DATA SUMMARY REPORT

AVIAN STUDIES IN THE KUPARUK OILFIELD, ALASKA, 2008

BETTY A. ANDERSON
ALICE A. STICKNEY
TIM OBRITSCHKEWITSCH
PAMELA E. SEISER
JOHN E. SHOOK

PREPARED FOR
CONOCOPHILLIPS ALASKA, INC.
ANCHORAGE, ALASKA

AND

THE KUPARUK RIVER UNIT

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

Cover: Brood-rearing Brant (*Branta bernicla*) feeding along the Beaufort Sea coast, August 2008.

AVIAN STUDIES IN THE KUPARUK OILFIELD, ALASKA, 2008

DATA SUMMARY REPORT

Prepared for

ConocoPhillips Alaska, Inc.
P.O. Box 100360
Anchorage, Alaska 99510
and
The Kuparuk River Unit

Prepared by

Betty A. Anderson
Alice A. Stickney
Tim Obritschkewitsch
Pamela E. Seiser
John E. Shook

ABR, Inc.—Environmental Research & Services
P.O. Box 80410
Fairbanks, Alaska 99708

April 2009

Printed on recycled paper.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACKNOWLEDGMENTS

We thank Caryn Rea, Senior Staff Biologist, ConocoPhillips Alaska, Inc., for her support for the Kuparuk avian studies, and thank the Kuparuk Field Environmental staff for their help with logistical and field support. Sandy Hamilton, Robert Wing and Morgan Stanton, Arctic Air Alaska, Inc., Fairbanks, were our able pilots for the aerial surveys.

Many ABR employees assisted with fieldwork. Our thanks to Julie Parrett for her diligence during the eider aerial surveys, and to Jeremy Maguire and Alex Prichard for the nesting and brood-rearing swan survey. Thanks also to Lauren Attanas, Robert Burgess, and Jennifer Boisvert for the many hours walking the tundra in search of nesting eiders, to Allison Zusi-Cobb, Dorte Dissing, and Will Lentz for their GIS skills, and to Pamela Odom for report preparation.

INTRODUCTION

From 1988–1999, ABR, Inc., conducted avian studies for ARCO Alaska, Inc., in the Kuparuk Oilfield on the Arctic Coastal Plain of Alaska. In 2000–2008, 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 2008 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. Annual surveys for Spectacled Eiders began in the Kuparuk Oilfield in 1993. 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. Tundra Swan surveys in the Kuparuk Oilfield began in 1988 and have continued annually. 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. Brant surveys were initiated in the Kuparuk Oilfield in 1988 and have continued annually since then, with some modifications in seasonal and geographic scope (see Brant chapter).

This report summarizes the results of surveys in 2008 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 2008 (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 warmer than average spring conditions in 2008. Mean monthly temperatures in 2008 were 2°C warmer for both May and June than the long-term (20-year) mean for those months (Table 1; www.ncdc.noaa.gov/oa/ncdc.html). Breakup on the Colville River in 2008 was average, both for date of peak discharge, and for surface elevation and discharge rate, and was considered a 2-year flood event (Michael Baker, Jr., Inc. 2008). Flood waters reached the head of the delta on 26 May, and excepting some brief ice-jam events, most of the flood had passed through that area by 31 May (Michael Baker, Jr., Inc. 2008). Peak breakup on the Kuparuk River occurred on 28 May 2008, 1 day later than the historical average. Snow was essentially gone by the end of May and all shallow lakes had melted. During the period of waterfowl arrival and peak nest initiation (15 May–15 June), 107 cumulative thawing degree-days were recorded, the fourth warmest in 20 years (range = 19–128 thawing degree-days; Table 1, Figure 1). The high number of cumulative thawing degree-days recorded for this same period was influenced by the warm temperatures in the end of May, when 34 thawing degree-days were recorded (the third warmest May), as well as warm temperatures in early June.

*Tables and figures are grouped at the end of each section in the order they are cited in text.

Table 1. Annual mean temperatures (°C) for May and June 1989–2008 in the Kuparuk study area, compared to the 20–year mean, and the thawing degree-days for 15 May–15 June in the same years.

Year	Mean Temperature (°C)		Cumulative Thawing Degree-Days[a]
	May	June	
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
2008	-2.6	7.1	107
20-year average	-4.8	5.0	61

[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.

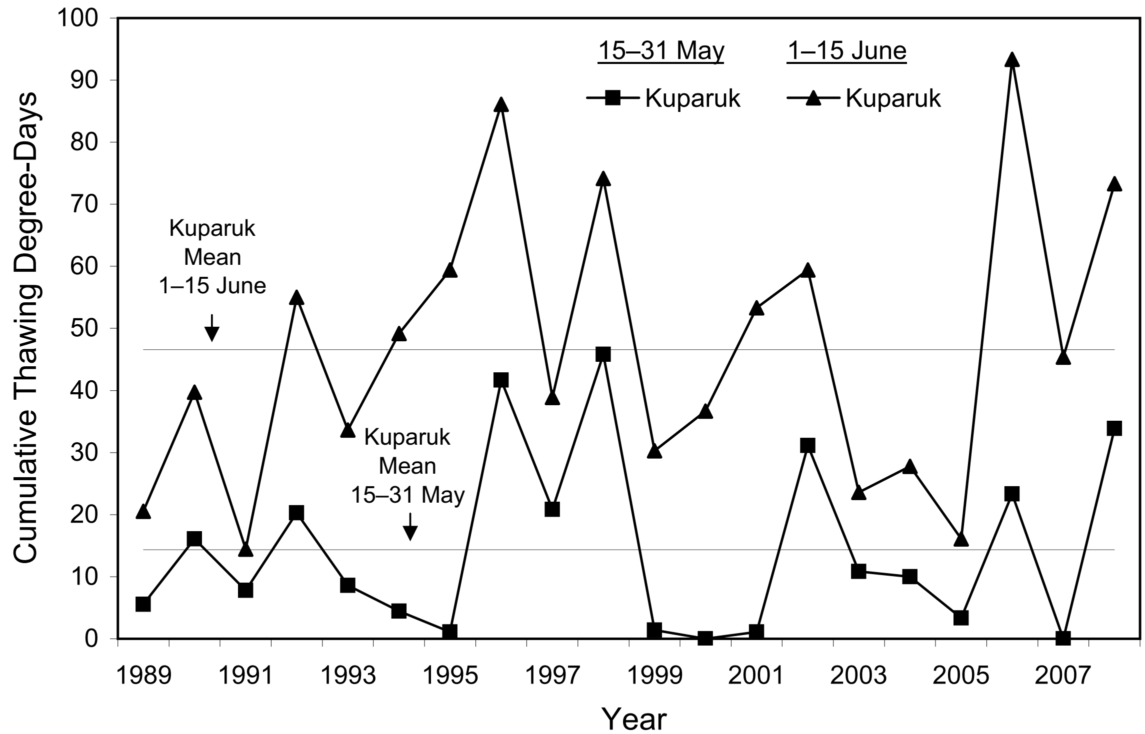

Figure 1. The number of cumulative thawing degree-days recorded between 15–31 May and 1–15 June and mean thawing degree-days for those same periods in the Kuparuk Oilfield, Alaska, 1989–2008.

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 2008 Spectacled Eider surveys in the Kuparuk Oilfield. The 2008 season was the 16th year of road and nest searches and the 15th 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 2008 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, 1995–2008) 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 and time-lapse cameras to evaluate causes of nesting failures (these data are not reported in this summary, but have been archived for future analysis; three time-lapse cameras were deployed in 2008).

2008 RESULTS

- In the Kuparuk Oilfield, a peak count of 27 Spectacled Eiders was recorded during the complete road survey of the oilfield on 7–8 June 2008 (Figure 2; Appendix 2); this count was a 28% increase from the peak count of 21 eiders on 10–11 June 2007. Daily running totals for Spectacled Eiders were at the lower range for counts recorded during previous warm years in the Kuparuk study area (Figure 3). Spectacled Eiders were already relatively abundant by the onset of road surveys on 6 June, which suggests an early arrival in the oilfield.
- As in previous years, most Spectacled Eiders in 2008 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) 2V, near DS-2F, near DS-2X, west of DS-2T, and a few observations near DS-2C (Figure 4). Eiders also were repeatedly observed in the CPF-1 area in the large basin complex west of DS-1E. In the CPF-3 area, Spectacled Eiders were seen south of Mine Site E and at several locations along the Oliktok Point Road and along the drill site road east of CPF-3 (Figure 4).

