												
Emperor Goose			1107	5							776		1892		3557			15	7164	16427	20
Gadwall											2										
Goldeneye								8	47												
Greater Scaup					78		412	125		88	506	9	116		29		70		5	122	
Gray Whale												4		2			1	2		1	4
Greater White-fronted Goose									20	157		10	3								
Harlequin Duck										8								10			
Harbor Seal			35						2	3		2	635		5	1				795	
King Eider		60	7																	20	
Large Gull	1	9	175	17	283		1048	11	763	145	157	245	1150	105	1132	17	28	193	457	981	161
Long-tailed Duck	102				4		8	5		4								10			
Mallard							3								5						
Mew Gull	201	7					21		10	452	660	153	355		512		6				
Medium Shorebird					15							1			300						
Moose																					
Northern Pintail		5	100				27		20	19	46		42		7		2		110		
Northern Shoveler							4				2	15									
Parasitic Jaeger										2										1	
Pacific Loon			1							3											
Pelagic Cormorant																					
Porpoise																					
Red-breasted Merganser			2	20	46		3	25	157	5	30	19	270		108			10			
Red Fox																					
Red-necked Grebe		2											2					1			2
Red-throated Loon		2			41		8			34	5	61	78				3			3	1
Sabine's Gull							1								22						
Sea Otter															41					98	1
Small Gull	2		20		107		353	128	40	169	260	100	102		133		190	123	10		108
Small Shorebird										510	187		975		5125				400		
Steller's Eider		575	3580								250			100					5	5638	22
Surf Scoter																					
Tundra Swan									32		2										
Wolf																					
White-winged Scoter					7						10	4		1	20			6		8	13

Table 2 (continued). Waterbird and mammal observations by survey segment, southwest Alaska 1-3 May 2009.

SPECIES	48	49	50	51	52	53	54	551	552	56	57	58	59	60	61	62	63	64
American Wigeon																		
Arctic Tern	63	15	1										1					
Bald Eagle adult		2	7	2	7							1	2	1		1	1	
Bald Eagle Nest																		
Bald Eagle juvinile		1	1		2		1						2					
Black-bellied Plover																		
Beluga Whale																		
Black Brant (Pacific Brant)													25	12877	16960	2190	4760	16094
Black-legged Kittiwake	1221	400										1						
Black Oystercatcher																		
Black Scoter	631	2487	143	1449	555	60	684	20	20832	6250	33	753	688	363	20			
Brown Bear													1					
Bufflehead																		
Canada Goose																		
Common Eider										427								
Common Loon		1																
Common Murre																		
Common Raven		10											15					
Cormorant spp.																		
Double-crested Cormorant																		
Emperor Goose	7		4063	4	4		595	6130	9797	15893	1225			5399	449	290		
Gadwall																		
Goldeneye																		
Greater Scaup							5		100					2				
Gray Whale	4	4	2									4	13					
Greater White-fronted Goose																		
Harlequin Duck															10			
Harbor Seal				1						11			80					
King Eider																		
Large Gull	171	576	884	543	408	171	201	567	6310	1400	1511	203	2497	434	1156	646	490	460
Long-tailed Duck	5	50																
Mallard																		
Mew Gull			60	1	262	100		200				2	10	10		10		
Medium Shorebird																		
Moose																		
Northern Pintail									22					2			7	
Northern Shoveler																		
Parasitic Jaeger																		
Pacific Loon																		
Pelagic Cormorant																		
Porpoise	1																	
Red-breasted Merganser			8	2		1		3			2				2		4	2
Red Fox		1																
Red-necked Grebe																		
Red-throated Loon		2																
Sabine's Gull												5						
Sea Otter			371	5	2	51		2		1197	252			1	11	11	1	96
Small Gull	48	125	585	100	135	50			10				100	80				
Small Shorebird			5						250		675		200	4050				
Steller's Eider	125		50						520	4733	1800		150	490	2285	1310	760	461
Surf Scoter																		
Tundra Swan																		
Wolf																		
White-winged Scoter	26	119		1														

Table 2 (continued). Waterbird and mammal observations by survey segment, southwest Alaska 1-3 May 2009.

