DATA SUMMARY REPORT

AVIAN STUDIES IN THE KUPARUK OILFIELD, ALASKA, 2007

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PREPARED FOR

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ANCHORAGE, ALASKA

AND

THE KUPARUK RIVER UNIT

PREPARED BY

ABR, INC.–ENVIRONMENTAL RESEARCH & SERVICES
FAIRBANKS, ALASKA

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INTRODUCTION

From 1985–1999, ABR, Inc., conducted avian studies for ARCO Alaska, Inc., in the Kuparuk Oilfield on the Arctic Coastal Plain of Alaska. In 2000–2007, we continued this work under the new operator of the Kuparuk Oilfield, ConocoPhillips Alaska, Inc. (formerly PHILLIPS Alaska, Inc.). The emphasis of this study in recent years has been on long-term monitoring of the distribution, abundance, and productivity of selected waterfowl populations. Our studies in 2007 focused on three species: Spectacled Eider (*Somateria fischeri*), Tundra Swan (*Cygnus columbianus*), and Brant (*Branta bernicla*). These species were selected for study in the oilfields for several reasons. The Spectacled Eider was listed by the U. S. Fish and Wildlife Service (USFWS) as a threatened species in 1993 and its population status on the North Slope is being monitored in support of the recovery efforts for this species. The Tundra Swan has been identified as an indicator species for the health of waterbird populations and their wetlands systems in the oilfields by federal and state agencies. Tundra Swans also use traditional nesting areas that may be affected by oilfield disturbances or new developments. Finally, Brant populations have been declining in Alaska for over a decade and this species is also considered to be sensitive to disturbance, particularly during the molting and brood-rearing periods.

This report summarizes the results of surveys in 2007 for these species. Unlike previous annual reports, this data report provides only a brief summary of the study objectives for each species and the annual survey results, along with supporting tables and figures, without an extensive discussion of results. A brief summary of methods is provided for the surveys conducted in 2007 (Appendix 1) and more details on methodology and previous analyses were presented in the 2003 and 2004 annual reports (Anderson et al. 2004, 2005).

CONDITIONS IN THE STUDY AREA

Birds returning to the Kuparuk Oilfield encountered cooler than average spring conditions in 2007. Mean monthly temperatures in 2007 were almost 3°C cooler for May than the long-term (19-year) mean for that month, whereas the mean temperature in June (4.2°C) was comparable to the long-term mean (Table 1; www.ncdc.noaa.gov/oa/ncdc.html). Breakup on the Colville River in 2007 was 3 days later than average, but within the historic 10-day period for peak water surface elevation. This breakup was considered a 3-year flood event (Michael Baker, Jr. Inc. 2007). Peak breakup on the Kuparuk River occurred on 7 June 2007, 2 days later than the historical average. Although snow persisted through late May, once snowmelt began, it proceeded rapidly, with the Kuparuk study area mostly (~85%) free of snow by the end of the first week of June. All but the deepest lakes were ice-free by the middle of June. During the period of waterfowl arrival and peak nest initiation (15 May–15 June), 46 cumulative thawing degree-days

Table 1. Annual mean temperatures (°C) for May and June 1989–2007 in the Kuparuk study area, compared to the 19-year mean, and the thawing degree-days for 15 May–15 June in the same years.

	Mean Temperature (°C)		Cumulative Thawing
Year	May	June	Degree-Days[a]
1989	-7.7	4.3	26
1990	-2.8	5.7	56
1991	-2.5	4.5	22
1992	-5.7	4.6	75
1993	-4.4	4.2	42
1994	-6.3	3.0	54
1995	-2.6	4.7	59
1996	-2.7	6.9	128
1997	-4.8	4.5	60
1998	-2.1	7.0	120
1999	-5.0	3.1	32
2000	-9.3	6.6	37
2001	-10.8	4.1	54
2002	-2.2	4.4	91
2003	-4.6	3.2	34
2004	-5.5	7.2	38
2005	-4.7	3.1	19
2006	-3.1	8.1	117
2007	-7.5	4.2	46
19-year average	-5.0	4.9	58

[a] Thawing degree-days are calculated as the cumulative number of degrees per day above freezing (0° C) for the period 15 May–15 June.

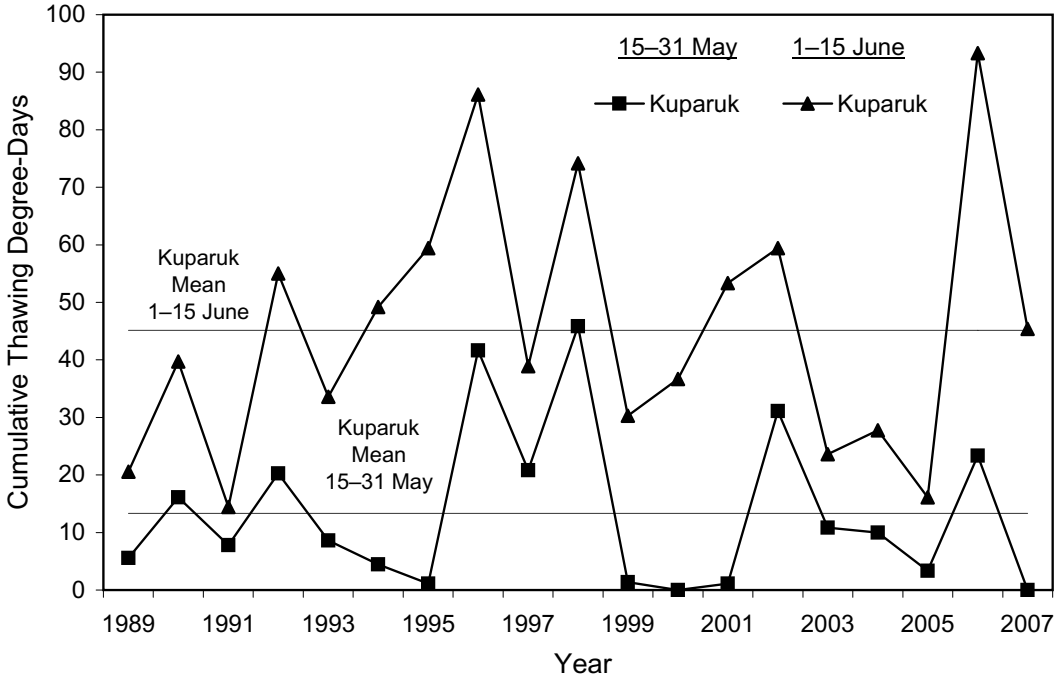

Figure 1. The number of cumulative thawing degree-days recorded between 15–31 May and 1–15 June and mean thawing degree-days for those same periods in the Kuparuk Oilfield, Alaska, 1989–2007.

were recorded, the ninth coolest in 19 years (range = 19–128 thawing degree-days; Table 1, Figure 1). The low number of cumulative thawing degree-days recorded for this same period was influenced by the cold temperatures in May, when no thawing degree-days were recorded (the lowest May except for 2000), rather than by colder temperatures in early June, when total cumulative thawing degree-days was comparable to the 19-year average (Figure 1).

SPECTACLED EIDER

The Spectacled Eider is one of four species of eiders that breed in arctic Alaska (Bellrose 1976). Spectacled, King (*S. spectabilis*), and Common (*S. mollissima*) eiders all nest in the oilfields on Alaska's North Slope (Johnson and Herter 1989). Spectacled Eiders have undergone severe declines in abundance, particularly on the Yukon-Kuskokwim Delta in western Alaska (Kertell 1991, Stehn et al. 1993). Based on this decline in abundance, the Spectacled Eider was listed by the USFWS as a "threatened species" on 9 June 1993 (58 FR 27474–27480) under the Endangered Species Act. The USFWS has also developed a Recovery Plan for the Spectacled Eider (USFWS 1996) that outlines the research needs for promoting the recovery of this species. These needs are being partially met by the annual aerial survey for eiders flown by the USFWS on the North Slope along with USFWS-sponsored research on nesting ecology and reproduction conducted on the YKD and industry-sponsored research on the North Slope (including this study and studies on the Colville River Delta).

In this report, we discuss the results of the 2007 Spectacled Eider surveys in the Kuparuk Oilfield. The 2007 season was the 15th year of road and nest searches and the 14th year of aerial surveys (no aerial survey was flown in 1994). The goals of the Spectacled Eider study include 1) monitoring population trends in the oilfields; 2) identifying important nesting habitats and determining how eiders are distributed relative to these habitats and oilfield infrastructure (roads, processing facilities, and drilling pads); and 3) monitoring the breeding biology and nesting success of eiders to determine if productivity is being negatively affected by oilfield activities or by natural processes. The 2007 study had four objectives to meet these goals:

1. conduct road surveys to monitor the distribution and abundance of Spectacled Eiders near facilities in the Kuparuk Oilfield during pre-nesting;
2. conduct an aerial survey for breeding pairs of Spectacled Eiders and determine regional distribution and abundance in the Kuparuk River Operating Unit, and compare the results of the survey with previous aerial surveys (1993, 1995–2006) to determine population trends;
3. evaluate the relationship between locations of breeding pairs observed during the pre-nesting road surveys and subsequent nest locations, and determine if multiple relocations of breeding pairs help in locating nests; and
4. monitor eider nests using thermistored eggs to evaluate causes of nesting failures (these data are not reported in this summary, but have been archived for future analysis; no time-lapse cameras were deployed in 2007).

2007 RESULTS

- In the Kuparuk Oilfield, a peak count of 21 Spectacled Eiders was recorded during the complete road survey of the oilfield on 10–11 June 2007 (Figure 2; Appendix 2); this count was a 16% decrease from the peak count of 25 eiders on 10–11 June 2006. Daily running totals for Spectacled Eiders were at the lowest range for counts recorded during previous cold years in the Kuparuk study area (Figure 3). Spectacled Eiders were already relatively abundant by the onset of road surveys on 8 June, which suggests an early arrival in the oilfield.
- As in previous years, most Spectacled Eiders in 2007 occurred in the Central Processing Facility No. 2 (CPF-2) area of the Kuparuk Oilfield, with observations clustered around the basin complex east of Drill Site (DS) 2C, near DS-2V, near DS-2F, and west of DS-2T (Figure 4). A few eiders also were observed in the CPF-1 area near DS-1E and northwest of DS-1D. In the CPF-3 area, most Spectacled Eiders were seen near Mine Site E and at several locations along the Oliktok Point Road (Figure 4).

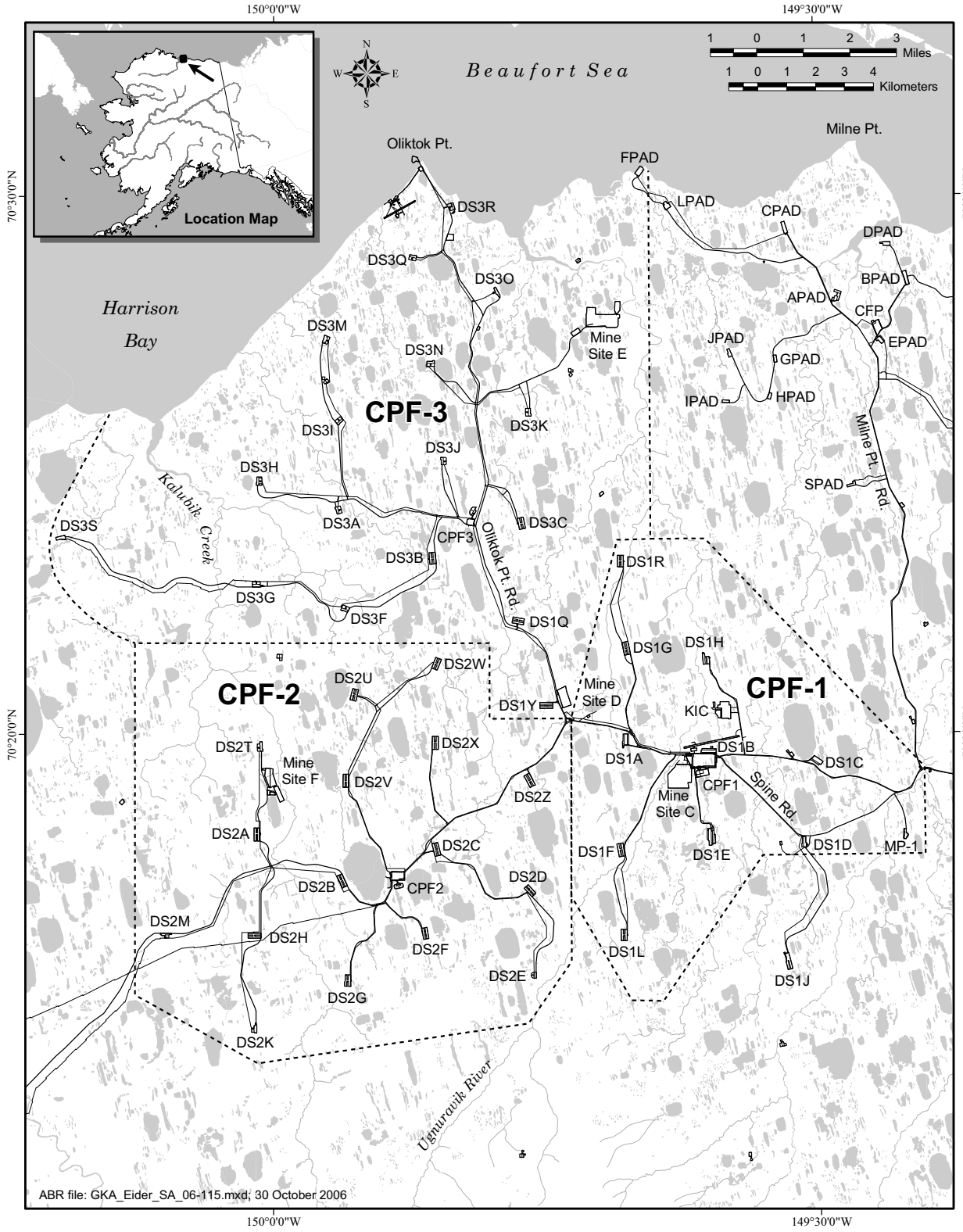

Figure 2. Study area for the Spectacled Eider study in the Kuparuk Oilfield, Alaska, 2007, showing the road system and boundaries of the three Central Processing Facility (CPF) areas.