- Spectacled Eiders were located a mean of 160.2 m from oilfield infrastructure (roads or pads) in 2008, 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 ~63% of all observations (*n* = 51) were in two major habitats: shallow open water (33%) and basin wetland complexes (10%). Almost 20% of all observations of Spectacled Eiders were in Drainage Impoundments, a type of human-modified habitat type. 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 conducted in 1993–2007 were associated with habitat types after a data review in early 2008.
- In 2008, an aerial survey was conducted on 13–15 June to locate Spectacled Eiders in the Kuparuk River Unit (Figure 5). During that survey, 14 Spectacled Eiders were counted on the ground in 10 groups (7 additional birds were observed flying; Table 4 and Figure 6). Spectacled Eider densities (non-flying birds only) were 0.02 total birds/km² and 0.02 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. Although the densities of total birds and breeding pairs in 2008 were the lowest recorded since the beginning of surveys in the Kuparuk study area in 1993, this trend does not appear to be reflected elsewhere in the oilfields or across the wider coastal plain. Spectacled Eider densities were higher in 2008 than in 2007 on both the Colville River delta (Johnson et al. 2009) and across the Arctic Coastal Plain (Larned et al. 2009). Based on 15 years of aerial surveys, the regional population of Spectacled Eiders in the Kuparuk Oilfield appeared to be relatively stable at least through 2007, and the numbers had increased following lower numbers in 2002–2006, continued monitoring will help determine if lower numbers in 2008 reflect a change in this trend (Table 5; Figure 7). The long-term population of Spectacled Eiders on the North Slope also has been relatively stable in recent years (Larned et al. 2009).
- In late June 2008, three Spectacled Eider nests and three probable Spectacled Eider nests (based on identification of contour feathers) were found during searches of nine locations in the oilfield (Table 6; Appendix 3). While searching for Spectacled Eiders, we also found 21 King Eider (*Somateria spectabilis*) nests, and 12 probable King Eider nests. In 2008, Spectacled Eider nests were located in the CPF-2 area near DS-2C, DS-2T, and DS-2V; in the CPF-1 area near DS-1E; and in the CPF-3 area south of Mine Site E (Figure 8). As in 1993–2007, at least one location supported more than one nesting pair of Spectacled Eiders in 2008 (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 2008, the mean distance of nests to the closest water (0.4 m) was the third lowest since 1993, and the mean distance of nests to the nearest waterbody (mean = 16.2 m) was higher than the long-term mean (10.2 m; *n* = 16 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 2008, as in previous years, continued to be located relatively far from the closest oilfield infrastructure (mean = 364 m; range = 142–510 m).

- In 2008, nesting success for Spectacled Eiders was 0% (2 of 8 nests; Table 6). Nesting success, which was defined as at least 1 egg hatching, was identical to the previous low recorded in 2004 and was well below the long-term mean for this study (mean = 39.1%; n = 16 years). 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 2008 was similar to the long-term mean for this species, suggesting that they were not as strongly affected by fox predation in 2008 (Table 6). Warmer spring temperatures apparently did not affect eider nesting success in 2008.
- In 2008, time-lapse cameras that recorded images every 30 sec were installed approximately 30 m from three Spectacled Eider nests (DS-1E, DS-2C, and DS-2T). Two of the nests were depredated by arctic foxes within a few days prior to the expected hatch date; foxes were recorded swimming to the nesting islands at both locations and repeatedly removing eggs. Prior to the predation event, both eider females showed high incubation constancy (>97% of total time) based on reviews of the time-lapse images, thus poor attendance did not appear to contribute to nesting failure. At the third eider nest monitored with a time-lapse camera (near DS-2T), the nest apparently failed following the removal of the eider eggs by a Canada Goose (*Branta canadensis*) that then laid a goose egg in the eider nest. The eider eggs were pushed out of the nest sometime between when the nest was found during the initial nest search and when the biologists returned to the nest to install the time-lapse camera. The biologists removed the goose egg and returned the eider eggs to the nest and covered them with down, and although the female eider was observed to return to the nest on several occasions over a span of about 3 days, she did not resume incubation at the nest and the eggs were apparently removed by avian predators (Glaucous Gulls [*Larus hyperborealis*] and jaegers [*Stercorarius* spp.] that were recorded on the time-lapse images of the nest. The thermistored eggs installed at these three eider nests failed to record nest temperatures due to a programming error, but we were able to calculate incubation constancy based on the time-lapse camera images, which had time-date stamps.

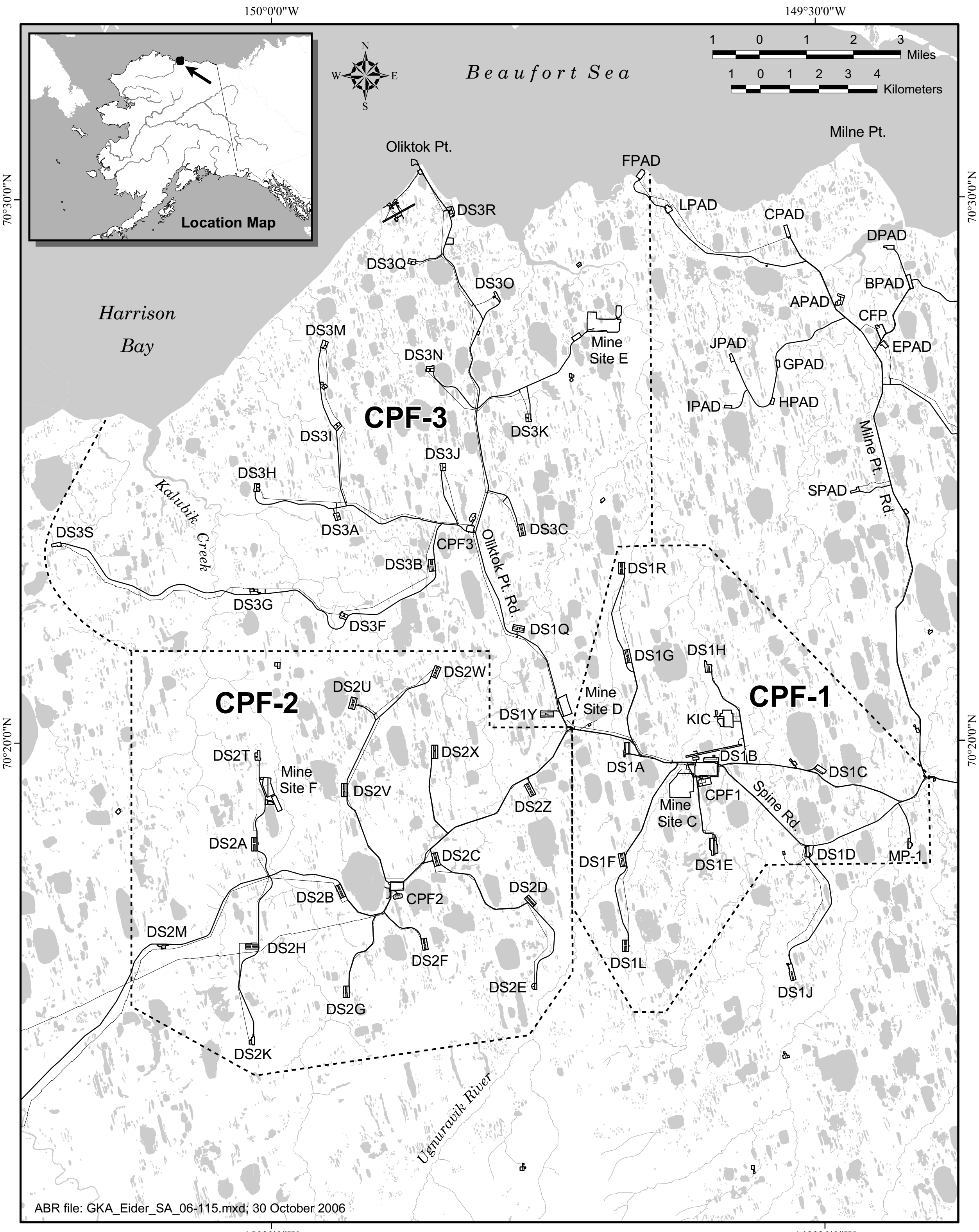

Figure 2. Study area for the Spectacled Eider study in the Kuparuk Oilfield, Alaska, 2008, showing the road system and boundaries of the three Central Processing Facility (CPF) areas.