SPECIES	65	66	67	68	69	80	81	82	83	84	85	86	90	91	92	93	97	99	107	112	113	114	115
American Wigeon											10												
Arctic Tern																							
Bald Eagle adult					1	2	1	4	6			1	3	1	3	1			1		2	1	
Bald Eagle Nest																							
Bald Eagle juvinile									1						1								
Black-bellied Plover																							
Beluga Whale																							
Black Brant (Pacific Brant)	16415	45	457	175		1545		148	1		70		154		137								
Black-legged Kittiwake			40																				
Black Oystercatcher																							
Black Scoter		251	129	26	256		86	121	38	23	10		74	3					10	101	10		10
Brown Bear		2																					
Bufflehead																							
Canada Goose																							
Common Eider									8			12											
Common Loon			2					7	1													2	
Common Murre																					1	3	
Common Raven		15										1			1								
Cormorant spp.								15														5	4
Double-crested Cormorant					10																		
Emperor Goose	330		3	1				45				45			394	150			32	265			
Gadwall																							
Goldeneye			2		1	15					50												
Greater Scaup	10				52															72			25
Gray Whale		1			1																		1
Greater White-fronted Goose														2									
Harlequin Duck		5	41			14	47	42	22	22	72		7		13	15			4	16			
Harbor Seal			201								25		1						15				
King Eider																							
Large Gull	1030	295	683	557	462	1032	16	111	40	28	179	29	187	28	746	191	20	100	148	1025	79	542	27
Long-tailed Duck			13	8	21				1					2									
Mallard						2														1			
Mew Gull				250		200	5	16			100					100		50	5	150			
Medium Shorebird																							
Moose																							
Northern Pintail				20	18						10						8						
Northern Shoveler																							
Parasitic Jaeger																							
Pacific Loon																							
Pelagic Cormorant								15				4							3		5	20	62
Porpoise																							
Red-breasted Merganser	27		5	25	24	11	3	6	4				43	1	75	13			9	93			4
Red Fox																							
Red-necked Grebe					50									3									
Red-throated Loon		4																					
Sabine's Gull																							
Sea Otter	5	2	57	28								15			1						2	2	
Small Gull		73	140	3	165	150		68			175		10		35	60			10	413	35	40	15
Small Shorebird				30											50	55							
Steller's Eider	1090					50				25	61		1										
Surf Scoter																							
Tundra Swan										1			10										
Wolf																			1				
White-winged Scoter						6	10	4							1						1		

Table 2 (continued). Waterbird and mammal observations by survey segment, southwest Alaska 1-3 May 2009.

SPECIES	116	117	118	124	125	126	127	128	129	130	131	132	133	134	135	136	137	Grand Total
American Wigeon																		14
Arctic Tern																		1130
Bald Eagle adult	1		2	1	4	4	10	1	1	5	1				2	3	5	102
Bald Eagle Nest						1	4	1		3							1	10
Bald Eagle juvinile																	2	11
Black-bellied Plover																		206
Beluga Whale																		24
Black Brant (Pacific Brant)					1113		200	113	15							172	550	82709
Black-legged Kittiwake	11		216		50			10					3					1952
Black Oystercatcher							1											1
Black Scoter		18	100	355	3	21	390	425	975		40	35	14	3			543	44877
Brown Bear							1		2		1		1					9
Bufflehead									20									44
Canada Goose																		52
Common Eider																		477
Common Loon				1		1	1	2	5	1		3	1				4	33
Common Murre			12									3		1			4	24
Common Raven													2					45
Cormorant spp.	4	19	2	268				12	2	1			1					341
Double-crested Cormorant																		11
Emperor Goose						80	166	541	429		439		458	74	2	1095	1127	91948
Gadwall																		2
Goldeneye																		123
Greater Scaup							2	75	50				9				6	1968
Gray Whale																		47
Greater White-fronted Goose									28									221
Harlequin Duck	2				54	3	159	12	275	3	142	6	20	3		8	50	1085
Harbor Seal							1		1				8				71	2143
King Eider																		87
Large Gull	95	40	1066	236	1604	351	1260	602	409	42	514	26	170	28	211	145	462	41915
Long-tailed Duck																		233
Mallard																		11
Mew Gull					465		11										100	4510
Medium Shorebird																		316
Moose							1											1
Northern Pintail	8				10													933
Northern Shoveler																		21
Parasitic Jaeger																		3
Pacific Loon																		4
Pelagic Cormorant	2			13	1								1					126
Porpoise				1														2
Red-breasted Merganser		26		7	276		64	18	35		152	5	18			10	61	1749
Red Fox																		1
Red-necked Grebe										1								61
Red-throated Loon																		242
Sabine's Gull																		35
Sea Otter				19		21	17		40	3	1	2	2				93	2450
Small Gull	425	16	152	90	100		76						148				225	5785
Small Shorebird																		12912
Steller's Eider																		25841
Surf Scoter		10				20	10	40	30		10	5	30	3				158
Tundra Swan																		45
Wolf																		1
White-winged Scoter			35	1		81	50	1									1	409