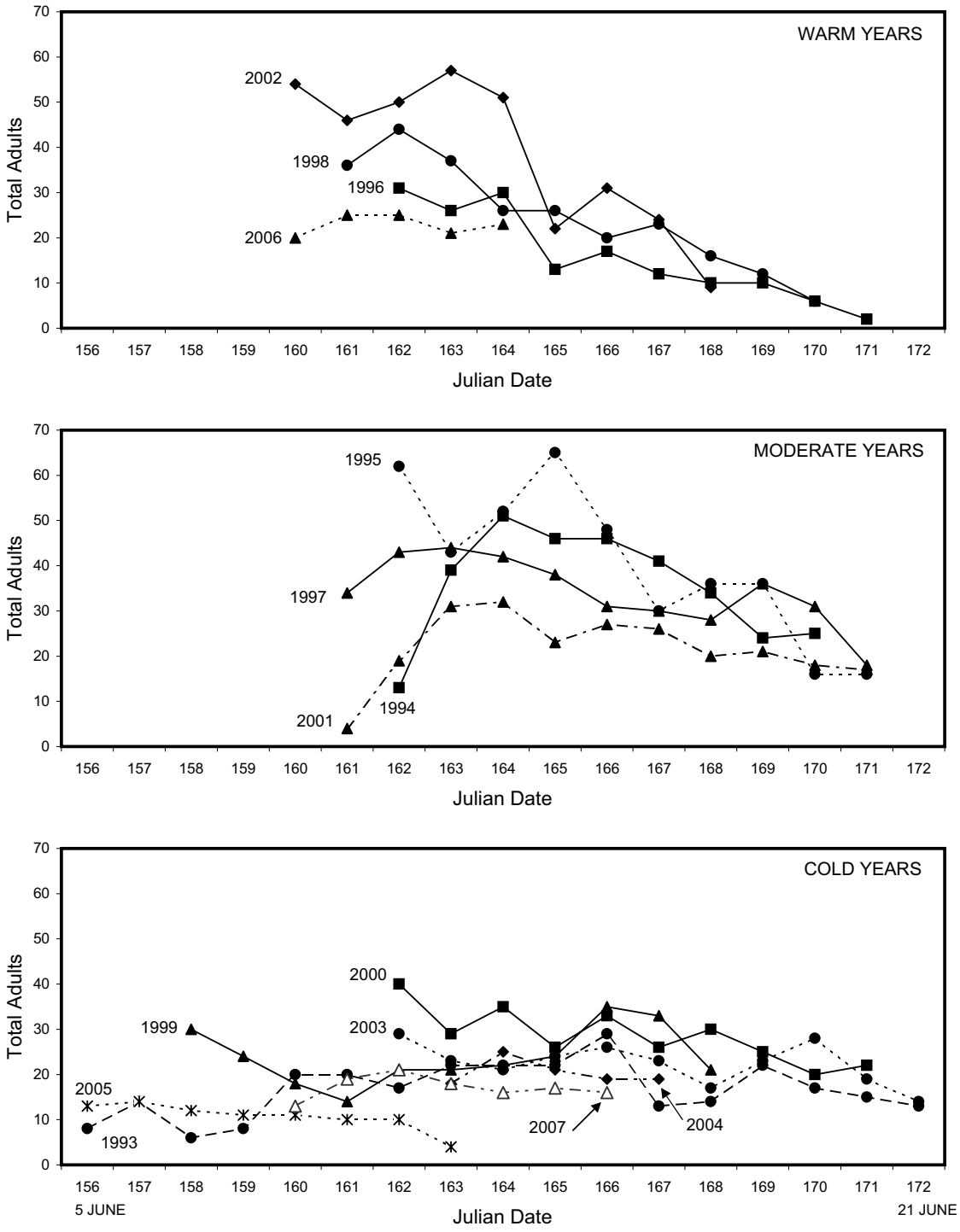

Figure 3. Daily running totals of Spectacled Eiders recorded during road surveys of the Kuparuk Oilfield, early to mid June, 1993–2007. Half of the study area was surveyed each day, thus the running total for the study area was calculated using consecutive days through the sample period. Years were assigned to cold (≤50 cumulative thawing degrees), moderate (>50 and ≤75 cumulative thawing degrees), or warm (>75 cumulative thawing degree days) categories depending on cumulative thawing degree-days between 15 May and 15 June each year.

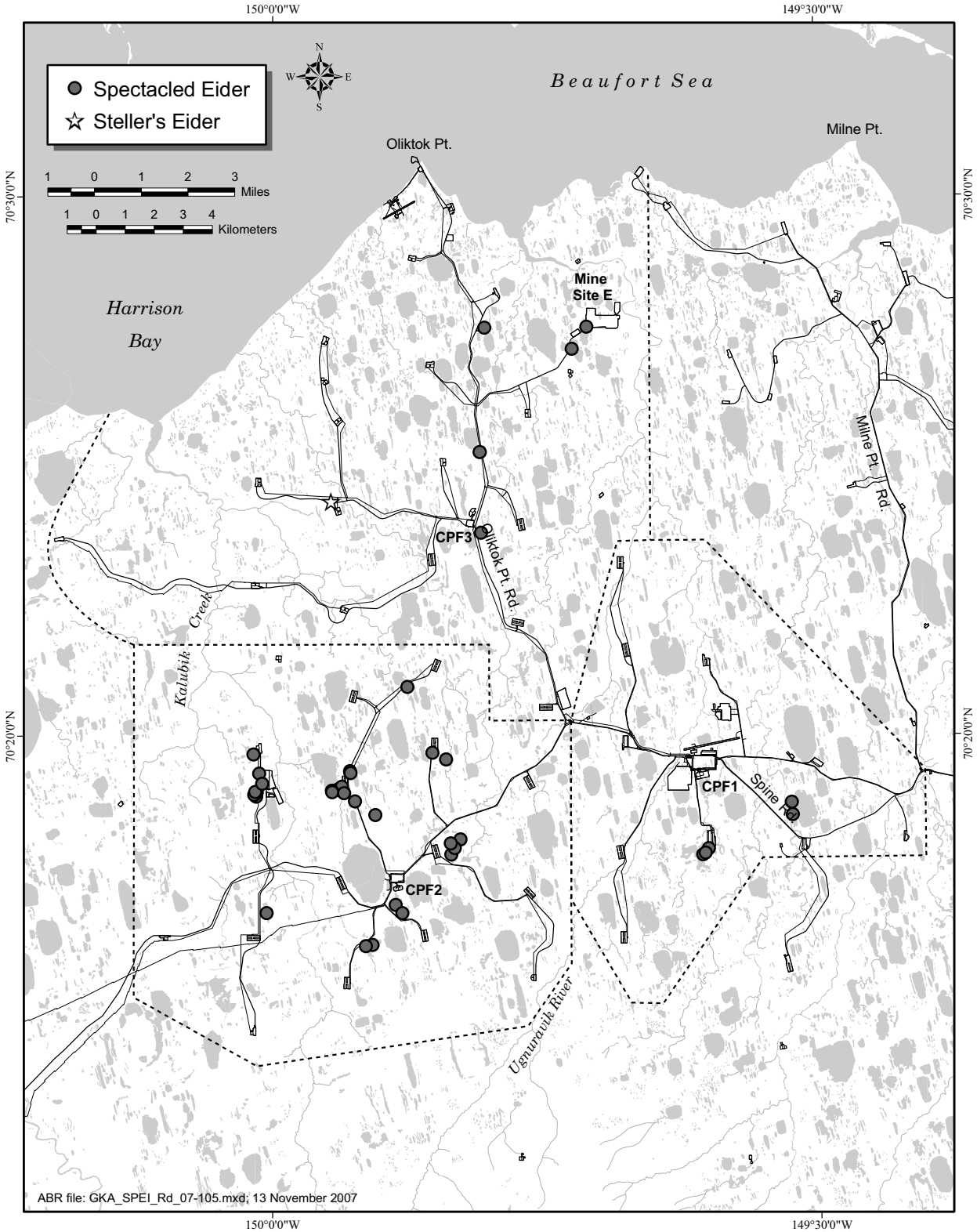

Figure 4. Distribution of Spectacled Eider observations during pre-nesting road surveys in the Kuparuk Oilfield, Alaska, 8–15 June 2007. Dashed areas delineate the CPF-1, CPF-2, and CPF-3 subareas used for comparisons of abundance and distribution.

- Spectacled Eiders were located a mean of 194.6 m from oilfield infrastructure (roads or pads) in 2007, which was at the low end of the range of distances recorded in previous years (range = 186.7–271.8 m; Table 2).
- Spectacled Eiders used a variety of habitat types during pre-nesting (Table 3), but ~73% of all observations (n = 41) were in two habitats: basin wetland complexes (46%) and shallow open water (27%). The ecological land survey for the Central Kuparuk Area has been completed (Roth et al. 2007) and the mapped eider locations from the road surveys will be associated with the habitat types after a data review in early 2008 (necessary due to changes in the basemaps used during the 15 years of road surveys).
- In 2007, an aerial survey was conducted on 12–14 June to locate Spectacled Eiders in the Kuparuk River Unit (Figure 5). During that survey, 46 Spectacled Eiders were counted on the ground in 26 groups (2 additional birds were observed flying; Table 4 and Figure 6). Spectacled Eider densities (non-flying birds only) were 0.07 total birds/km² and 0.04 breeding pairs/km². Densities of Spectacled Eiders derived from these breeding-pair surveys are reflections of the regional breeding population in the Kuparuk River Unit. Based on 14 years of aerial surveys, the regional population of Spectacled Eiders in the Kuparuk Oilfield appears to be relatively stable, and the numbers have increased following lower numbers in 2002–2006 (Table 5; Figure 7). The long-term population of Spectacled Eiders on the North Slope also has been relatively stable in recent years (W. Larned, USFWS, pers. comm.).
- In late June 2007, three Spectacled Eider nests and five probable Spectacled Eider nests (based on identification of contour

Table 2. Mean distances (m) of Spectacled Eider observations to oilfield facilities during pre-nesting in the Kuparuk Oilfield, Alaska, 1993–2007. Only observations within the 500-m road survey area are included.

	Distance (m) to Nearest Oilfield Facility			
Year	Mean	SD	Range	n[a]
1993	231.3	125.9	9–506	115
1994	244.8	126.0	23–478	70
1995	223.0	139.2	7–500	94
1996	245.4	139.2	16–504	46
1997	271.8	124.8	50–499	80
1998	259.3	118.2	17–538	67
1999	195.2	130.3	13–495	66
2000	252.6	134.6	21–494	71
2001	264.5	125.6	13–483	53
2002	229.6	146.2	9–494	76
2003	254.8	152.9	9–495	68
2004	186.7	133.7	3–415	29
2005	261.3	146.4	8–457	22
2006	225.6	142.5	6–498	34
2007	194.6	142.7	4–459	38

[a] n = number of observations.

Table 3. Habitat use (% of observations) of pre-nesting Spectacled Eiders in the Kuparuk Oilfield, Alaska, 1993–2007. Includes all observations (both within and outside the 500-m survey area).

	Percentage of Observations														
Habitat[a]	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NEARSHORE WATERS				2.0											
FRESH WATERS															
Deep Open Lake	3.7		0.9	2.0	1.0	3.5	2.8	1.2	3.1	4.1	1.1			5.6	2.4
Shallow Open Water	1.5				1.0	15.3		4.8							26.8
Lower Perennial Stream							2.8	1.2							
Aquatic Sedge	23.1	19.8	16.4	29.4	30.3	10.6	26.8	28.9	32.3	45.4	30.7	25.0	45.8	41.7	
Aquatic Grass	23.9	29.1	40.9	21.6	24.2	11.8	18.3	18.1	13.8	9.3	18.2	2.8	12.5	2.8	
Drainage Impoundment	2.2		7.3		2.0		4.2	1.2		2.1			4.2		
BASIN WETLAND COMPLEX	45.5	46.5	29.1	45.1	38.4	48.2	40.9	33.7	38.5	38.1	38.6	47.2	37.5	47.2	46.3
MEADOWS															
Wet Meadow		1.2	3.6		1.0	4.6			1.5						12.2
Moist Meadow		1.2	1.8			3.5					2.3				4.8
Flooded Tundra		2.3			2.0	5.9	4.2	10.8	10.8	1.0	9.1	25.0		2.8	4.9
Partially Vegetated Gravel															2.4
Number of Observations	134	86	110	51	99	85	71	83	65	97	88	36	24	36	41

[a] Habitat type follows hierarchical habitat classification described in Anderson and Cooper (1994) except for Flooded Tundra, which represents an ephemeral habitat found only during spring melt.