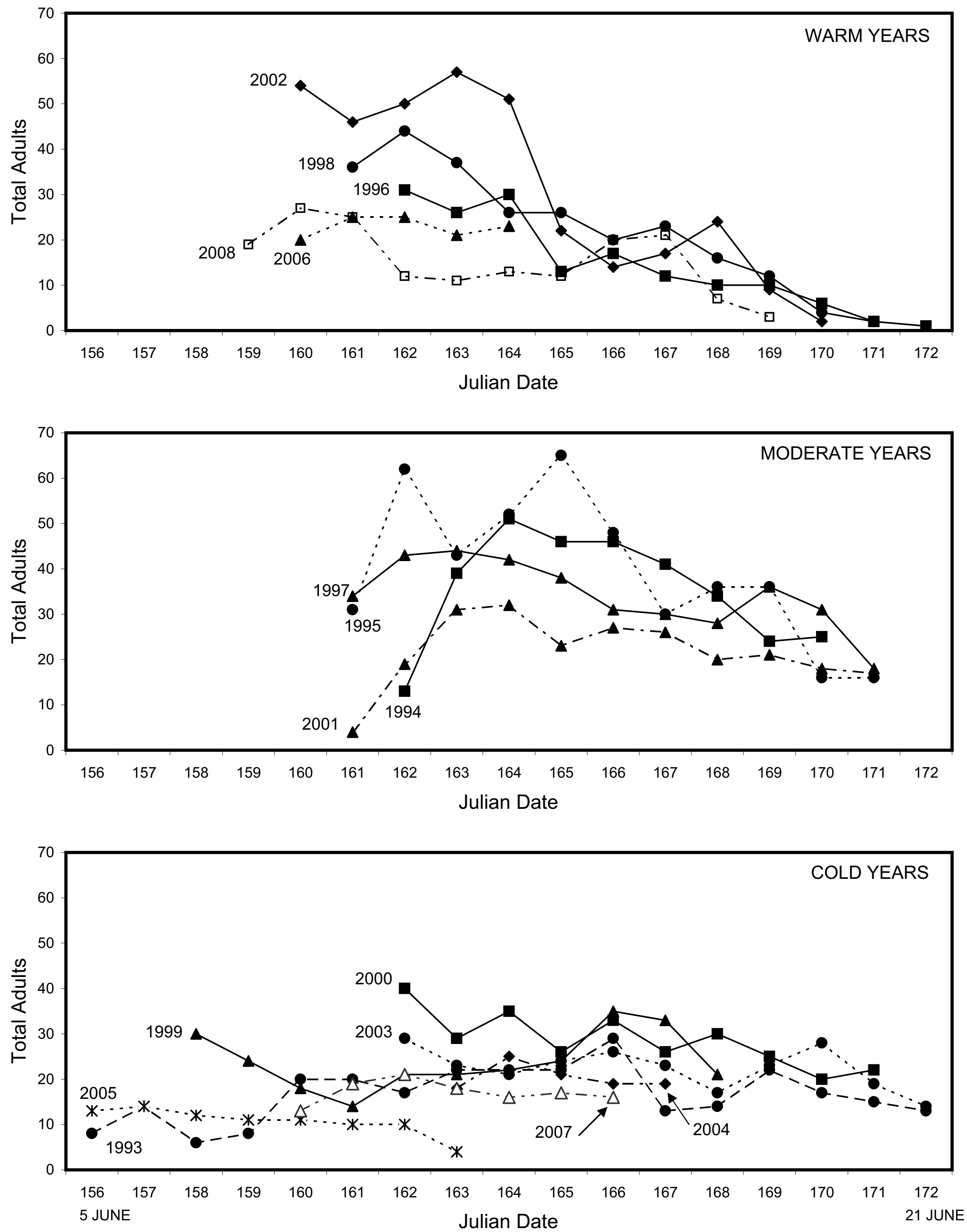

Figure 3. Daily running totals of Spectacled Eiders recorded during road surveys of the Kuparuk Oilfield, early to mid June, 1993–2008. Half of the study area was surveyed each day, thus the running total for the study area was calculated using consecutive days through the sample period. Years were assigned 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.

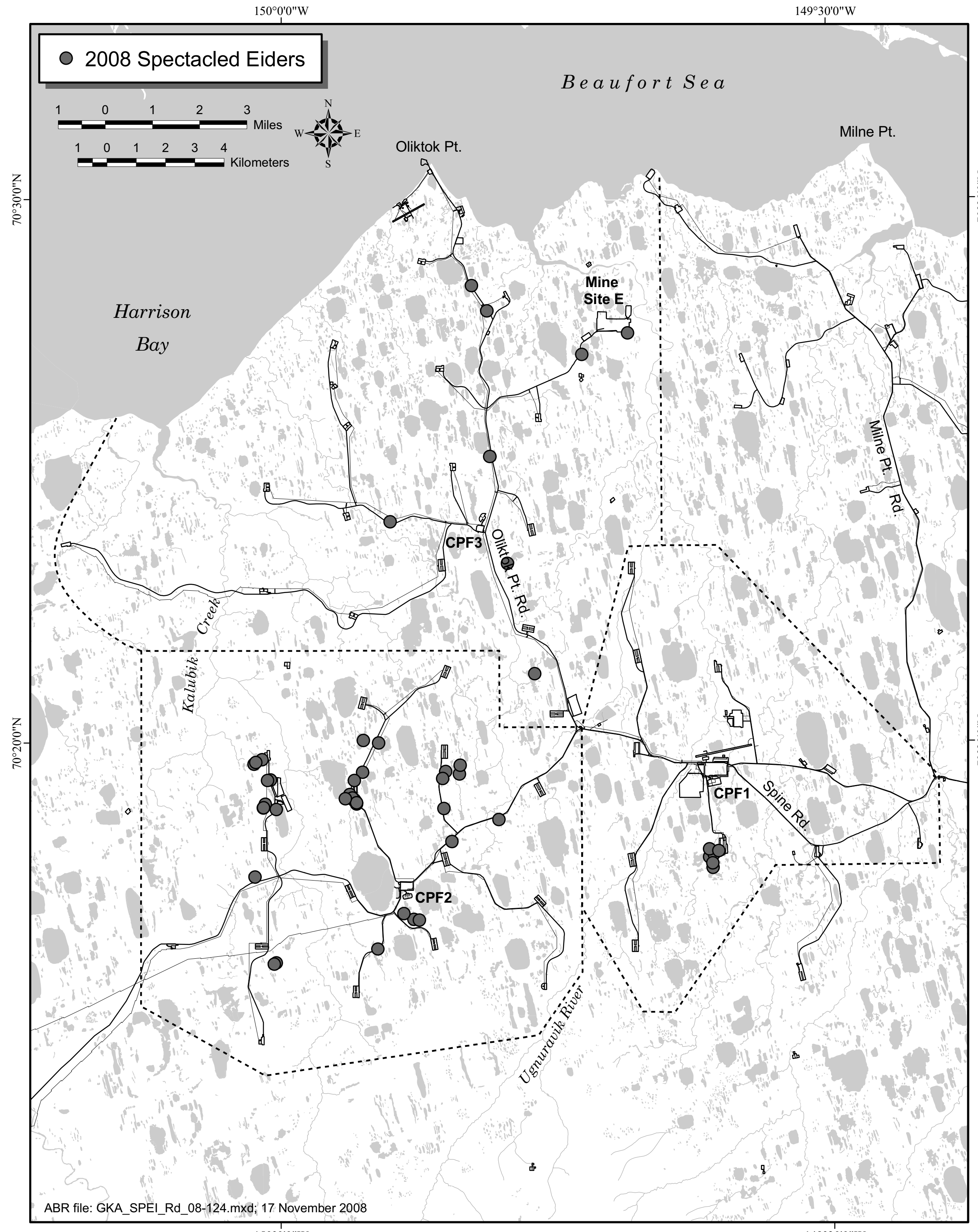

Figure 4. Distribution of Spectacled Eider observations during pre-nesting road surveys in the Kuparuk Oilfield, Alaska, 6–18 June 2008. Dashed areas delineate the CPF-1, CPF-2, and CPF-3 subareas used for comparisons of abundance and distribution.

Table 2. Mean distances (m) of Spectacled Eider observations to oilfield facilities during pre-nesting in the Kuparuk Oilfield, Alaska, 1993–2008. Only observations within the 500-m road survey area are included.

Year	Distance (m) to Nearest Oilfield Facility			n[a]
	Mean	SD	Range	
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
2008	160.2	147.5	3–483	47

[a] n = number of observations.

Table 3. Habitat use (% of observations) of pre-nesting Spectacled Eiders in the Kuparuk Oilfield, Alaska, 2008. Includes all observations (both within and outside the 500-m survey area).

Habitat[a]	Percentage of Observations
FRESH WATERS	
Deep Open Water without Islands	5.9
Deep Open Water with Islands	2.0
Shallow Open Water without Islands	15.7
Shallow Open Water with Islands	17.6
Sedge Marsh	11.8
Grass Marsh	2.0
BASIN WETLAND COMPLEXES	
Young Basin Wetland Complex	2.0
Old Basin Wetland Complex	7.8
MEADOWS	
Nonpatterned Wet Meadow	5.9
Patterned Wet Meadow	2.0
Moist Tussock Tundra	5.9
Flooded Tundra	2.0
HUMAN MODIFIED	
Drainage Impoundment	19.6
Number of Observations	51

[a] Habitat type follows hierarchical habitat classification described in Roth et al. (2007, 2008), except for Flooded Tundra, which represents an ephemeral habitat found only during spring melt.