Table 3. Spring Emperor Goose Survey, southwest Alaska, 1981-2009.

YEAR	DATES	POPULATION SIZE		3-YEAR AVG.	% CHANGE	OBSERVERS
		NUMBER	% CHANGE			
1981	4/23-4/27	91267				R.King/C.Dau
1982	5/2-5/4	100643	10			"
1983	4/25-4/29	79155	-21	90355		"
1984	4/26-5/4	71217	-10	83672	-7	"
1985	5/12-5/16	58833	-17	69735	-17	"
1986	5/4-5/7	42231	-28	57427	-18	"
1987	4/30-5/4	51633	22	50899	-11	"
1988	5/2-5/6	53784	4	49216	-3	"
1989	5/3-5/6	45800	-15	50406	2	"
1990	4/28-5/4	67581	48	55722	11	"
1991	5/2-5/7	70972	5	61451	10	"
1992	4/30-5/5	71319	<1	69957	14	"
1993	4/30-5/5	52546	-26	64946	-7	"
1994	4/29, 5/2-6	57267	9	60377	-7	"
1995	5/3-5/6	54852	-4	54888	-9	"
1996	4/27-4/30	80034	46	64051	17	"
1997	4/25-4/28	57059	-29	63982	<-1	"
1998	5/4-5/7	39749	-30	58947	-8	"
1999	4/27-5/1	54600	37	50469	-14	"
2000	4/28-5/3	62565	15	52305	4	E.Mallek/C.Dau
2001	4/29-5/4	84396	35	67187	28	"
2002	5/3-5/6	58743	-30	68568	2	"
2003	4/29-5/3	71160	21	71433	4	"
2004	4/30-5/3	47352	-33	59085	-17	"
2005	4/20-4/23	53965	14	57492	-3	"
2006	4/27-5/2	76108	41	59142	3	"
2007	4/24-4/29	77541	2	69205	17	"
2008	4/29-4/30	64944	-16	72864	5	"
2009	5/1-5/3	91948	42	78144	7	"

Table 4. Primary staging sites and proportions of emperor geese from the 2009 aerial survey of southwest Alaska in comparison to long-term averages

Location (Segment/s)	2009 Number (%)	1981-2009 Number (Avg. % Total)
Yukon-Kuskokwim Delta (1-10)	NS[1]	537 (1)
Kuskokwim Bay (11-17)	0	201 (<1)
Chagvan Bay/Nanvak Bay (20, 22)	1112 (1)	1215 (2)
Egegik Bay (36-37)	776 (1)	947 (1)
Ugashik Bay (38)	1892 (2)	1727 (3)
Cinder River Estuary (39-43)	3572 (4)	6387 (10)
Port Heiden (44-45)	23591 (26)	19687 (30)
Seal Islands Lagoon (46-47)	11473 (12)	8153 (12)
Port Moller/Nelson Lagoon (50-54, 56-58, 551-552)	37711 (41)	20068 (30)
Izembek Lagoon (60-65)	6468 (7)	3377 (5)
Pavlof Bay (91-92)	394 (<1)	299 (<1)
Ivanof Bay (112)	265 (<1)	469 (<1)
Chignik Bay (125)	80 (<1)	227 (<1)
Wide Bay (136-137)	2222 (2)	1306 (2)

[1] NS= Not surveyed.