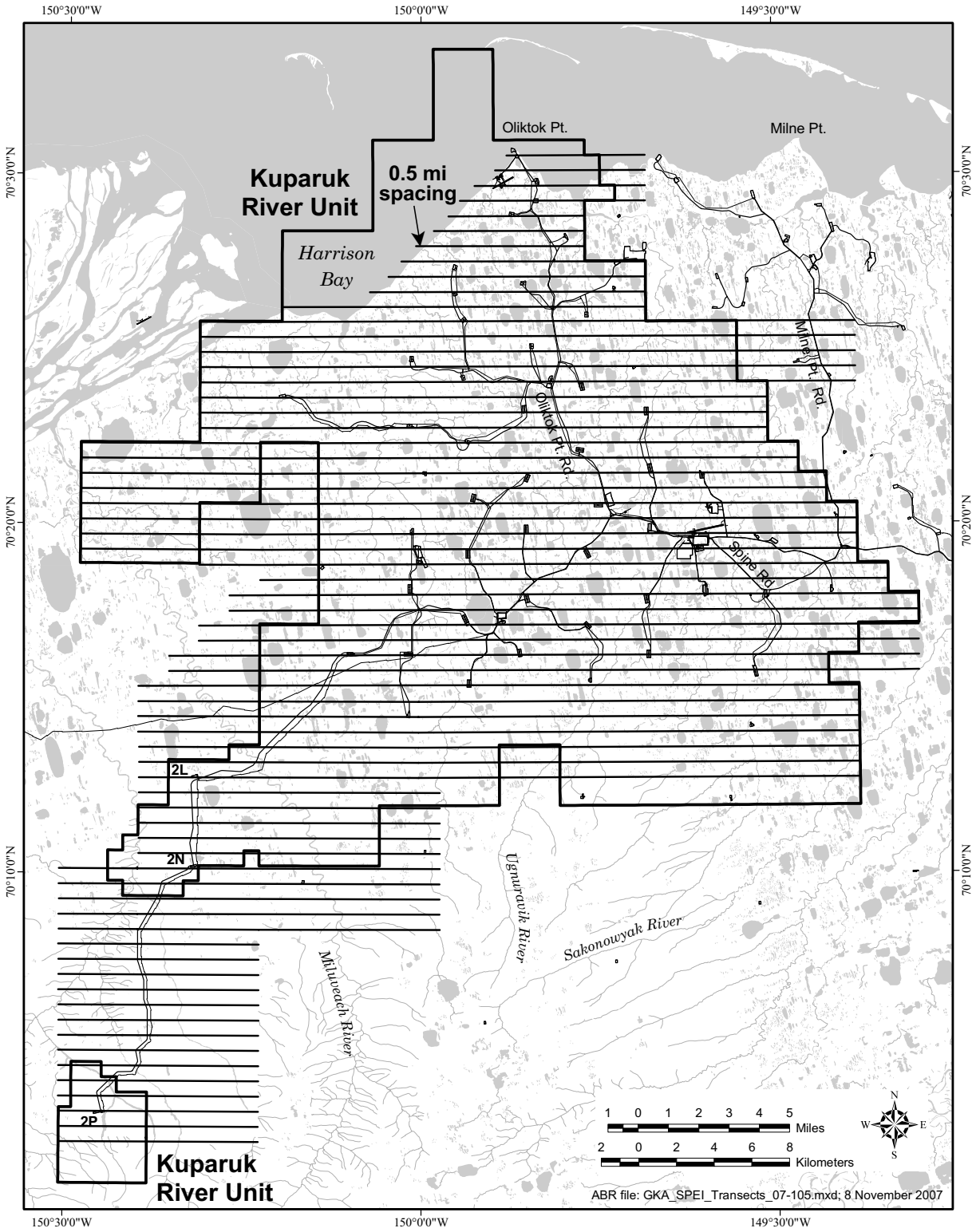

Figure 5. The aerial survey area for Spectacled Eiders in the Kuparuk Oilfield, Alaska, 2007. Transects were spaced 0.5 miles apart. Survey transects were extended in 2007 to conform to the western boundary of the newer Kuparuk River Unit boundary (some areas no longer in the new unit boundary were still surveyed).

Table 4. Numbers and densities (per km²) of Spectacled Eiders recorded during a pre-nesting aerial survey of the Kuparuk Oilfield, Alaska, 12–14 June 2007.

	Non-flying	Flying	All Birds
Numbers Observed			
Males	26	1	27
Females	20	1	21
Total Birds	46	2	48
Observed Pairs	20	1	21
Number of Sightings	26	1	27
FWS Indicated Total Birds[a]	52		
Density (birds/km²)[b]			
Breeding Pairs[c]	0.04	<0.01	0.04
Total Birds[d]	0.07	<0.01	0.07
FWS Indicated Total Birds	0.08		

[a] FWS Indicated Total Birds is calculated according to the standard protocol (USFWS 1987a); flying birds are not counted.
Total indicated birds = (lone males × 2) + (flocked males × 2) + (pairs × 2) + (group total × 1).
1) "lone males" are single, isolated males without a visible associated female;
2) "flocked males" are two or more males in close association (limited to 2–4 males per flock; no females in the flock);
3) a "pair" is a male and female in close association; and
4) a "group" is three or more of a mixed-sex grouping of the same species in close association, which cannot be separated into singles or pairs (one female with two males was considered to be a pair and a lone male, and one female with three males was considered to be a pair and two lone males).

[b] Density calculated based on a total area surveyed of 640.4 km².

[c] Number of breeding pairs = total males counted not in flocks (flock > 4 males).

[d] Unadjusted density of total birds = total birds/km² surveyed.

feathers) were found during searches of nine locations in the oilfield (Table 6; Appendix 3). While searching for Spectacled Eiders, we also found 10 King Eider (*Somateria spectabilis*) nests, 11 probable King Eider nests, and 4 nests of eiders that could not be definitively identified to species (i.e., insufficient contour feathers available, or contour feathers could not be definitively attributed to either species). In 2007, Spectacled Eider nests were located in the CPF-2 area near DS-2C, DS-2X, and DS-2V; in the CPF-1 area near DS-1E; and in the CPF-3 area south of Mine Site E and in the Brant colony west of DS-3C (Figure 8). One of the unidentified eider nests, which many have been a Spectacled Eider, was in an area near DS-2F that had supported 1–2 Spectacled Eider nests in recent years. As in 1993–2006, at least one location supported more than one nesting pair of Spectacled Eiders in 2007 (Table 7). Annual reuse of these areas indicate that traditional "colony sites" are used by Spectacled Eiders in the Kuparuk Oilfield, although some pairs nest singly.

- In all years, Spectacled Eider nests were located close to water. In 2007, the mean distance of nests to the closest water (4.2 m) was the second highest since 1993, and the mean distance of nests to the nearest waterbody (mean = 12.8 m) was higher than the long-term mean (9.9 m; n = 15 years) (Table 8). For these two measurements, 'water' is defined as any type of water, including ephemeral ponds or flooded tundra, whereas a 'waterbody' is a clearly defined, permanent waterbody, such as a small pond or lake. Nests in 2007, as in previous years, continued to be

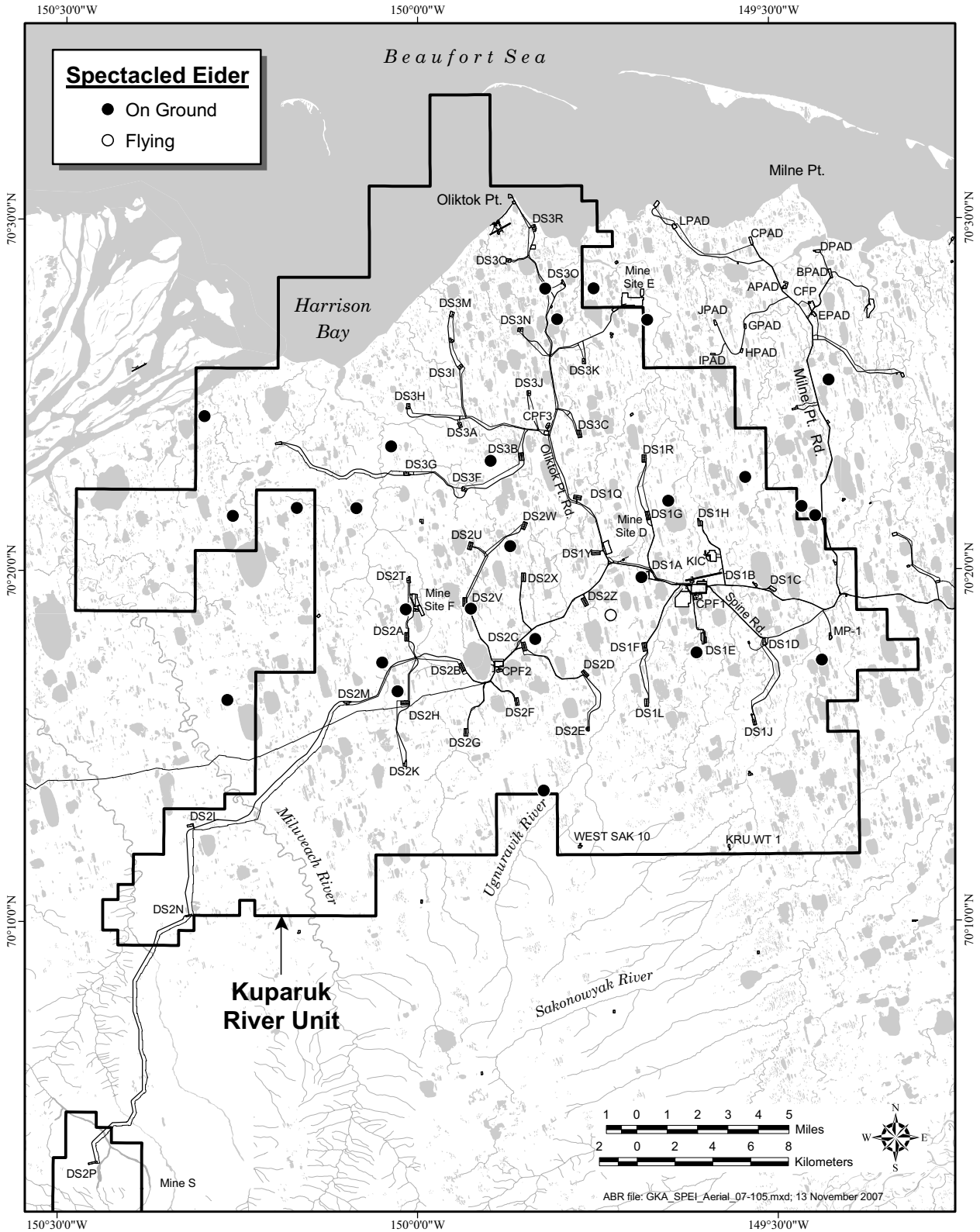

Figure 6. Distribution of Spectacled Eiders observed on the aerial survey of the Kuparuk Oilfield, Alaska, 12–14 June 2007.

located relatively far from the closest oilfield infrastructure (mean = 407 m; range = 233–546 m).

- In 2007, nesting success for Spectacled Eiders was 25% (2 of 8 nests; Table 6). Nesting success, which was defined as at least 1 egg hatching, was substantially lower than the all-time high (92.3%) recorded in 2005, and was well below the long-term mean for this study (mean = 41.7%; *n* = 15 years). The residual effects of the removal of arctic foxes (*Alopex lagopus*) from the Kuparuk area during winter 2004–2005, which probably contributed to the higher nesting success in 2005–2006, are no longer evident and the poor nesting success strongly suggests that numbers of arctic foxes have increased in the study area. A comparison with nesting success for King Eiders in 2007 tends to support this conclusion that predators adversely influenced nesting success, as this species had the second-lowest nesting success (9.5%) recorded during our 15-year study. Although temperatures were cooler in May than in previous years, the June conditions were more normal (mean temperatures and snow melt) and probably did not adversely affect eiders that normally begin nesting in mid–late June.

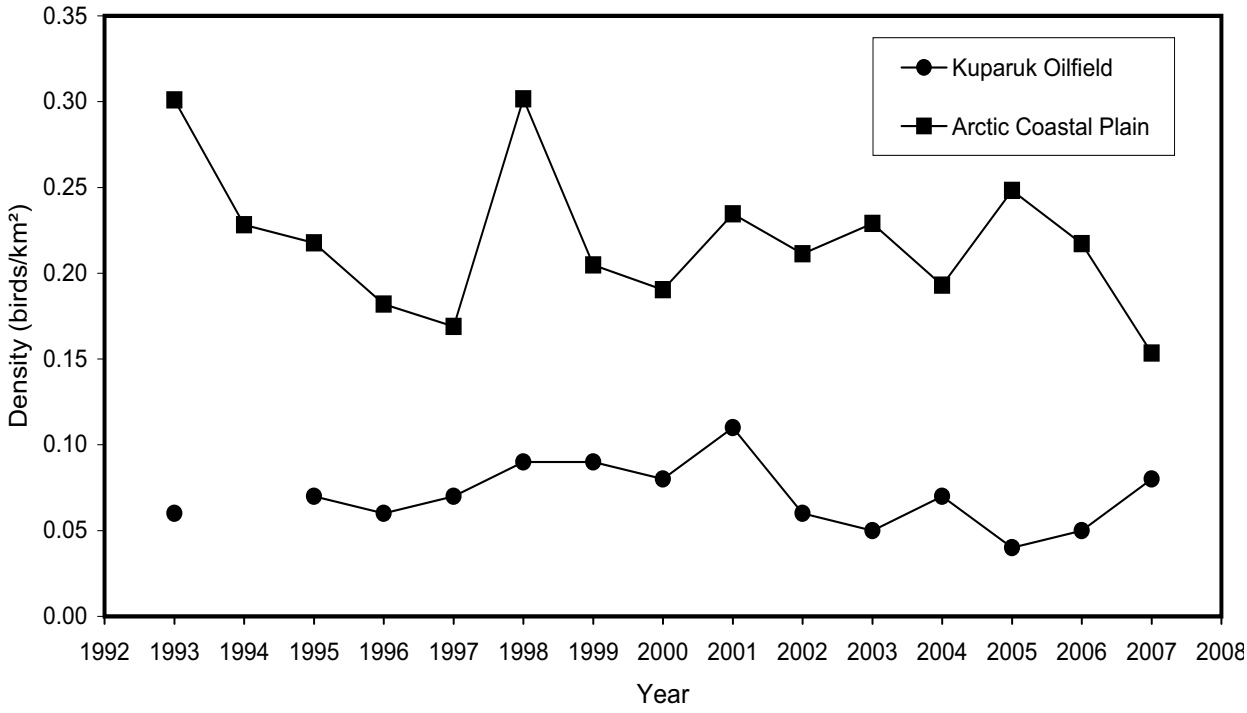

Figure 7. Trends in Spectacled Eider densities (indicated total birds/km²) based on aerial surveys of the Kuparuk River Unit (this study) and across the entire Arctic Coastal Plain, June 1993–2007. A visibility correction factor is not used for these data.