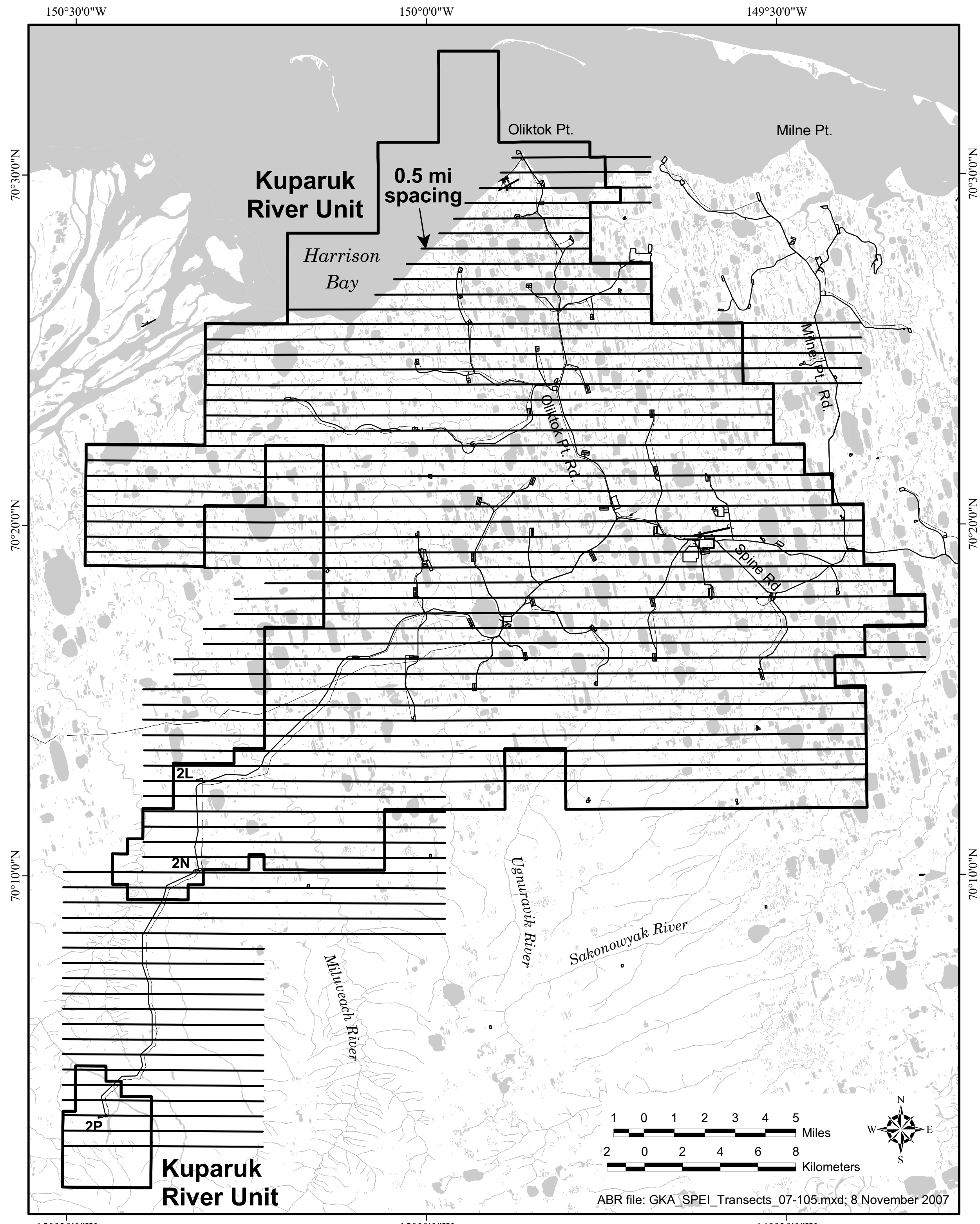

Figure 5. The aerial survey area for Spectacled Eiders in the Kuparuk Oilfield, Alaska, 2008. Transects were spaced 0.5 miles apart. Survey transects were extended in 2008 to conform to the western boundary of the newer Kuparuk River Unit boundary (some areas no longer in the new unit boundary were still surveyed).

Table 4. Numbers and densities (per km²) of Spectacled Eiders recorded during a pre-nesting aerial survey of the Kuparuk Oilfield, Alaska, 13–15 June 2008.

	Non-flying	Flying	All Birds
Numbers Observed			
Males	10	4	14
Females	4	3	7
Total Birds	14	7	21
Observed Pairs	4	1	5
Number of Sightings	10	4	14
FWS Indicated Total Birds[a]	20		
Density (birds/km²)[b]			
Breeding Pairs[c]	0.02	<0.01	0.02
Total Birds[d]	0.02	0.01	0.03
FWS Indicated Total Birds	0.03		

[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.

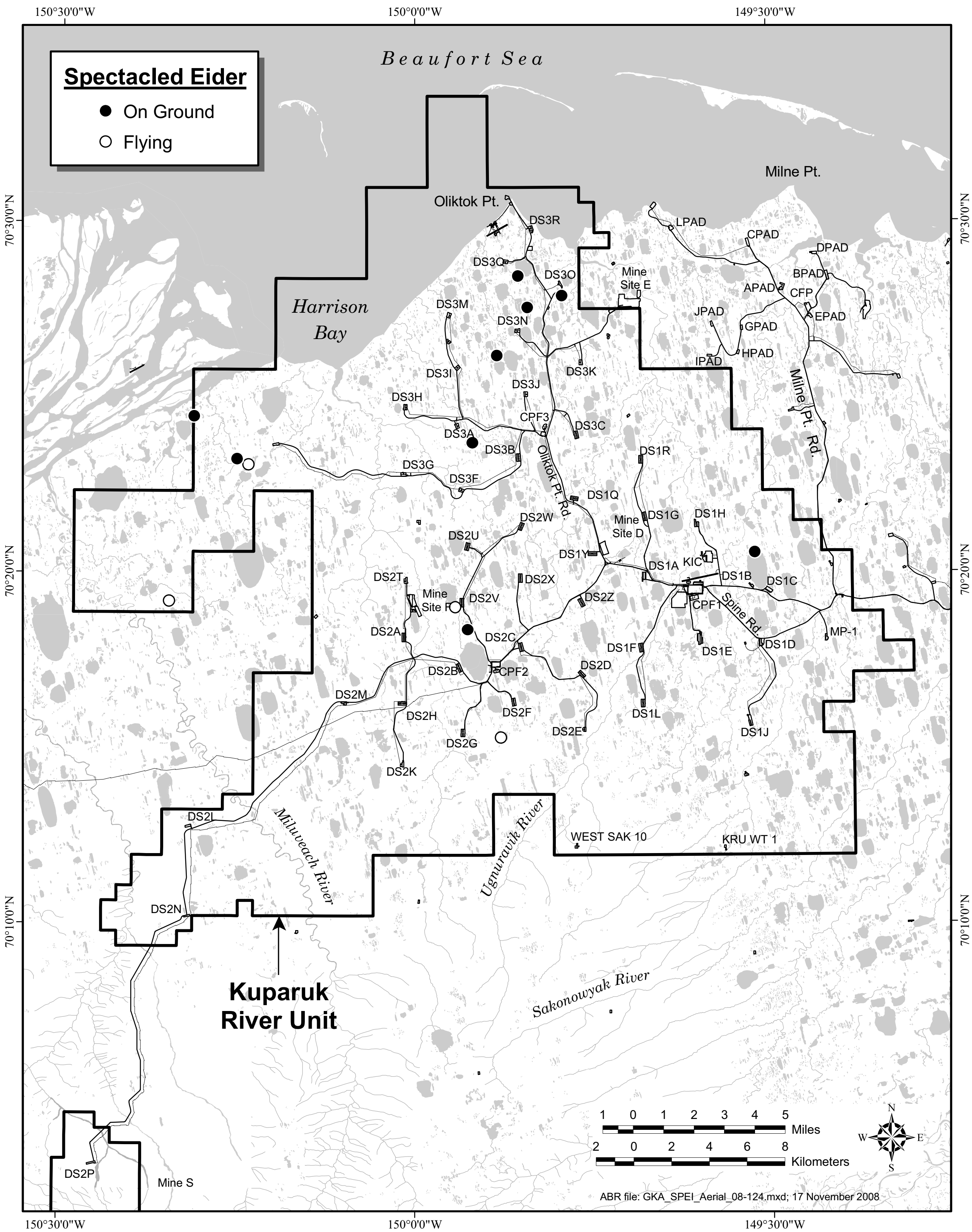

Figure 6. Distribution of Spectacled Eiders observed on the aerial survey of the Kuparuk Oilfield, Alaska, 13–15 June 2008.

Table 5. Numbers and densities (per km²) of Spectacled Eiders recorded during pre-nesting aerial surveys of the Kuparuk Oilfield, Alaska, 1993, 1995–2008.

	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	24	14	0.04	0.07	0.05	12_14
2008	14	7	21	20	14	0.02	0.02	0.03	13–15

[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).

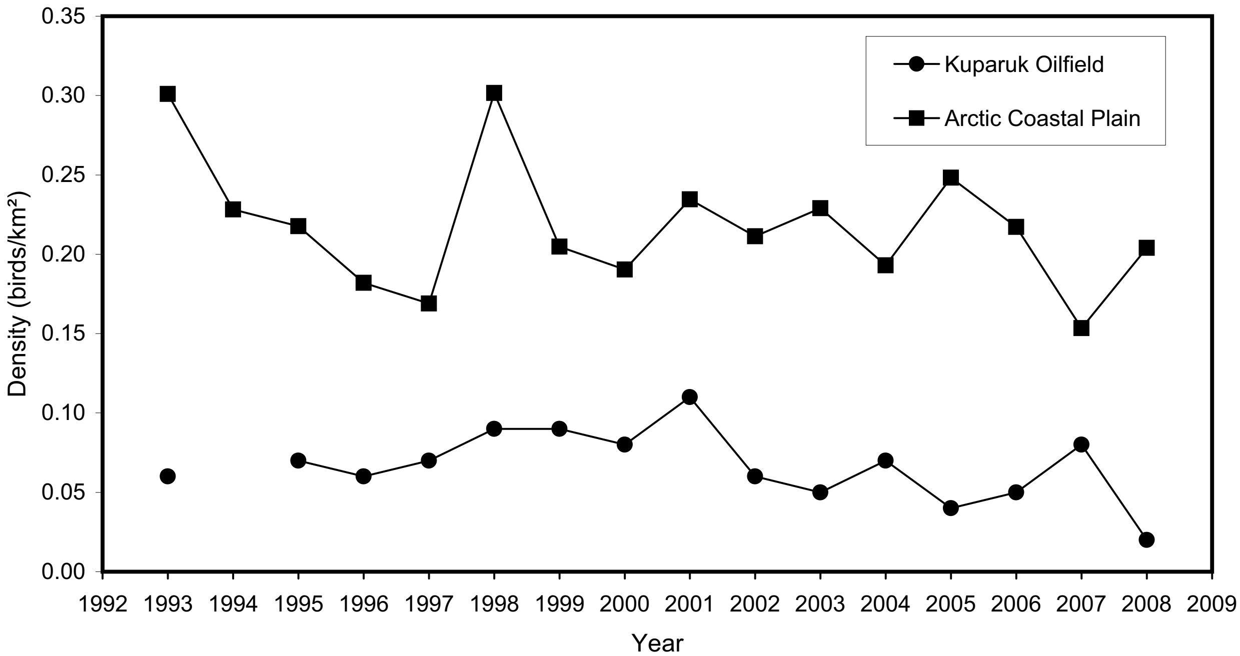

Figure 7. Trends in Spectacled Eider densities (indicated total birds/km²) based on aerial surveys of the Kuparuk River Unit (this study) and across the entire Arctic Coastal Plain, June 1993–2008. A visibility correction factor is not used for these data.