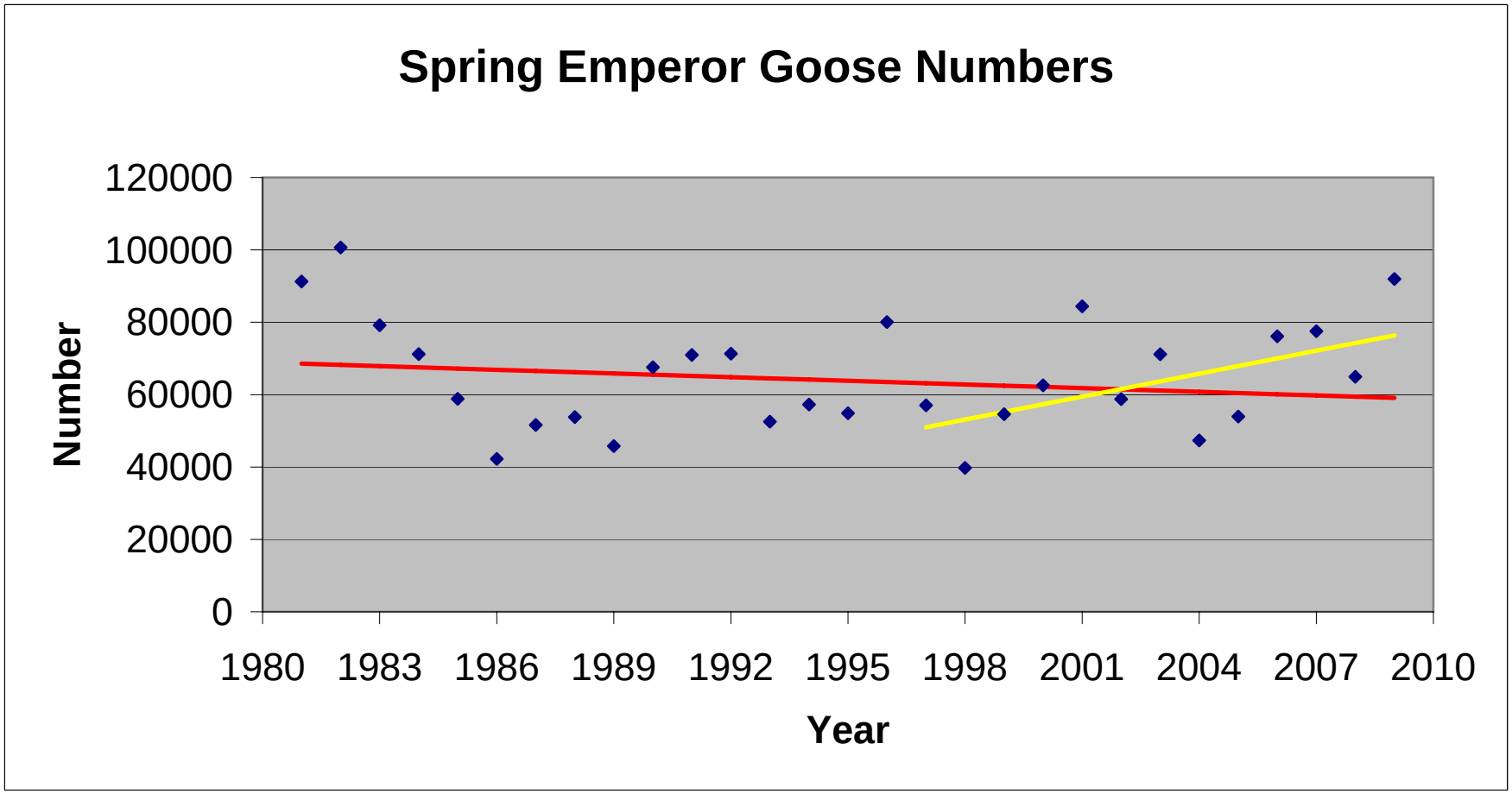

Figure 3. Spring emperor goose numbers 1981-2009 (blue). Trend information was derived from simple linear models. Twenty-nine year trend (1981-2009, red): mean = 65,147, slope = -76, p = 0.83, mean annual growth rate = -0.12%. Ten-year trend (2000-2009, yellow): mean = 68,872, slope = 1,477, p = 0.37, mean annual growth rate = 2.14%.