Table 5. Numbers and densities (per km²) of Spectacled Eiders recorded during pre-nesting aerial surveys of the Kuparuk Oilfield, Alaska, 1993, 1995–2007.

	Numbers of Eiders Observed					Density (birds/km²)[a]			
Year	Non-flying Birds	Flying Birds	Total Birds	FWS Indicated Total Birds[b]	Number of Sightings	Breeding Pairs[c]	Total Birds[d]	FWS Indicated Total Birds	Survey Dates (June)
1993 – First Survey	79	46	125	91	66	0.14	0.24	0.17	12 & 15
– Second Survey	24	17	41	34	26	0.06	0.08	0.06	18–20
1995	32	2	34	39	17	0.04	0.06	0.07	14–16
1996	22	18	40	32	24	0.05	0.07	0.06	10–14
1997	33	18	51	40	24	0.06	0.09	0.07	12–14, 16
1998	43	15	58	50	32	0.06	0.1	0.09	11–12, 14
1999	26	50	76	50	23	0.08	0.14	0.09	12–13
2000	36	24	60	40	27	0.07	0.11	0.08	13–14
2001	54	7	61	58	28	0.07	0.12	0.11	14–16
2002	22	5	27	32	22	0.03	0.04	0.06	13–15
2003	27	4	31	44	23	0.04	0.05	0.08	15–16
2004	24	3	27	38	21	0.04	0.05	0.07	17–18
2005	14	4	18	20	12	0.02	0.03	0.04	13–15
2006	21	3	24	24	14	0.03	0.05	0.05	12–13
2007	46	2	48	27	27	0.04	0.07	0.08	12–14

[a] Density calculated based on total area surveyed of 525.1 km² (1993), 550.5 km² (1995–1998), 525.4 km² (1999–2006), and 640.4 km² (2007); the 1998 densities were calculated for the smaller study area used in 1995–1997 because no eiders were recorded in the expanded Tarn area surveyed at 50% coverage in 1998.

[b] FWS Indicated Total Birds is calculated according to the standard protocol (USFWS 1987a) as described in Table 4; flying birds are not counted.

[c] Number of breeding pairs = total males counted (flying and non-flying combined).

[d] Unadjusted density of total birds = total birds/km² surveyed (flying and non-flying combined).

Table 6. Numbers and fates of eider nests found in the Kuparuk Oilfield, Alaska, 1993–2007, and annual nest search effort.

Species	Year	Total Nests[a]	Successful Nests		Nest Search Effort (No. Areas Searched)[b]
			Number	Percent	
Spectacled Eider					
	1993	17	6	35.3	33
	1994	14	5	35.7	24
	1995	14	4	28.6	17
	1996	16	7	43.8	17
	1997	11	3	27.3	13
	1998	12	5	41.7	10
	1999	5	3	60.0	11
	2000	11	7	63.6	13
	2001	8	1	12.5	10
	2002	18[c]	9	50.0	11
	2003	17[d]	8	47.1	13
	2004	4	0	0	10
	2005	13[e]	12	92.3	9
	2006[h]	8	5	62.5	12
	2007[h]	8	2	25.0	9
	Mean	11.7	5.1	41.7	
King Eider					
	1993	16	12	75.0	
	1994	19	6	31.6	
	1995	8	1	12.5	
	1996	17	7	43.8[f]	
	1997	14	1	7.1	
	1998	20	5	25.0	
	1999	13	2	15.4	
	2000	19	8	42.1	
	2001	17	3	20.0[g]	
	2002	26	11	42.3	
	2003	16	4	25.0	
	2004	17	4	23.5	
	2005	13	7	53.8	
	2006[h]	21	7	33.3	
	2007	21	2	9.5	
	Mean	17.1	5.3	30.5	

[a] Includes nests for known and probable (based on feather identification) species, but does not include unidentified eider nests (all failed): 1993 = 4 nests; 1994 = 2 nests; and 1997 = 2 nests.

[b] Number of distinct areas in the Kuparuk Oilfield searched for Spectacled Eider nests. No areas were searched specifically for King Eiders. UAF researchers searched 3 areas in 2004 and 1 area in 2005 without ABR assistance.

[c] Five nests found by Laura Phillips, UAF, during her nest searches for King Eiders were included in this total.

[d] Three nests found by Laura Phillips, UAF, during her nest searches for King Eiders were included in this total.

[e] One nest found by Rebecca McGuire, UAF, during her nest searches for King Eiders was included in this total.

[f] One nest was still active when last checked; therefore, nesting success was based on 16 nests total.

[g] Two nests had unknown fates; therefore, nesting success calculated for 15 nests total.

[h] An additional four failed nests could not be definitely identified to species in 2006 and in 2007.

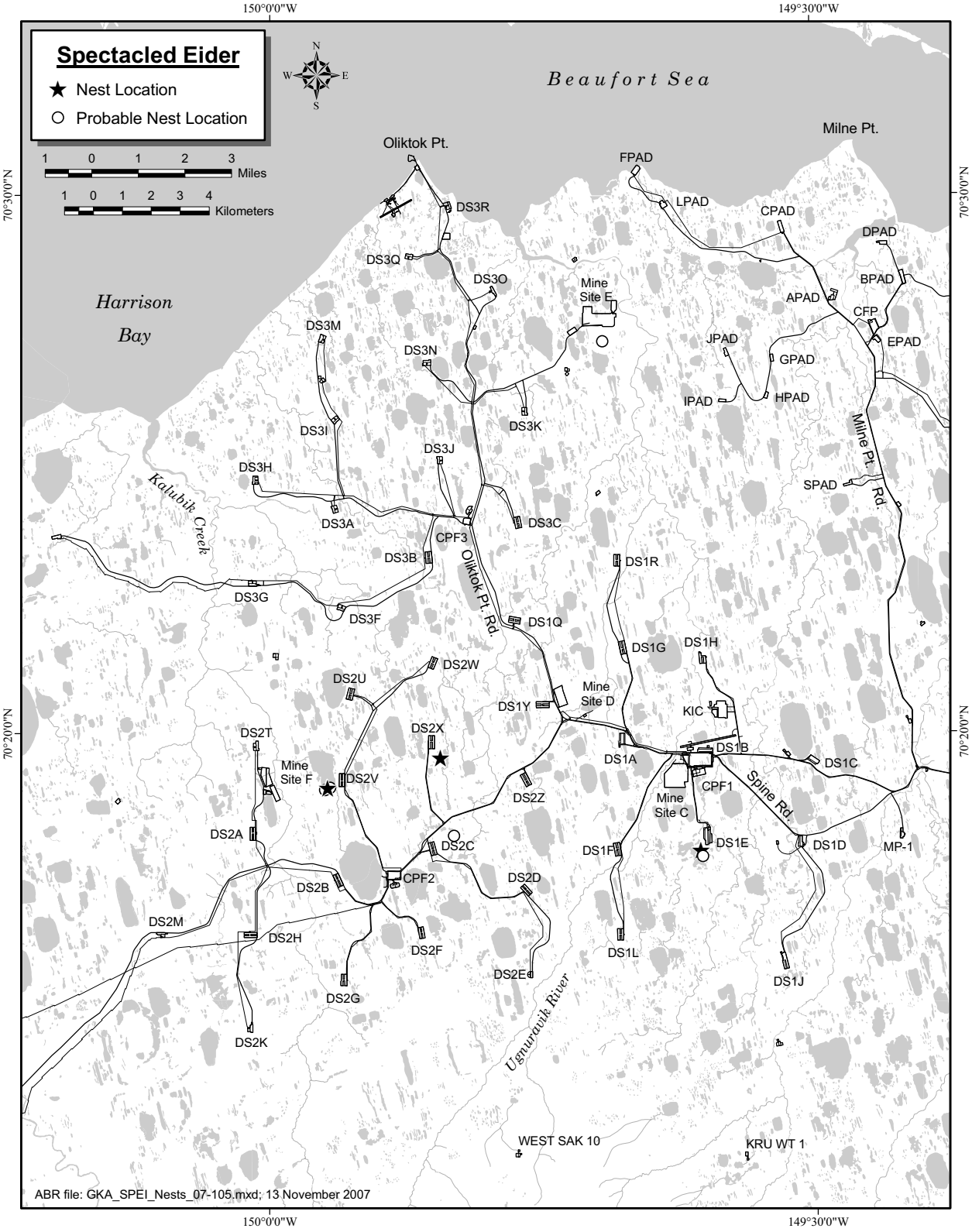

Figure 8. Locations of known and probable Spectacled Eider nests in the Kuparuk Oilfield, Alaska, 2007.

Table 7. Numbers of Spectacled Eider nests by locations used in one or more years in the Kuparuk Oilfield, Alaska, 1993–2007.

	Total Nests (number of total that were probable Spectacled Eider nests)														
Nesting Location	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Colonies[a]															
S of DS-1E	0	1	0	0	0	2 (1)	1	0	0	5	2	0	2	2	2 (1)
N of DS-1Y	2 (1)	2 (1)	1 (1)	1	1 (1)	0	0	1	1	0	1	0	0	0	0
E of DS-2C	5 (2)	4 (2)	4	4 (1)	3 (2)	2	1	1	4 (3)	0 (2)	2	1	0	1	1 (1)
N of DS-2F	1 (1)	1	1	0	0	2	0	1	1	1	0	0	1	0	0[c]
N of DS-2K	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0
W of DS-2V	0	0	1 (1)	2	1	0	1	2	0	1	0	1	3	0	3 (2)
S of DS-2T	0	0	0	1	0	0	1	2	1	0	3	0	4	1	0
S of DS-2X	2	2 (1)	2 (1)	2 (1)	2 (2)	2 (2)	1	1 (1)	1	0	2 (1)	0	0	1	1
W of DS-2X	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
W of DS-3C (CPF-3 Brant Colony)	2 (2)	2 (1)	0	3 (2)	1 (1)	4 (3)	0	1 (1)	0	2	1	0	1	1	0
S of Pit E	0	0	2 (1)	1	2	0	0	0	0	0	2	1 (1)	0	1	1 (1)
Annual Locations[b]															
N of CPF-2	0	0	0	0	0	0	0	1 (1)	0	0	0	0	0	0	0
N of DS-2H	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
DS-3N	0	0	0	1	1 (1)	0	0	0	0	0	0	0	0	0	0
DS-3Q	0	1 (1)	1 (1)	1	0	0	0	0	0	0	0	0	0	0	0
N of CPF-3	1 (1)	0	1	0	0	0	0	0	0	0	0	0	0	0	0

[a] Colonies were locations that supported more than one nesting pair in at least one year.
[b] Annual locations supported one pair in more than one year.
[c] One nest that may have been a Spectacled Eider was located here, but species could not be confirmed with feather samples.

Table 8. Distances (m) of Spectacled Eider nests to the nearest water, waterbody, and oilfield infrastructure (road or pad) in the Kuparuk Oilfield, Alaska, 1993–2007.