Table 6. Numbers and fates of eider nests found in the Kuparuk Oilfield, Alaska, 1993–2008, 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
	2008	6	0	0.0	10
	Mean	11.4	4.8	39.1	
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	
	2008[i]	33	14	45.2	
	Mean	18.1	5.9	45.2	

[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.

[i] Two nests had unknown fates; therefore, nesting success calculated for 31 nests total.

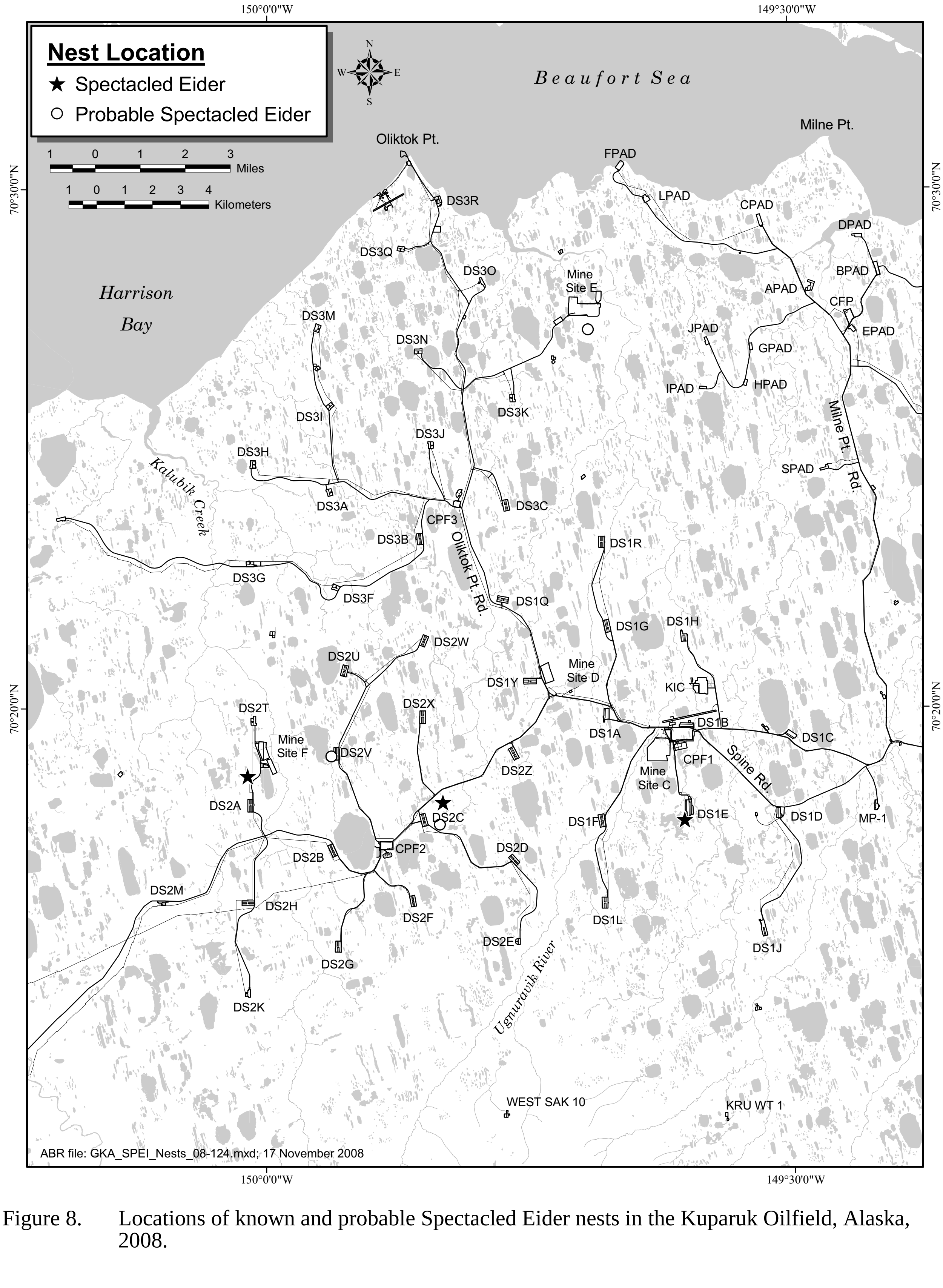

Figure 8. Locations of known and probable Spectacled Eider nests in the Kuparuk Oilfield, Alaska, 2008.

Table 7. Numbers of Spectacled Eider nests by locations used in one or more years in the Kuparuk Oilfield, Alaska, 1993–2008.

	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	2008
Colonies[a]																
S of DS-1E	0	1	0	0	0	2 (1)	1	0	0	5	2	0	2	2	2 (1)	1
N of DS-1Y	2 (1)	2 (1)	1 (1)	1	1 (1)	0	0	1	1	0	1	0	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)	1
N of DS-2F	1 (1)	1	1	0	0	2	0	1	1	1	0	0	1	0	0[c]	0
N of DS-2K	0	1	1	0	0	0	0	0	0	2	0	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)	2 (2)
S of DS-2T	0	0	0	1	0	0	1	2	1	0	3	0	4	1	0	1
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	0
W of DS-2X	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
W of DS-3C	2 (2)	2 (1)	0	3 (2)	1 (1)	4 (3)	0	1 (1)	0	2	1	0	1	1	0	0
(CPF-3 Brant Colony)																
S of Pit E	0	0	2 (1)	1	2	0	0	0	0	0	2	1 (1)	0	1	1 (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	0
N of DS-2H	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
DS-3N	0	0	0	1	1 (1)	0	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	0
N of CPF-3	1 (1)	0	1	0	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, 1993–2008.

	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
2008	0.4	0.1	0.3–0.5	3	0.4	0.3	0.1–1	6
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
2008	31.8	27.3	0.4–50	3	16.2	24.3	0.1–50	6

Table 8. Continued.

	Known Nests				All Nests[a]			
	Mean	SD	Range	n	Mean	SD	Range	n
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
2008	252	114	142–369	3	364	146	142–510	6

[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.

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 1989, 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. 2008).

The Tundra Swan study had two objectives in 2008:

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.

2008 RESULTS

- Aerial surveys were flown to collect information on Tundra Swan abundance and distribution during the nesting and brood-rearing periods in 2008. The nesting survey was conducted during 23–25 June 2008 and the brood-rearing survey during 17–20 August 2008.
- For analysis of the 2008 data, we divided the data into two study areas to streamline our annual analyses and allow consistent annual comparisons among areas with differing levels of survey effort. The areas consist of the 'Kuparuk' study area (2380 km^2), 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). The second study area was designated as 'South Kuparuk' (375 km^2). Portions of the South Kuparuk study area were included each year of the swan surveys, but the coverage was less consistent until the last several years (Appendix 4). The remaining results reported below are only for the Kuparuk study area.
- During the nesting aerial survey, 580 Tundra Swans were recorded at 358 locations in the Kuparuk study area (Table 9; Appendix 5). Not only was this number the highest total of swans ever recorded, but swan density (0.24 swans/km^2) in 2008 was 41% higher than the long-term mean for the study area (Appendix 6). The number of adult swans counted remained consistent with the long-term trend for total adults, which has shown a significantly increasing population within the oilfield since 1989 ($r^2 = 0.33$, $P < 0.01$).
- In 2008, 101 Tundra Swan nests (0.04 nests/km^2) were found in the Kuparuk study area (Figure 10), a 13% decrease from 2007 (Table 9), but a 16% increase over the 20-year mean (86.1 nests; 1989–2008). Since 1989, total numbers of nests generally have been on an increasing trend in the oilfield ($r^2 = 0.26$ $P < 0.02$), although they have fluctuated annually. The annual number of swan nests is highly correlated with spring temperatures encountered by swans during the arrival and nest 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). The increase in

the number of nests in 2008 likely was attributable to the good conditions in the study area (i.e., rapid snow melt at the end of May and warmer than average temperatures in both May and June) at the time when swans would be initiating nests.

- During the brood-rearing survey, 946 swans (690 adults and 256 young) were observed at 367 locations in the Kuparuk study area (Table 10; Appendix 7). The total number of swans recorded during brood-rearing in 2008 was 37% higher than the 20-year mean (691 total swans), and the highest total ever recorded. The number of adults alone also increased 19% between June and August in 2008, due mostly to an increase in the number of nonbreeding adults (+22%). The number of estimated breeding adults increased 10% between June and August 2008, probably due to a combination of nests missed by observers during the June survey and some movement of broods into the study area from adjacent unsurveyed areas.
- In 2008, 97 broods (256 young) of Tundra Swans were counted in the Kuparuk study area (Table 10, Figure 12). The number of broods counted in 2008 was the second highest recorded in the oilfield since monitoring began in 1989. Not only was the number of broods present high, the mean brood size of 2.6 young/brood (range = 1–5 young), was 8% higher than the 19-year mean (2.4 young/brood) and the second largest mean brood-size recorded for this study. The percentage of broods with three or more young (52%) was 62% higher than the long-term mean and greater than that recorded in each of the previous 11 years. Approximate nesting success in 2008 (96%) was good, as reflected by both the number of broods and young produced (approximate nesting success is calculated as the percentage of the number of broods observed divided by the number of observed nests, but some nests or broods probably are missed during surveys). Annual nesting success and clutch size of Tundra Swans have been correlated to weather conditions in the nesting area, with years with cool springs typically associated with lower nesting success than years with warmer, more favorable springs. The overall conditions of early snowmelt and above average temperatures during nest initiation and incubation in 2008 were likely large contributors to the higher numbers of nests and nest success this year.