	Known Nests				All Nests[a]			
	Mean	SD	Range	n	Mean	SD	Range	n
Water								
1993	3.0	3.2	0.2–10	8	2.0	2.4	0.2–10	17
1994	0.7	1.2	0.1–4	8	0.8	1.0	0.1–4	14
1995	2.4	2.0	0.5–7	9	2.1	2.0	0.5–7	15
1996	0.6	0.8	0.1–3	12	1.0	1.6	0.1–6	16
1997	5.4	9.7	0.1–20	4	2.9	5.8	0.1–20	7
1998	0.8	0.7	0.1–2	6	2.3	4.2	0.1–15	12
1999	5.7	10.8	0.5–25	5	5.7	10.8	0.5–25	5
2000	0.7	0.5	0.1–1.5	8	1.0	0.9	0.1–3	11
2001	0.8	0.7	0.2–2.0	5	1.0	1.0	0.1–3	8
2002	0.5	0.5	<0.1–2	15	0.4	0.4	<0.1–2	18
2003[b]	2.5	5.0	0.1–20	15	2.6	4.9	0.1–20	16
2004	0.5	0.5	0.1–1	3	2.9	4.8	0.1–10	4
2005	3.0	8.1	0.1–30	13	3.0	8.1	0.1–30	13
2006	0.2	0.2	0.1–0.5	6	0.3	0.2	0.1–0.5	8
2007	0.6	0.8	0.1–1.5	3	4.2	10.4	0.1–30	8
Waterbody								
1993	3.7	3.5	0.2–10	8	2.5	2.7	0.2–10	17
1994	1.3	1.9	0.1–5	8	2.5	5.2	0.1–20	14
1995	8.4	6.2	0.5–15	9	9.6	8.2	0.5–30	15
1996	0.6	0.8	0.1–3	12	2.0	3.8	0.1–15	16
1997	5.4	9.7	0.1–20	4	4.4	6.4	0.1–20	7
1998	1.4	1.9	0.1–5	6	3.9	5.5	0.1–15	12
1999	16.3	21.3	0.5–50	5	16.3	21.3	0.5–50	5
2000	17.1	27.3	0.1–75	8	13.8	23.6	0.1–75	11
2001	13.6	20.6	1.0–50	5	11.5	16.8	1.0–50	8
2002	4.6	11.0	<0.1–40	15	3.9	10.1	<0.1–40	18
2003[b]	24.8	36.9	0.2–100	15	23.6	35.9	0.2–100	16
2004	2.1	0.5	0.3–4	3	3.7	4.5	0.3–10	4
2005	27.2	31.4	0.5–100	13	27.2	31.4	0.5–100	13
2006	6.9	10.6	0.3–25	6	10.2	15.2	0.3–40	8
2007	0.7	0.7	0.1–1.5	3	12.8	17.2	0.1–40	8
Oilfield Infrastructure								
1993	540	149	353–742	8	500	180	123–742	17
1994	514	206	162–801	8	498	209	162–855	14
1995	427	102	239–591	9	430	156	208–823	15
1996	420	194	114–872	12	425	178	114–872	16
1997	521	144	345–662	4	479	221	82–900	7
1998	372	85	345–662	4	454	160	212–718	12
1999	398	167	194–598	5	398	167	194–598	5
2000	325	160	138–666	8	349	154	138–666	10[c]
2001	549	390	315–1240	5	491	306	315–1240	8
2002	384	200	52–723	15	407	194	52–723	18
2003	463	217	177–896	16	456	212	177–896	17
2004	478	298	129–804	3	499	247	219–804	4
2005	389	157	68–665	13	389	157	68–665	13
2006	406	108	264–531	6	409	94	264–537	8
2007	334	89	233–402	3	407	106	233–546	8

[a] All nests includes known and probable (based on feathers) nests.
[b] One Spectacled Eider nest did not have distance to the nearest waterbody or water.
[c] One probable Spectacled Eider nest excluded from the analysis because its precise location was unknown.

STELLER'S EIDER

Steller's Eiders (*Polysticta stelleri*) occasionally occur in the Prudhoe Bay and Kuparuk oilfields but have not been recorded as nesting; they breed mainly in western and northwestern Alaska and are considered to be casual east of Point Barrow (Johnson and Herter 1989, Quakenbush et al. 2002, USFWS 2002). The Steller's Eider was placed on the threatened list under the Endangered Species Act on 11 June 1997 (62 FR 31748–31757). The USFWS prepared a recovery plan for this species in 2002 (USFWS 2002) and have concentrated their research efforts in the Barrow area, which is the primary breeding location for the listed population.

2007 RESULTS

- Two pairs of Steller's Eiders were seen in the Kuparuk Oilfield on 11 June 2007. These pairs were resting in a nonpatterned wet meadow just west of DS-3A (Figure 4). This observation is the first one for Steller's Eiders during 15 years of surveys in the Kuparuk Oilfield for this study. Three other incidental observations (not confirmed by biologists for this study) of single pairs of Steller's Eiders were recorded in the Kuparuk field in 1995 (17 June, CPF-3 brant colony; M. Kirk, USFWS, pers. comm.), 2000 (13 June, near Mine Site F; S. Schlentner, ABR, pers. comm), and 2001 (10 June, near DS-1F; D. Lum, ABR, pers. comm.). Although no Steller's Eiders were recorded in the Kuparuk study area during the aerial survey (12–14 June 2007) for pre-nesting eiders, one male was seen on the Colville River Delta on 13 June 2007 (see Johnson et al. 2008). Nesting efforts by Steller's Eiders at their main breeding areas in the Barrow region apparently were limited in 2007 (R. Ritchie, ABR, pers. comm.), which may explain the occurrence of Steller's Eiders in the oilfields this year (i.e., failed or non-breeding adults are more likely to disperse from the traditional nesting area).

TUNDRA SWAN

Tundra Swans are an important component of the waterbird community in northern Alaska. In addition, the health of the Tundra Swan population in the oilfields is viewed by many observers to be a good indicator of the overall health of waterbird populations and the wetland ecosystems that attract and support these populations. Accordingly, swans have received considerable attention from both the oil industry and regulatory agencies, especially when planning and permitting new developments. ConocoPhillips Alaska, Inc., traditionally has included Tundra Swans in their environmental planning for the oilfields. For example, nest and brood locations for Tundra Swans are identified on environmental sensitivity maps for oil-spill response in the Kuparuk and Prudhoe Bay oilfields, and avoidance of traditional swan nest sites is a consideration when planning new infrastructure. Current and long-term information on the local abundance, distribution, productivity, and population trends of swans are essential to these planning programs and assessments. Since 1988, ABR has monitored these population parameters annually in a number of areas, including the Kuparuk study area, by conducting aerial surveys during nesting and brood-rearing (Anderson et al. 2007).

The Tundra Swan study had two objectives in 2007:

1. locate and map the distribution of nests and enumerate numbers of adults during nesting; and
2. locate and map the distribution of broods, enumerate adults and young, and assess productivity of swans during brood-rearing.

2007 RESULTS

- Aerial surveys were flown to collect information on Tundra Swan abundance and distribution during the nesting and brood-rearing periods in 2007. The nesting survey was conducted during 19–21 June 2007 and the brood-rearing survey during 21–22 August 2007.
- For analysis of the 2007 data, we divided the old study area into two new study areas to streamline our annual analyses and

allow consistent annual comparisons among areas with differing levels of survey effort. The new areas consist of a revised Kuparuk study area (2380 km²) which comprised all regions that were consistently surveyed in all years of the study, including a section that was formerly part of the Oil and Gas Lease 54 (Figure 9) and not previously covered in analyses. The second study was designated as the 'South Kuparuk' study area (375 km²). Portions of the South Kuparuk study area were included each year of the swan surveys, but the coverage was less

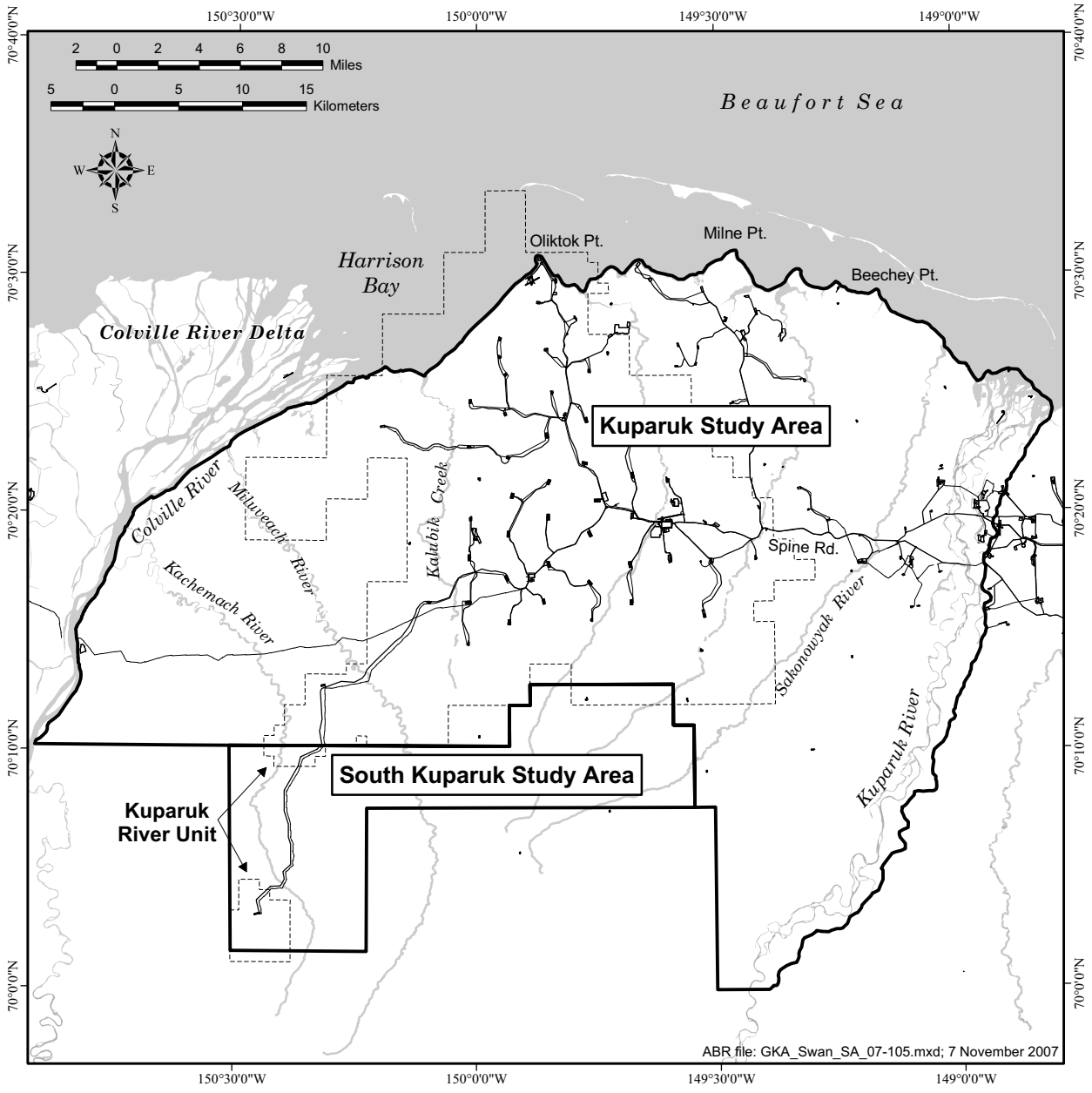

Figure 9. The aerial survey areas for Tundra Swans in the Greater Kuparuk Area, Alaska, 2007. Two study areas were designated in 2007—the Kuparuk study area and the Kuparuk South study area (see Appendix 4 for explanation of study area boundaries).

consistent until the last several years. Survey results for the South Kuparuk study area are reported in Appendix 4. The remaining results reported below are only for the Kuparuk study area.

- During the nesting aerial survey, 512 Tundra Swans were recorded at 308 locations in the Kuparuk study area (Table 9; Appendix 5). Swan density (0.22 swans/km²) in 2007 was 29% higher than long-term mean (Appendix 6). The number of swans counted remained consistent with the long-term trend for total adults, which shows a significantly increasing population within the oilfield since 1989 ($r^2 = 0.24$, $P < 0.03$).
- In 2007, 116 Tundra Swan nests (0.05 nests/km²) were found in the Kuparuk study area (Figure 10), a 22% increase from 2006 (Table 9), and a 35% increase over the 19-year mean (86.1 nests; 1989–2007). Since 1989, total numbers of nests generally have been on an increasing trend in the oilfield ($r^2 = 0.24$, $P < 0.03$), although they fluctuate annually. Nest numbers are highly correlated with temperatures encountered by swans during the arrival and nest

Table 9. Numbers of Tundra Swans and nests observed during June aerial surveys in the common Kuparuk study area, Alaska, 1989–2007. Swans and nests recorded in the Kuparuk South study area are presented in Appendix 4 and a more detailed description of survey results for 2007 is presented in Appendix 5.

		Observed Number of Adults			Estimated Number of Adults	
Year	Number of Nests	with Nests	without Nests	Total	Breeders	Nonbreeders
1989	45	71	190	261	90	171
1990	77	126	170	296	154	142
1991	81	115	275	390	162	228
1992	79	128	233	361	158	203
1993	70	118	231	349	140	209
1994	50	67	257	324	100	224
1995	107	181	284	465	214	251
1996	122	215	269	484	244	240
1997	75	121	242	363	150	213
1998	108	203	372	575	146	359
1999	73	119	235	354	170	208
2000	85	142	361	503	166	333
2001	83	149	280	429	166	263
2002	115	195	294	489	230	259
2003	74	114	309	423	148	275
2004	92	141	244	385	184	201
2005	89	149	248	397	178	219
2006	95	142	235	377	190	187
2007	116	189	323	512	232	280

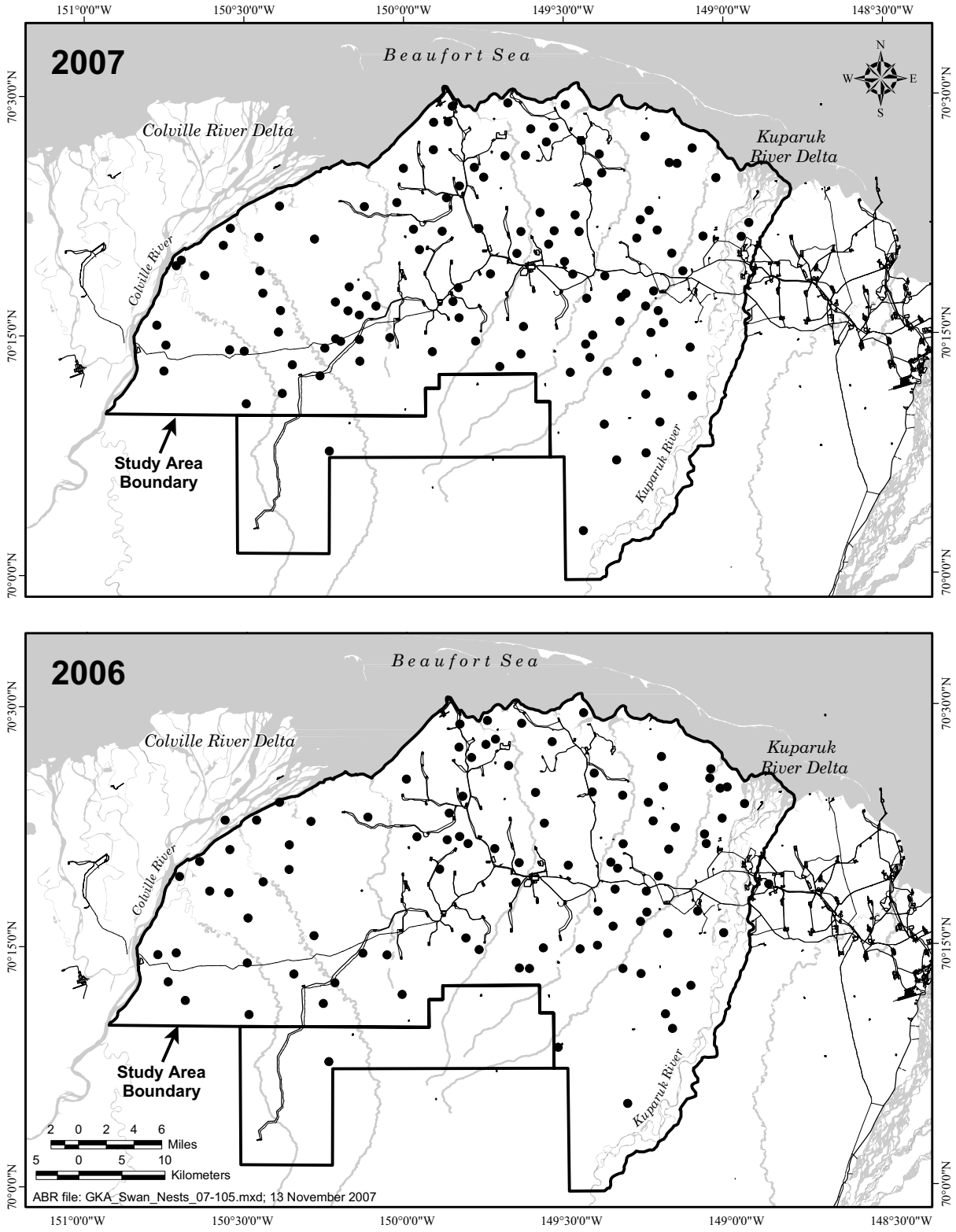

Figure 10. Locations of Tundra Swan nests observed in the Kuparuk and Kuparuk South study areas, Alaska, June 2006 and 2007 (see Figure 9 for study area boundaries).

initiation period (15 May–15 June), with fewer nests being active during years with low cumulative thawing degree-days and more nests being active during years with high cumulative thawing degree-days (Figure 11). Despite the seemingly cool spring in 2007, the increase in nest numbers likely was attributable in part to the good conditions in the study area (i.e., the average June temperatures and the rapid snowmelt) at the time when swans would be initiating nests.

- During the brood-rearing survey, 754 swans (574 adults and 180 young) were observed at 300 locations in the Kuparuk study area (Table 10; Appendix 7). The total number of swans recorded during brood-rearing in 2007 was 11% higher than the 19-year mean (677 total swans). The number of adults alone also increased 12% between June and August in 2007, due mostly to an increase in the number of nonbreeding adults (+47%). The number of estimated breeding adults decreased 31% between June and August 2007, which probably is due to a combination of nest failure, brood mortality, and, possibly, some movement of broods out of the study area.
- In 2007, 81 broods (189 young) of Tundra Swans were counted in the Kuparuk study area (Table 10, Figure 12). The number of broods counted in 2007 was the fifth highest recorded in the oilfield since consistent monitoring began in 1989. Although the number of broods present was relatively high, the mean brood size of 2.2 young/brood (range = 1–5 young), was slightly lower (4%) than the 18-year mean (2.3 young/brood). The percentage of broods with three or more young (41%) was similar to the long-term mean and greater than the numbers recorded in the previous 4 years. Approximate nesting success in 2007 (70%) was fair, however. Nesting success and clutch size have been correlated to weather conditions in the nesting area, with years with cool springs typically having lower nesting success than years with warmer, more favorable springs. The reason for the only fair nesting success is unknown, but may have been partially the result of lower clutch sizes influenced by the cool temperatures in May, and subsequent loss of small broods between the time of hatching and the time of the brood-rearing survey.

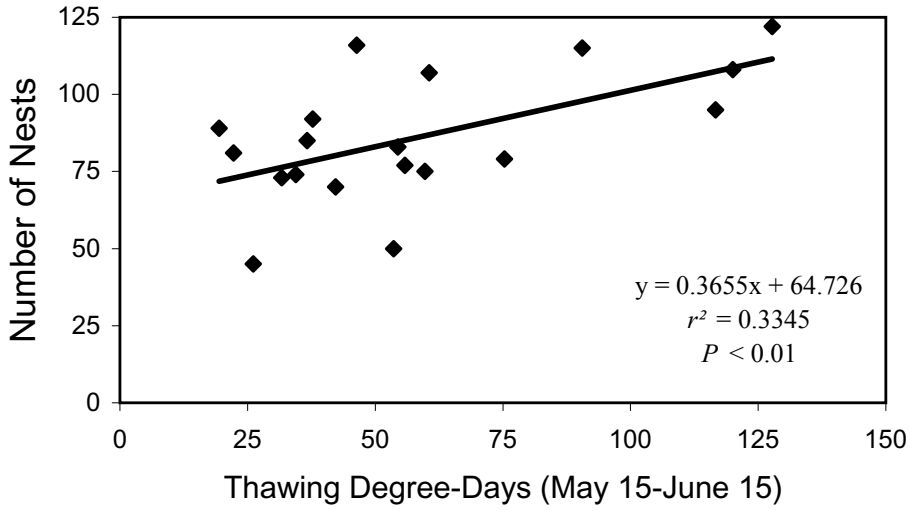

Figure 11. Numbers of Tundra Swan nests by year in relation to cumulative thawing degree-days between 15 May–15 June, in the Kuparuk study area, Alaska, 1989–2007.

Table 10. Numbers of Tundra Swans and broods observed during August aerial surveys in the Kuparuk study area, Alaska, 1989–1993, 1995–2007. No brood-rearing survey was conducted in 1994. Swans and broods recorded in the Kuparuk South study area are presented in Appendix 4 and a more detailed description of survey results for 2007 is presented in Appendix 7.

Year	Number of		Mean Brood Size	Observed Number of Adults			Total Swans	Percent Young	Estimated Number of Adults	
	Broods	Young		with Broods	without Broods	Total			Breeders	Nonbreeders
1989	45	103	2.3	84	319	403	506	20.4	90	313
1990	75	208	2.8	147	285	432	640	32.5	150	282
1991	69	175	2.5	134	373	507	682	25.7	138	369
1992	73	194	2.7	145	339	484	678	28.6	146	338
1993	72	179	2.5	141	332	473	652	27.5	144	329
1995	82	222	2.7	159	343	502	724	30.7	164	338
1996	99	271	2.7	187	331	518	789	34.3	198	320
1997	60	134	2.2	118	483	601	735	18.2	120	481
1998	74	172	2.3	141	391	532	704	24.4	148	384
1999	45	110	2.4	92	372	464	574	19.2	90	374
2000	56	113	2.0	107	579	686	799	14.1	112	574
2001	71	151	2.1	141	413	554	705	21.4	142	412
2002	69	173	2.5	137	342	479	652	26.5	138	341
2003	60	113	1.9	118	358	476	589	19.2	120	356
2004	97	211	2.2	185	385	570	781	27.0	194	376
2005	57	111	1.9	111	346	457	568	19.5	114	343
2006	87	171	2.0	135	318	483	654	26.1	174	309
2007	81	180	2.2	158	416	574	754	23.9	162	412

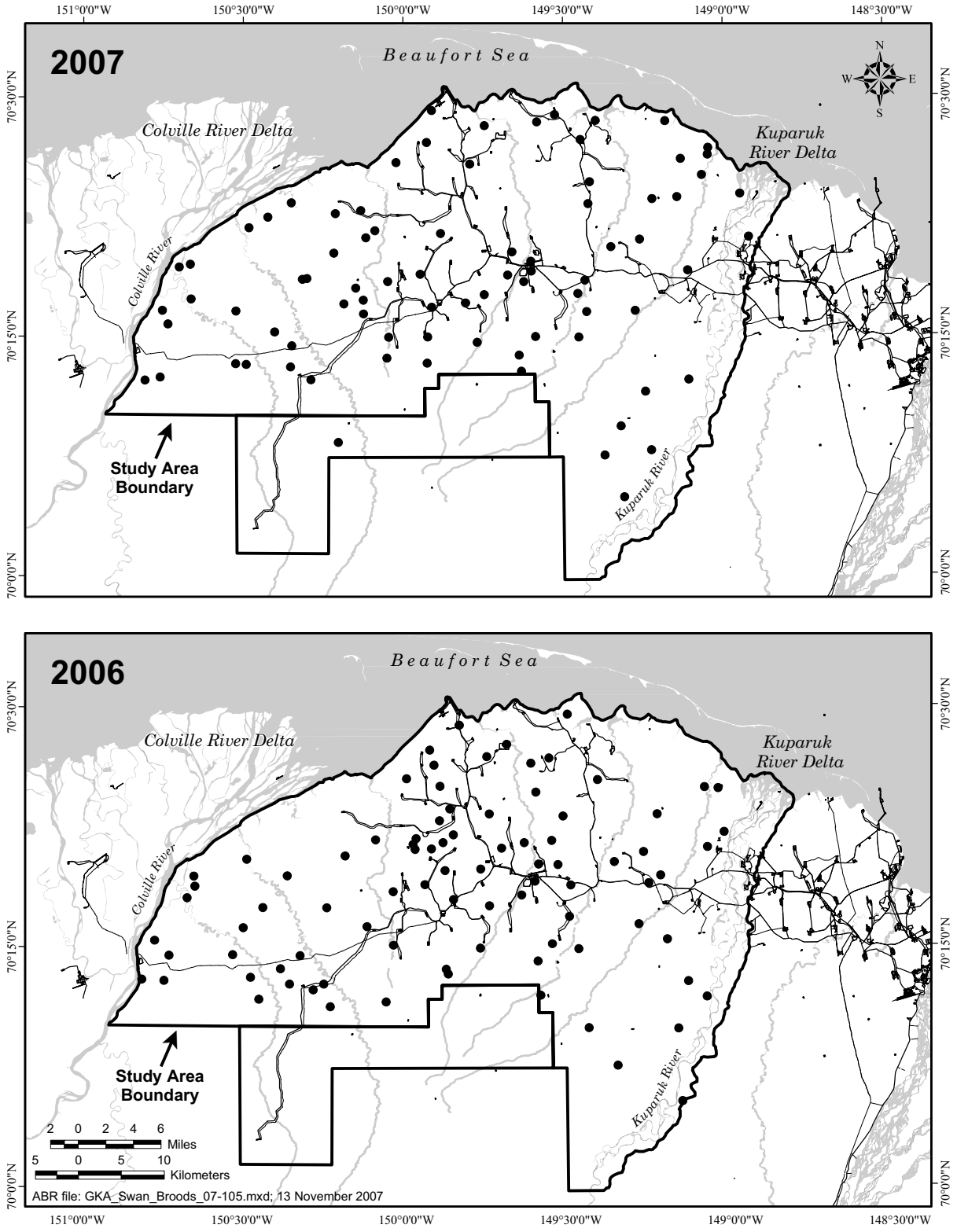

Figure 12. Locations of Tundra Swan broods observed in the in the Kuparuk and Kuparuk South study areas, Alaska, August 2006 and 2007 (see Figure 9 for study area boundaries).

BRANT

A small percentage (<5%; Sedinger et al. 1993) of the Pacific Flyway population of Brant breeds on the Arctic Coastal Plain of Alaska. Prior to the mid-1980s, information on the distribution, abundance, and nesting success of Brant in this area was collected only sporadically. In 1966, King (1970) surveyed the entire Arctic Coastal Plain of Alaska and saw large flocks of nonbreeding Brant (~25,000 total). Flocks of nonbreeders also were noted in previous years by Hansen (in King 1970). Unlike Hansen, however, King also saw brood-rearing groups of Brant, indicating the presence of a nesting population on the coastal plain. In the late 1970s to early 1980s, Gavin (1977, 1980) also noted locations of nesting Brant during aerial surveys of the central Arctic Coastal Plain where oil production was taking place.

Within the oilfields, Brant can be found breeding in scattered smaller colonies (e.g., Surfcote and near Lake Colleen in Prudhoe Bay, near CPF-3 and DS-2C in Kuparuk, and near C Pad in the Milne Point area) and in several larger colonies (e.g., Howe Island on the Sagavanirktok River delta, and on the northern Colville River Delta). Locations of breeding colonies outside the oilfields are less well known, but some have been mapped in areas surveyed between Kasegaluk Lagoon and the western Colville River Delta (Ritchie et al. 2008). Brood-rearing and molting areas used by Brant are better known, as they are usually located in the relatively limited coastal salt marshes along the Beaufort Sea, including the Fish Creek area, Colville River Delta, Oliktok Point and Milne Point areas, mouth of the Putuligayuk River, and the Sagavanirktok River. Although the vast majority of molting Brant on the Arctic Coastal Plain are located at Teshekpuk Lake (Bollinger and Derksen 1996), most areas that support brood-rearing Brant on the coastal plain also have small groups of molting birds (i.e., usually failed or non-breeding birds from nearby nesting colonies) (Ritchie et al. 2008).