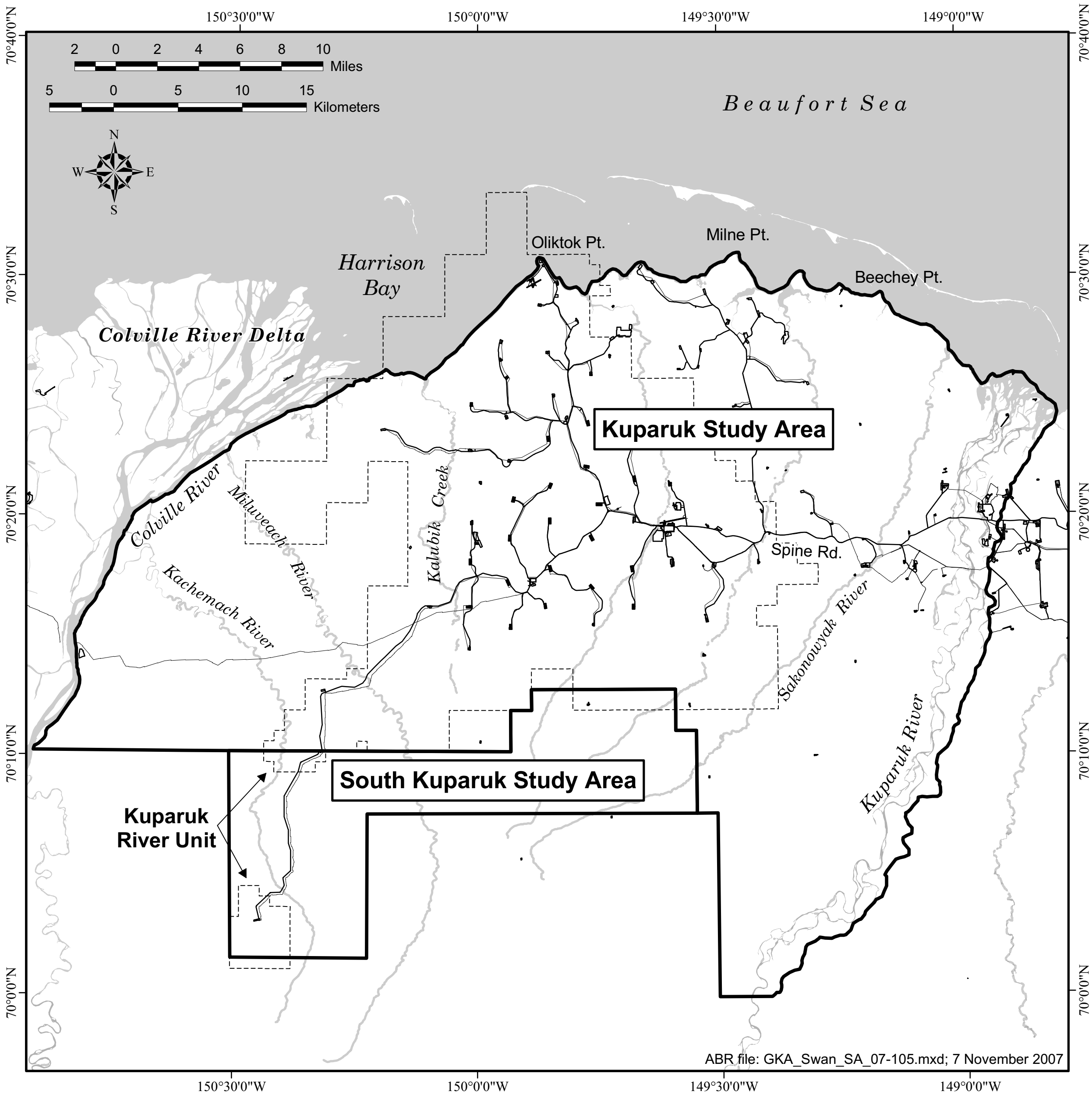

Figure 9. The aerial survey areas for Tundra Swans in the Greater Kuparuk Area, Alaska, 2008.

Table 9. Numbers of Tundra Swans and nests observed during June aerial surveys in the Kuparuk study area, Alaska, 1989–2008. Swans and nests recorded in the South Kuparuk study area are presented in Appendix 4 and a more detailed description of survey results for 2008 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
2008	101	165	415	580	202	378

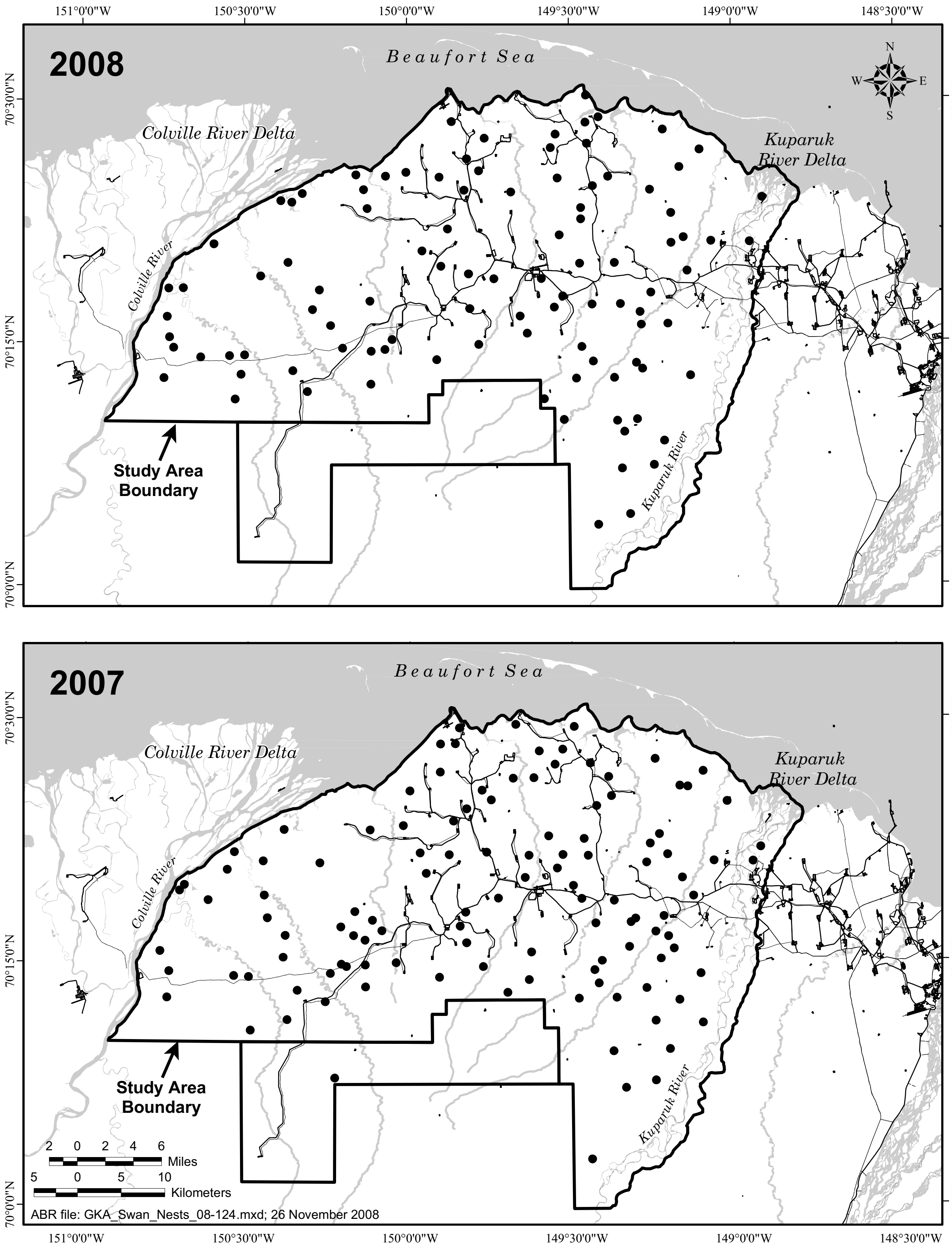

Figure 10. Locations of Tundra Swan nests observed in the Kuparuk and Kuparuk South study areas, Alaska, June 2007 and 2008 (see Figure 9 for study area boundaries).

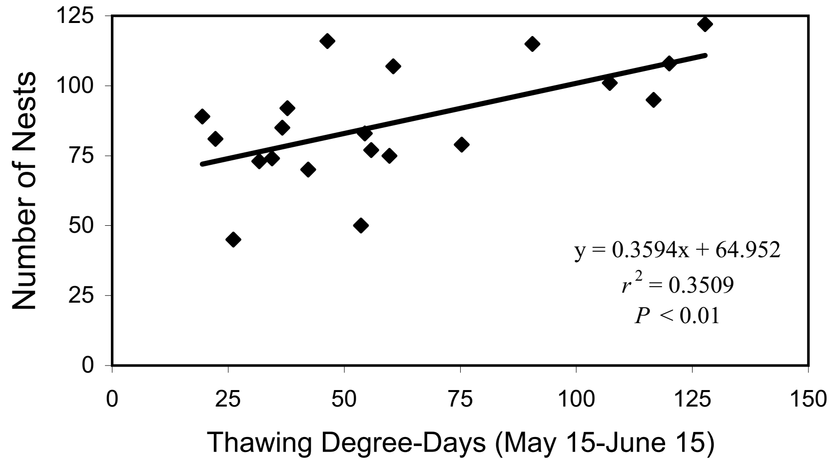

Figure 11. Numbers of Tundra Swan nests by year in relation to cumulative thawing degree-days between 15 May–15 June, in the Kuparuk study area, Alaska, 1989–2008.