Since the mid-1980s, Brant have received considerable attention from both the oil industry and regulatory agencies because of the substantial declines in the Pacific Flyway population (Raveling 1984, Sedinger et al. 1993). Brant are traditional in their use of nesting and brood-rearing areas and, hence, are potentially vulnerable to changing conditions in those areas. Brant during brood-rearing, in particular, are sensitive to various types of disturbance associated with oil development, including noise, and vehicular and aircraft traffic. For example, studies in the Lisburne Development Area in Prudhoe Bay found that Brant were more responsive to vehicular disturbances at greater distances during brood-rearing than they were during pre-nesting and nesting (Murphy and Anderson 1993). In contrast, Brant nesting in a colony near Central Processing Facility 3 (CPF-3) in the Kuparuk Oilfield were not significantly disturbed by noise from that facility (Hampton et al. 1988). Thus, the specific disturbance type and relative distance of birds to the disturbance are important factors in determining the relative effects of oilfield-related disturbance on Brant.

Beginning in 1988, surveys supported by ARCO Alaska, Inc. (now ConocoPhillips Alaska, Inc.), have focused specifically on the distribution of nesting and brood-rearing Brant within the Kuparuk Oilfield. Since the early 1990s, aerial surveys were conducted almost annually during brood-rearing. The objective of the 2007 brood-rearing survey was to count Brant adults and goslings and to locate their brood-rearing/molting areas between Heald Point and the Miluveach River along the Arctic Coast.

2007 RESULTS

- One aerial survey was conducted on 29–30 July 2007 along three sections of the coast between the Sagavanirktok and Colville rivers to locate Brant brood-rearing areas and count numbers of adults and goslings (Figure 13). Brant were counted in 18 brood-rearing (adults with young) groups and 9 molting (adults without young) groups between the Sagavanirktok and Colville rivers, for a total count of 1878 birds (1445 adults and 433 goslings; Table 11, Figure 14).
- Goslings comprised 23% of the total number of birds counted, which was the fourth-lowest gosling percentage ever recorded during these surveys. The total number of goslings counted (433) was

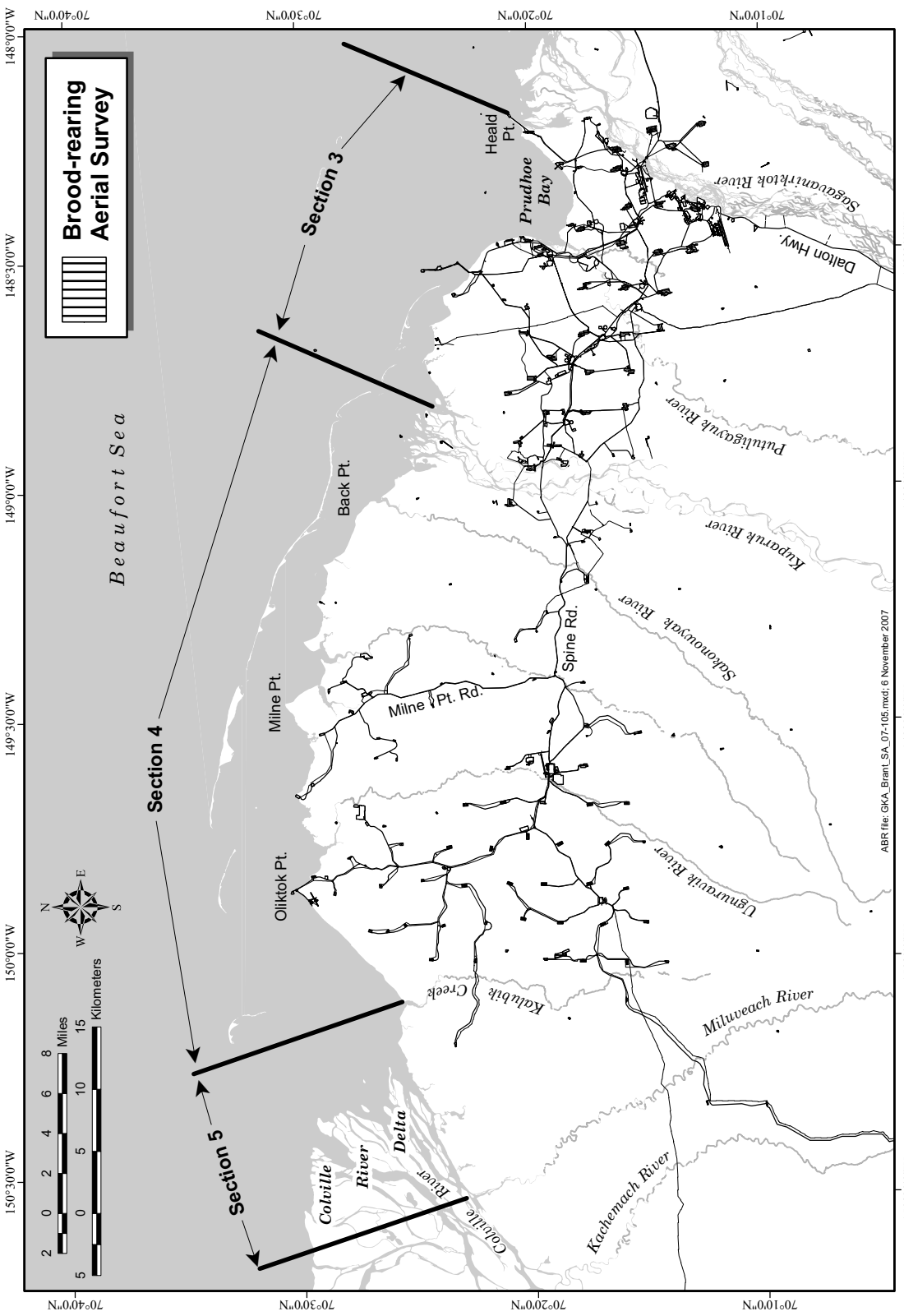

Figure 13. Study area for the aerial survey for brood-rearing/molting Brant between the Colville and Sagavanirktok rivers, Alaska, August 2007.

Table 11. Numbers of brood-rearing (adults and young) and molting (adults only) groups of Brant observed during aerial surveys in late July and early August along coastal sections between the Colville and Sagavanirktok rivers, Alaska, 1989–2007. Counts were either from visual observations or aerial photographs taken during the surveys.

	Section 3 Heald Point to Kuparuk River				Section 4 Kuparuk River to Kalubik Creek				Section 5 Kalubik Creek to Miluveach River				Total Survey Area			
	Brood-rearing		Molting		Brood-rearing		Molting		Brood-rearing		Molting		Brood-rearing		Molting	Grand
Year[a]	Adults	Young	Adults	Total	Adults	Young	Adults	Total	Adults	Young	Adults	Total	Adults	Young	Adults	Total
1989	291	171	2	464	357	255	5	617	109	86	0	195	757	512	7	1276
1990	484	360	0	844	648	663	0	1311	177	205	0	382	1309	1228	0	2537
1991	351	102	9	462	381	279	49	709	234	276	0	510	966	657	58	1681
1992	391	112[b]	119	622[b]	160	124	0	284	0	0	0	0	551	236	119	906
1993	105	68	238	411	607	536	69	1212	31	46	0	77	743	650	307	1700
1994	216	148	150	514	492	414	21	927	0	0	0	0	708	562	171	1441
1995	229	12	56	297	831	718	20	1569	22	33	0	55	1082	763	76	1921
1996	ns[c]	ns	ns	ns	594	533	0	1127	12[d]	18[d]	0[d]	30[d]	606	551	0	1157
1997	109	51	140	300	294	232	82	608	ns	ns	ns	ns	403	283	222	908
1998	40	23	143	206	370	290	42	702	192	218	0	410	602	531	185	1318
1999	269	160	300	729	504	367	16	887	0	0	0	0	773	527	316	1616
2000	252	120	82	454	706	712	0	1418	0	0	0	0	958	832	82	1872
2001	143	16	69	228	344	140	0	484	124	32	0	156	611	188	69	868
2002	50	6	350	406	55	24	99	178	0	0	0	0	105	30	449	584
2003	60	22	349	431	751	616	0	1367	124	81	0	205	935	719	349	2003
2004	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
2005	407	133	24	564	901	743	42	1686	28	33	0	61	1336	909	66	2311
2006	135	64	347	546	197	69	34	300	0	0	0	0	332	133	381	846
2007	102	32	370	504	853	401	120	1374	0	0	0	0	955	433	490	1878

[a] Numbers for 1989–1993 and 1996 are a mean from two surveys; numbers for 1994, 1995, 1997–2007 are from one survey only.
[b] Includes an inland group seen by ground observers.
[c] ns = not surveyed.
[c] This section only surveyed once that year.

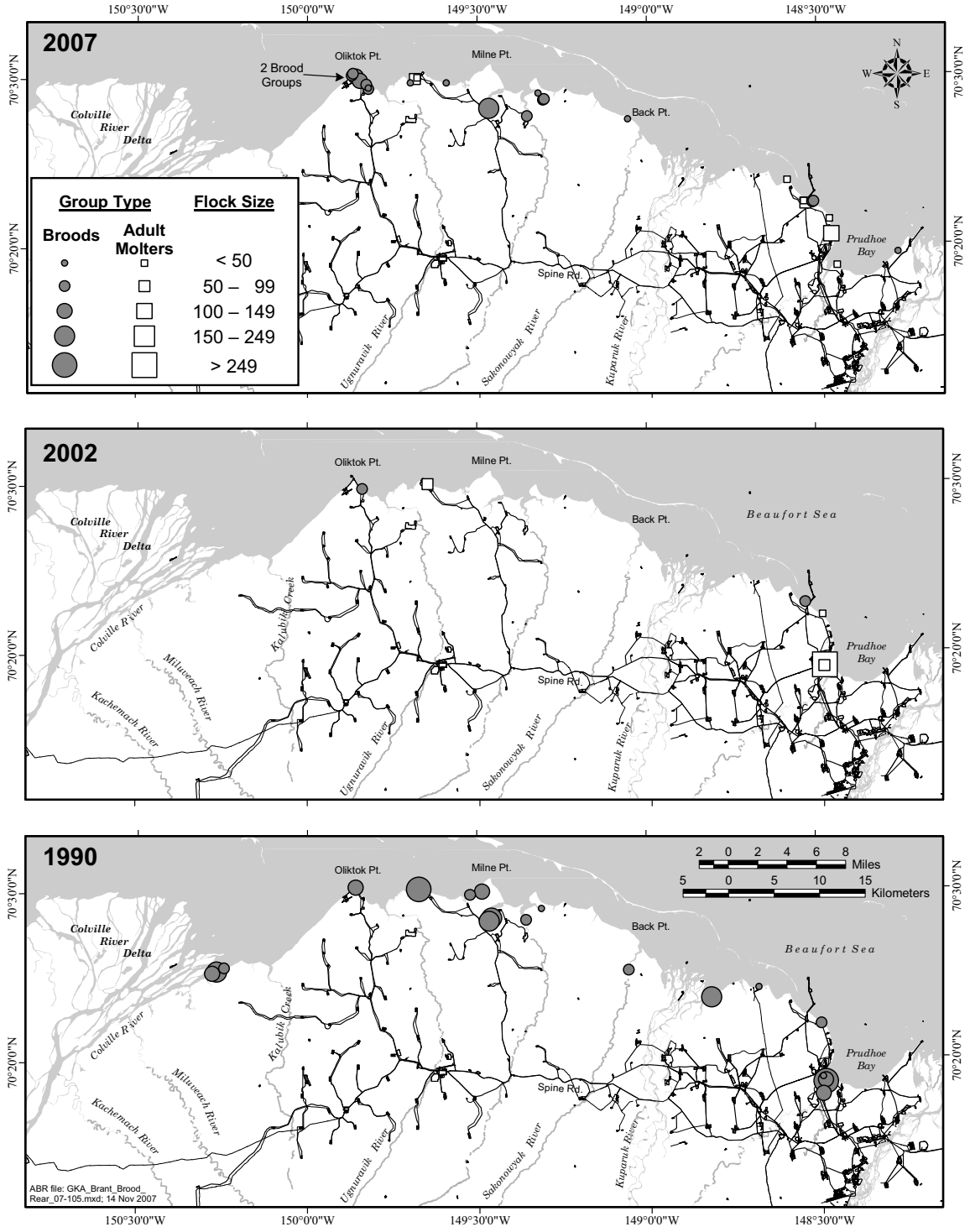

Figure 14. Locations and sizes of brood-rearing (adults and young) and molting (adults only) groups of Brant between the Colville and Sagavanirktok rivers, Alaska, in 1990, 2002, and 2007. The years other than 2007 are for comparison only: 1990 for high numbers of brood-rearing Brant and 2002 for low numbers. Only the survey in 1990 that was flown on a similar date was included for comparability with the single surveys in 2002 and 2007.

below the annual mean of 541 goslings for the 18 years of surveys. In contrast, more adult Brant were counted in 2007 than in any other year, including the highest count for non- or failed-breeding Brant (i.e., molting groups of adults only). When these molting adults are excluded, the percentage of goslings for brood-rearing groups only increased to 31%.

- In Section 4 (Kuparuk River to Kalubik Creek), 1374 Brant (973 adults and 401 goslings) were recorded, the fourth highest count for this section since the surveys began in 1989. The total number of goslings in Section 4 was near the annual mean (395), however, goslings comprised only 29% of all birds (the fourth-lowest percentage among years), reflecting the high number of adults present. The total number of adults (973) and the number of adults in molting groups without young (120) were the highest ever recorded, and the number of adults in brood-rearing groups (853) was the second-highest ever recorded in this section.
- During the Brant brood-rearing survey, one brood-rearing group (188 adults and 107 young) of Snow Geese (*Chen caerulescens*) was observed near the Colville River and two small groups (11 adults and 8 young) were observed in Prudhoe Bay.

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Appendix 1. Methods for avian surveys in the Kuparuk Oilfield, Alaska, 2007.

Brief summaries of methods used for aerial and road surveys, and ground nest searches and nest fate assessments for eiders are presented below; complete methods are presented in Anderson et al. (2004, 2005).

Aerial Surveys

The following table summarizes the aerial survey methods used for conducted for pre-nesting eiders, nesting and brood-rearing Tundra Swans, and for brood-rearing/molting Brant.

Species	Eiders	Tundra Swan		Brant
Season	Pre-nesting	Nesting	Brood-rearing	Brood-rearing
Aircraft	C-185/206	C-185/206	C-185/206	SuperCub/Scout
Flight Altitude	30–50 m	150 m	150 m	
Flight Speed	145 kph	145 kph	145 kph	
Number of Observers	2	2	2	1
Survey Type	E-W transects (fixed-width)	E-W transects[a] (fixed-width)	E-W transects[a] (fixed-width)	Coast and selected embayments
Transect Spacing	0.5 miles	1.6 km	1.6 km	None, circling of larger groups
Transect Width	400 m (200 m each side)	800 m (400 m each side)	800 m (400 m each side)	na
Percentage Coverage of Study Area	50%	100%	100%	na
Data Collection Media	Photo-mosaic maps/ audio tape	Photo-mosaic maps/USGS topographic maps/ aerial photographs taken of nest sites	Photo-mosaic maps	USGS topographic maps/ aerial photographs taken of large groups

[a] This survey followed the standard protocol of the U.S. Fish and Wildlife Service for swan surveys (USFWS 1987b, 1991).

Eider Road Surveys

Road surveys in the Kuparuk Oilfield encompassed all habitats within ~500 m of the road system. The road to the farthest south Meltwater drill site (DS-2P) was surveyed only once to look for areas of suitable habitats for eiders; if none was found, this area was not included in subsequent surveys. In brief, the methodology for road surveys was for a single observer in a truck to drive the roads and count and map (on 1:1000-scale photo-mosaic maps of the oilfield) all eiders seen, regardless of distance from the road. In addition to the main roads (Spine Road, Oliktok Point Road) in the oilfield, we surveyed all secondary roads to drill and mine sites, and surveyed around the perimeter of the gravel pad at each drill site to count any eiders near the pad but not visible from the road.

The entire study area was surveyed every two days (1/2 of area each day); except as noted above for the 16 June survey, which was a 'high-grade' survey of only areas where Spectacled Eiders had been seen on previous surveys. All observations of eiders were digitized and added to the geographic information system (GIS) database initiated in 1993. Distances of Spectacled Eider observations to the nearest oilfield facility (road or pad) were determined using GIS.

Eider Nest Searches and Nest Fate

Ground searches for eider nests were conducted at selected locations based on where repeated sightings of breeding pairs occurred during the road surveys and where nests were located in 2006. Searchers walked the perimeters of all waterbodies in the selected area and searched for active (females present and incubating) or failed (nest scrapes or bowls) eider nests. Most Spectacled Eiders nest within 25 m of waterbodies, but searches extended out to at least 50 m to ensure coverage. Artificial eggs implanted with temperature sensors (thermistored eggs) were placed in active Spectacled Eider nests for later analysis of incubation constancy.

During July, all nests that still were active when initially located were revisited to determine their final fate (apparent nest success). A nest was considered to be successful if at least one egg hatched (based on presence of a membrane[s] separated from the shell [indicative of hatch] in the nest bowl). Thermistored eggs were retrieved during the nest-fate visit and data were downloaded in the field office for later analysis. All nest locations were digitized and added to the GIS database. Distances of nests were estimated to the nearest water (any type) and permanent waterbody and nest locations were mapped on the aerial photographs or maps (1:1000), or GPS coordinates were taken at the nest site, so that distance to the nearest oilfield facility (road or pad) could be determined later using GIS.

Appendix 2. Numbers of Spectacled Eiders counted on road surveys in the Kuparuk Oilfield, Alaska, 8–15 June 2007. Eiders seen ≤500m from the survey route and those seen at >500 m are reported separately because only eiders seen at ≤500 m were used in the analyses.

	≤500 m					>500 m					Total				
Date	Males	Females	Total	Pairs	*n*	Males	Females	Total	Pairs	*n*	Males	Females	Total	Pairs	*n*
8 June	6	5	11	5	6						6	5	11	5	6
9 June	1	1	2	1	1						1	1	2	1	1
10 June	8	7	15	7	8	1	1	2	1	1	9	8	17	8	9
11 June	2	2	4	2	2						2	2	4	2	2
12 June	8	6	14	6	8						8	6	14	6	8
13 June	1	1	2	1	1						1	1	2	1	1
14 June	8	4	12	4	7	2	1	3	1	1	10	5	15	5	8
15 June	1	0	1	0	1						1	0	1	0	1
16 June[a]	8	6	14	6	4	1	1	2	1	1	9	7	16	7	5
Total	43	32	77	33	39	4	3	6	3	3	47	35	82	35	41

[a] Survey conducted on this day was a "high-grade" survey of areas where Spectacled Eiders had been seen on previous days and not a complete road survey of the study area.

Appendix 3. Nest-site characteristics for successful and failed eider nests in the Kuparuk Oilfield, 2007.

Species	General Location	Nest Fate	Clutch Size	Number of Membranes	Microsite Habitat	Waterbody Habitat	Distance to Nearest (m)		
							Waterbody	Water	Oilfield Facility
Spectacled Eider	DS-2V	Successful	3	3	Moist Sedge Shrub Meadow	Deep Open Water	0.1	0.1	402
	DS-2X	Successful	4	3	Moist Sedge Shrub Meadow	Basin Wetland Complex	1.5	1.5	367
	DS-1E	Failed	4	0	Wet Sedge Willow Meadow	Basin Wetland Complex	0.5	0.25	233
Probable Spectacled Eider	South of Pit E	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	0.5	0.5	513
	DS-1E	Failed	0	0	Wet Sedge Willow Meadow	Basin Wetland Complex	30	0.1	395
	DS-2C	Failed	1	0	Nonpatterned Wet Meadow	Basin Wetland Complex	0.25	0.25	546
	DS-2V	Failed	0	0	Moist Sedge Shrub Meadow	Deep Open Water	30	30	308
	DS-2V	Failed	0	0	Moist Sedge Shrub Meadow	Deep Open Water	40	1.0	489
King Eider	DS-2C	Successful	5	2	Nonpatterned Wet Meadow	Basin Wetland Complex	0.5	0.5	675
	DS-2C	Successful	0	5	Nonpatterned Wet Meadow	Basin Wetland Complex	0.5	0.5	491
	South of Pit E	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	15	5	315
	CPF-3 Brant Colony	Failed	2	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	10	10	335
	CPF-3 Brant Colony	Failed	3	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	0.2	0.2	690
	CPF-3 Brant Colony	Failed	3	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	0.2	0.2	471
	DS-2C	Failed	5	0	Nonpatterned Wet Meadow	Basin Wetland Complex	35	0.2	150
	DS-1E	Failed	0	0	Wet Sedge Willow Meadow	Basin Wetland Complex	7	1	206
	DS-1E	Failed	0	0	Wet Sedge Willow Meadow	Basin Wetland Complex	30	1	198
	DS-1E	Failed	5	0	Wet Sedge Willow Meadow	Basin Wetland Complex	0.2	0.2	330
Probable King Eider	South of Pit E	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	1	1	331
	South of Pit E	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	0.6	0.6	393
	South of Pit E	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	0.5	0.5	485
	South of Pit E	Failed	1	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	1	1	331
	DS-2C	Failed	2	0	Nonpatterned Wet Meadow	Basin Wetland Complex	0.2	0.2	706
	DS-2C	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	10	1	432
	DS-2C	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	1.5	0.5	247
	DS-2G	Failed	1	0	Nonpatterned Wet Meadow	Basin Wetland Complex	10	1	308
	DS-2G	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	1.5	0.5	247
	DS-2V	Failed	0	0	Moist Sedge Shrub Meadow	Deep Open Water	10	10	422
	DS-1E	Failed	1	0	Wet Sedge Willow Meadow	Basin Wetland Complex	2	2	279
Unidentified Eider	South of Pit E	Failed	1	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	15	1	90
	CPF-3 Brant Colony	Failed	0	0	Moist Sedge Shrub Meadow	Basin Wetland Complex	40	0.2	567
	DS-2F	Failed	1	0	Nonpatterned Wet Meadow	Basin Wetland Complex	10	0.5	290
	DS-2F	Failed	0	0	Nonpatterned Wet Meadow	Shallow Open Water	0.3	0.3	272

[a] Nest located by University of Alaska Fairbanks researcher.
nd = no data collected.

Appendix 4. Numbers of Tundra Swans, nests and broods observed during June aerial surveys in the South Kuparuk study area, Alaska, 1989–2007.

	Nesting				Brood-rearing					
		Observed Number of Adults					Observed Number of Adults			
Year	Number of Nests	with Nests	without Nests	Total	Number of Broods	Number of Young	with Broods	without Broods	Total	Total Swans
1989		2	2	4				2	2	2
1990	1							2	2	2
1991			5	5						
1992			2	2						
1993										
1994										
1995										
1996		1	1	2						
1997	1		2	2				1	1	1
1998	1		7	7	1	1	1			1
1999		2	5	7				7	7	7
2000	1		2	2				3	3	3
2001		2	2	4				2	2	2
2002	1	1	5	6	1	1	2		2	3
2003	1		4	4				3	3	3
2004			6	6						
2005		1	4	5				2	2	2
2006	1	2	5	7				2	2	2
2007	1	2	2	4	1	4	2		2	6

Appendix 5. Numbers of Tundra Swans and nests recorded (by USGS quadrangle) during aerial surveys in the Kuparuk and South Kuparuk study area, Alaska, 19–21 June 2007.

Location (USGS Quadrangle)	Adults with Nests				Adults without Nests					
	Pairs	Single Adults	Total	Number of Nests	Pairs	Single Adults	Flocks	Flocked Swans	Total	Total Swans
Beechey Point										
A-4	5	5	15	10	7	10			24	39
A-5	4	4	12	8	10	7	1	3	30	42
B-4	18	7	43	25	17	15	1	3	52	95
B-6	24	14	62	38	44	24	2	12	124	186
C-6	0	0	0	0	0	2			2	2
Harrison Bay									0	0
A-1	7	4	18	11	3	1	2	4	11	29
A-2	1	1	3	2	1	3			5	8
B-1	13	6	32	19	22	15	1	3	62	94
B-2	4	2	6	6	3	2	2	8	16	22
Total	76	43	191	119	107	79	9	33	326	517

Appendix 6. Densities (number/km²) of Tundra Swans and nests observed during June aerial surveys in the Kuparuk study area, Alaska, 1989–2007. Densities are not calculated for the smaller South Kuparuk study area.

		Adults		
Year	Nests	with Nests	without Nests	Total
1989	0.02	0.03	0.08	0.11
1990	0.03	0.05	0.07	0.12
1991	0.03	0.05	0.12	0.16
1992	0.03	0.05	0.10	0.15
1993	0.03	0.05	0.10	0.15
1994	0.02	0.03	0.11	0.14
1995	0.04	0.08	0.12	0.20
1996	0.05	0.09	0.11	0.20
1997	0.03	0.05	0.10	0.15
1998	0.03	0.09	0.16	0.24
1999	0.04	0.05	0.10	0.15
2000	0.03	0.06	0.15	0.21
2001	0.03	0.06	0.12	0.18
2002	0.05	0.08	0.12	0.21
2003	0.03	0.05	0.13	0.18
2004	0.04	0.06	0.10	0.16
2005	0.04	0.06	0.10	0.17
2006	0.04	0.06	0.10	0.16
2007	0.05	0.08	0.14	0.22

Appendix 7. Numbers of Tundra Swans and broods recorded (by quadrangle) during aerial surveys in the Kuparuk and South Kuparuk study areas, Alaska, 20–21 August 2007.

Location (USGS Quadrangle)	Brood Groups						Non-brood Groups					Total		
	Pairs	Single Adults	Total Adults	Broods	Young	Mean Brood Size	Pairs	Single Adults	Flocks	Flocked Swans	Total Adults	Adults	Swans	Percent Young
Beechey Point														
A-4	6		12	6	13	2.2	21	5	1	3	50	62	75	17.3
A-5	4		8	4	10	2.5	14	4	1	3	35	43	53	18.9
B-4	13	1	27	14	32	2.3	32	11			75	102	134	23.9
B-5	24	1	49	25	60	2.4	44	17	3	10	115	164	224	26.8
Harrison Bay														
A-1	8		16	8	19	2.4	7	2	1	4	20	36	55	34.5
A-2	2		4	2	6	3.0	2	3	1	4	11	15	21	28.6
B-1	17	1	35	18	32	1.8	30	11	4	23	94	129	161	19.9
B-2	4	1	9	5	12	2.4	2	1	1	11	16	25	37	32.4
Total	78	4	160	82	184	2.2	152	54	12	58	416	576	760	24.2