Table 10. Numbers of Tundra Swans and broods observed during August aerial surveys in the Kuparuk study area, Alaska, 1989–1993, 1995–2008. No brood-rearing survey was conducted in 1994. Swans and broods recorded in the South Kuparuk study area are presented in Appendix 4 and a more detailed description of survey results for 2008 is presented in Appendix 7.

Year	Number of Broods	Number of Young	Mean Brood Size	Observed Number of Adults with Broods	Observed Number of Adults without Broods	Observed Number of Adults Total	Total Swans	Percent Young	Estimated Number of Adults Breeders	Estimated Number of Adults 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
2008	97	256	2.6	182	508	690	946	24.5	194	496

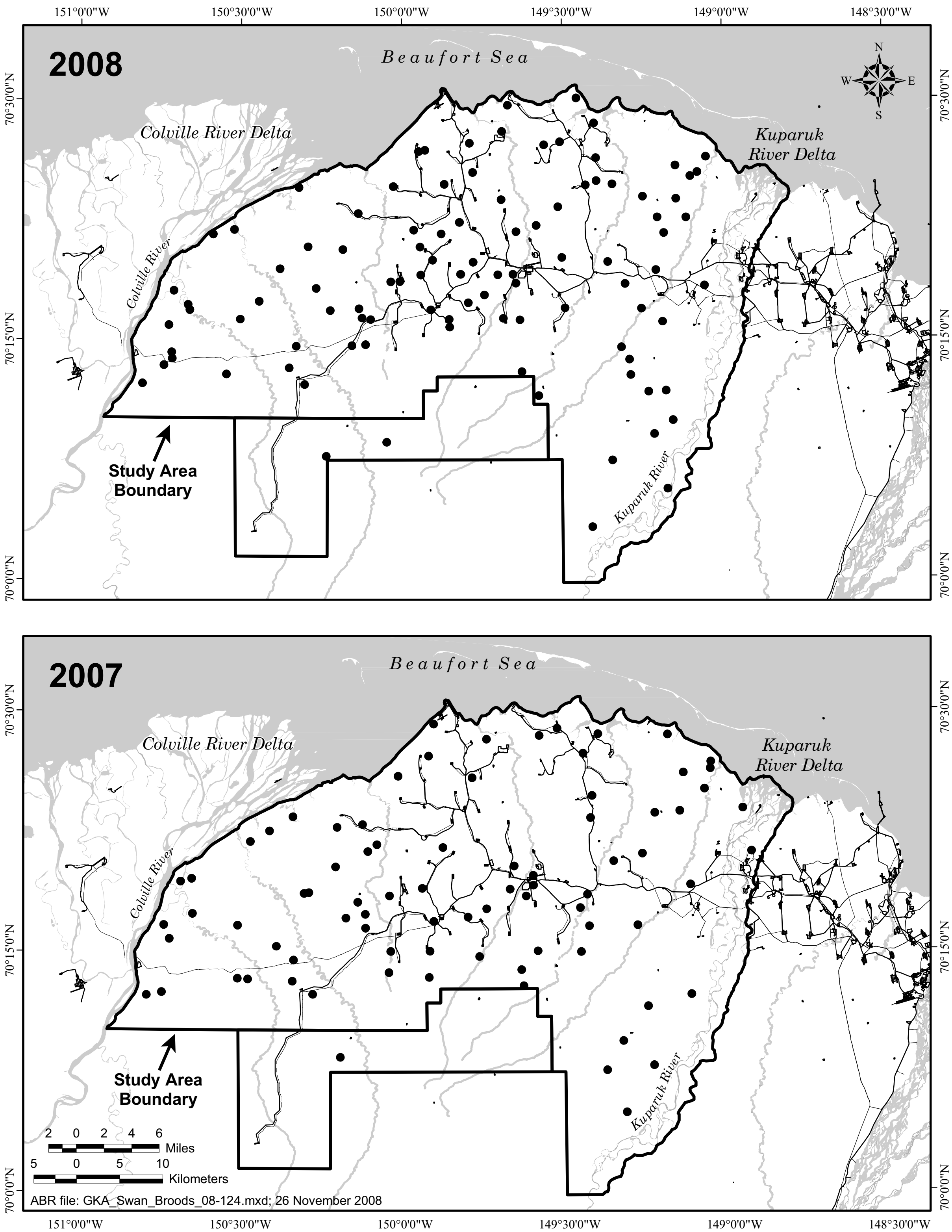

Figure 12. Locations of Tundra Swan broods observed in the in the Kuparuk and Kuparuk South study areas, Alaska, August 2007 and 2008 (see Figure 9 for study area boundaries).

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 2008 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.

2008 RESULTS

- One aerial survey was conducted on 28–29 July 2008 along three sections of the Beaufort Sea coast between the Sagavanirktok and Colville rivers to locate brood-rearing areas used by Brant and to count numbers of adults and goslings (Figure 13). Brant were counted in 15 brood-rearing (adults with young) groups and 6 molting (adults without young) groups between the Sagavanirktok and Colville rivers, for a total count of 2421 birds (1551 adults and 870 goslings; Table 11, Figure 14).
- Brant goslings comprised 36% of the total number of birds counted, which was slightly higher than the annual mean (34%) for the 19 years of surveys. The total

number of goslings (870) was the third highest total for goslings ever recorded and was considerably higher than the annual mean of 559 goslings. More adult Brant were counted in 2008 than in any other year, including the third highest count for adults in brood-rearing groups, and the fourth highest count for non- or failed-breeding Brant (i.e., molting groups of adults only).

- In Section 4 (Kuparuk River to Kalubik Creek), 1884 Brant (1125 adults and 759 goslings) were recorded, the highest count for this section since the surveys began in 1989. Goslings comprised 40.3% of all birds and 42.2% of birds in brood-rearing groups, near the annual means of 39.6% and 41.8%, respectively. However, the total number of goslings in the section (759) was the highest ever recorded and 83% higher than the annual mean (414), reflecting the higher numbers of adults as well as young observed in 2008. The total number of adults (1125) and the number of adults in brood-rearing groups (1039) were the highest ever recorded, and the number of adults in molting groups (86) was the third-highest count ever recorded in this section.
- During the Brant brood-rearing survey, five brood-rearing groups (322 adults and 341 young) of Snow Geese (*Chen caerulescens*) were observed near the Colville River and two groups (76 adults and 73 young) were observed in Prudhoe Bay. The 663 Snow Geese counted just east of the Colville River represented a substantial increase over previous counts in Section 5, and reflected growth of the nesting colony of Snow Geese on the Colville River Delta in recent years (Johnson et al. 2008).

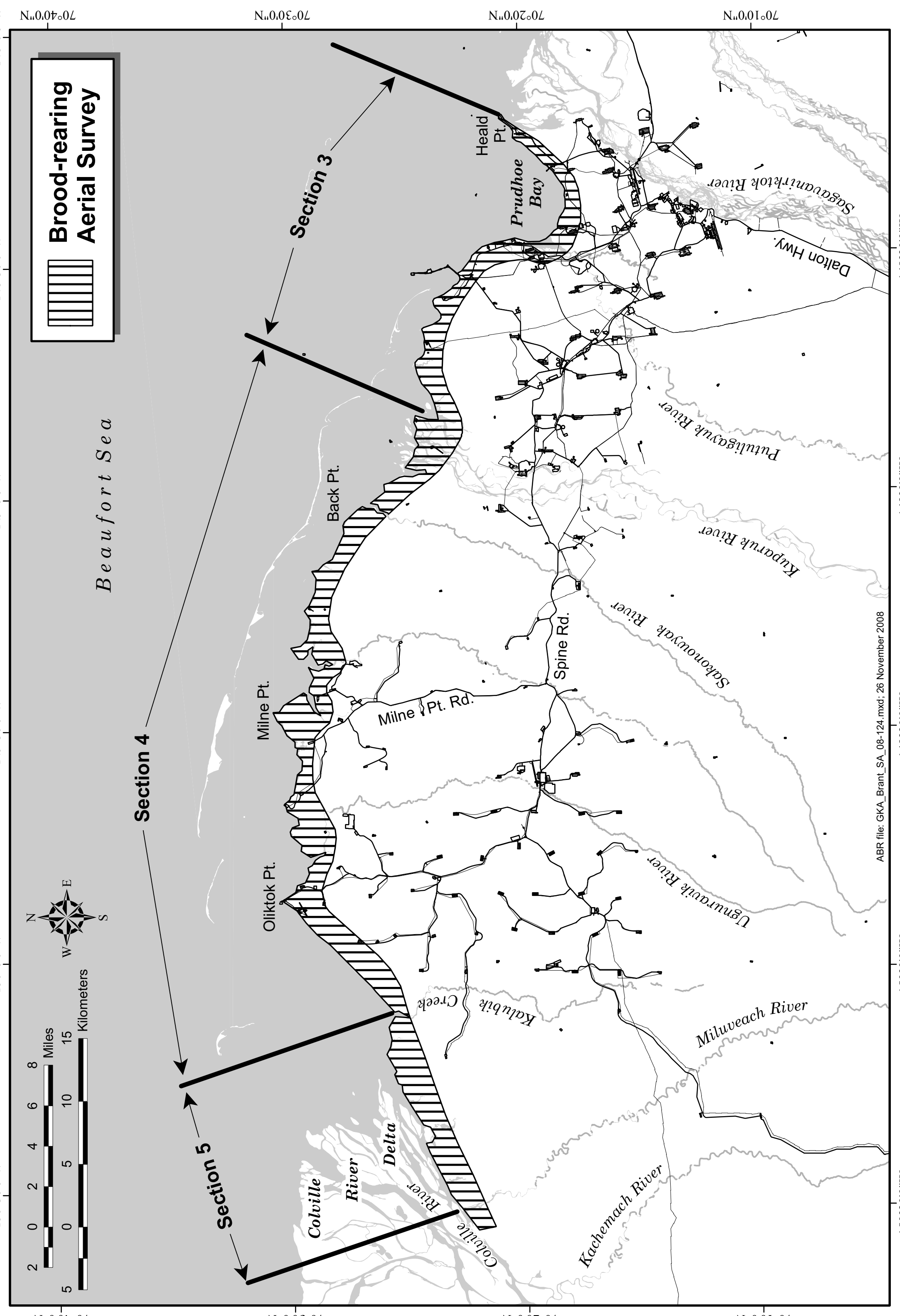

Figure 13. Study area for the aerial survey for brood-rearing/molting Brant between the Colville and Sagavanirktok rivers, Alaska, July 2008.

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, 1989–2008. 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
2008	98	47	266	411	1039	759	86	1884	62	64	0	126	1199	870	352	2421

[a] Numbers for 1989–1993 and 1996 are a mean from two surveys; numbers for 1994, 1995, 1997–2008 are from one survey only.
[b] Includes an inland group seen by ground observers.
[c] ns = not surveyed.
[c] This section surveyed only once that year.

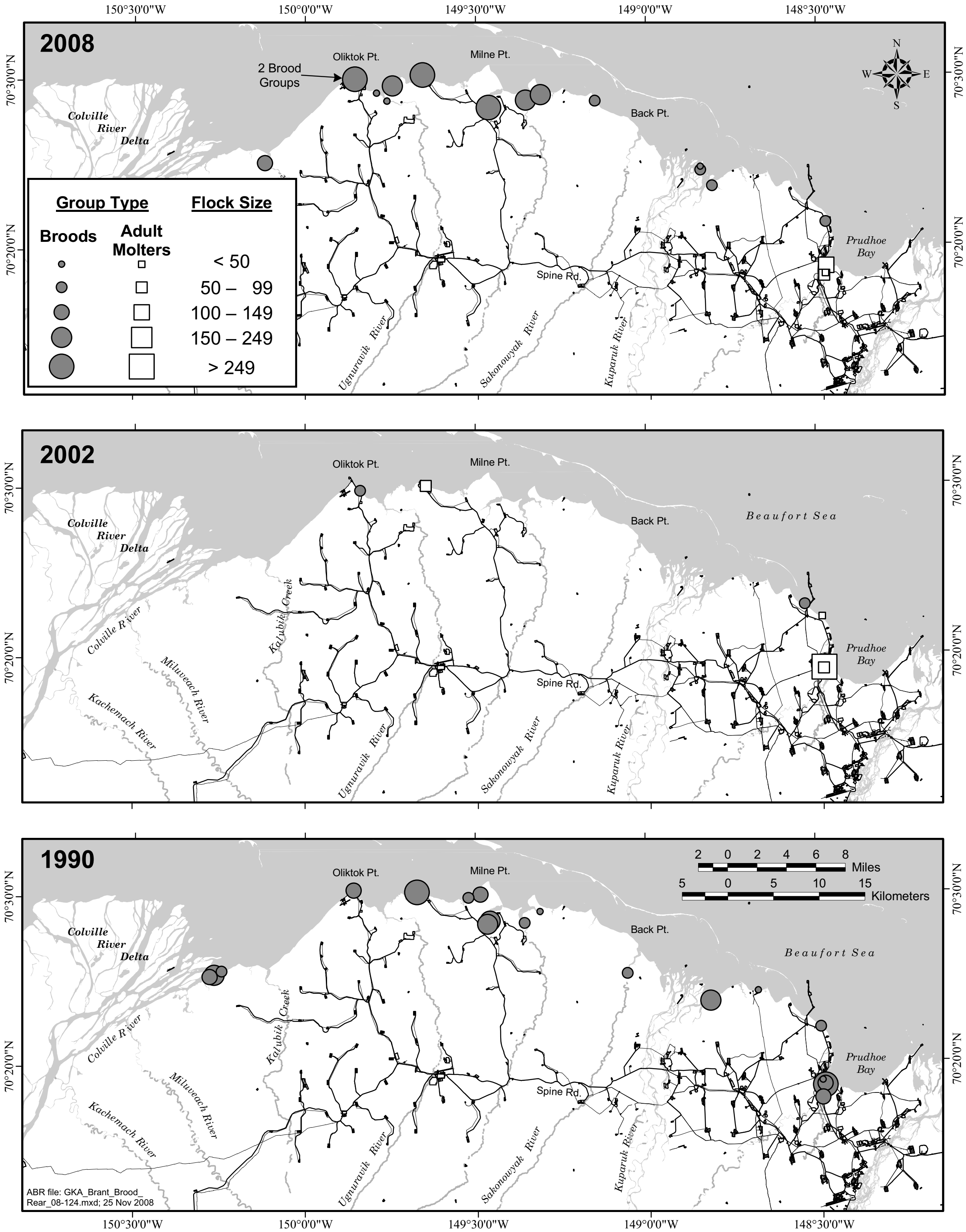

Figure 14. Locations and sizes of brood-rearing (adults and young) and molting (adults only) groups of Brant between the Colville and Sagavanirktok rivers, Alaska, in 1990, 2002, and 2008. The years other than 2008 are for comparison only: 1990 for high numbers of brood-rearing Brant and 2002 for low numbers. Only the survey in 1990 that was flown on a similar date was included for comparability with the single surveys in 2002 and 2008.

LITERATURE CITED

Anderson, B. A., A. A. Stickney, T. Obritschkewitsch, and J. E. Shook. 2008. Avian studies in the Kuparuk Oilfield, Alaska, 2007. Data Summary Report prepared for ConocoPhillips Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, and J. E. Shook. 2007. Avian studies in the Kuparuk Oilfield, Alaska, 2006. Data Summary Report prepared for ConocoPhillips Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK. 36 pp.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, J. E. Shook, J. P. Parrett, and L. B. Attanas. 2005. Avian studies in the Kuparuk Oilfield, Alaska, 2004. Final rep. prepared for ConocoPhillips Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK. 83 pp.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, J. E. Shook, J. P. Parrett, and L. B. Attanas. 2004. Avian studies in the Kuparuk Oilfield, Alaska, 2003. Final rep. prepared for ConocoPhillips Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK. 83 pp.

Bellrose, F. C. 1976. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA. 544 pp.

Bollinger, K.S., and D.V. Derksen. 1996. Demographic characteristics of Brant near Teshekpuk Lake, Alaska. Journal of Field Ornithology 67:141-158.

Gavin, A. 1977. Ecological and environmental report: Prudhoe Bay region, North Slope of Alaska 1977. Unpubl. rep. prepared for ARCO Alaska, Inc., Anchorage, AK. 17 pp.

Gavin, A. 1980. An arctic coastal environment, Prudhoe Bay, Alaska. Paper presented to Second Symposium on Management, Conservation, and Utilization of the Coastal Zone, 17–20 November 1980. 20 pp.

Hampton, P. D., L. C. Orr, and L. Byrne. 1988. An evaluation of the effects of noise on waterfowl in the vicinity of CPF-3, Kuparuk Field, Alaska. Final report prepared for ARCO Alaska, Inc., Anchorage, AK, and the Kuparuk River Unit by Environmental Science and Engineering, Anchorage, AK.

Johnson, C. B., A. M. Wildman, J. P. Parrett, J. R. Rose, and T. Obritschkewitsch. 2008. Avian studies for the Alpine Satellite Development Project, 2007. Fifth Annual Report, prepared for ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corp., Anchorage, AK, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 28 pp.

Johnson, C. B., A. M. Wildman, J. P. Parrett, J. R. Rose, T. Obritschkewitsch, and A. A. Stickney. 2009. Avian studies for the Alpine Satellite Development Project, 2008. Sixth Annual Report, prepared for ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corp., Anchorage, AK, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 68 pp.

Johnson, S. R., and D. R. Herter. 1989. Birds of the Beaufort Sea. BP Exploration (Alaska) Inc., Anchorage, AK. 372 pp.

Kertell, K. 1991. Disappearance of the Steller's Eider from the Yukon-Kuskokwim Delta, Alaska. Arctic 44: 177–187.

King, J. D. 1970. The swans & geese of Alaska's Arctic Slope. Wildfowl 21: 11–17.

Larned, W., R. Stehn, and R. Platte. 2009. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska, 2008. Unpublished report by U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 42 pp.

Michael Baker, Jr., Inc. 2008. 2008 Colville River Delta spring breakup and hydrologic assessment. Draft Report, prepared for ConocoPhillips Alaska, Inc., Anchorage, AK, by Michael Baker, Jr., Inc., Anchorage, AK.

Murphy, S. M., and B. A. Anderson. 1993. Lisburne Terrestrial Monitoring Program–The effects of the Lisburne Development Project on geese and swans, 1985–1989. Final synthesis rep. prepared for ARCO Alaska, Inc., Anchorage, AK, by Alaska Biological Research, Inc., Fairbanks, AK. 202 pp.

Quakenbush, L. T., R. H. Day, B. A. Anderson, F. A. Pitelka, and B. J. McCaffrey. 2002. The historical and present distribution and abundance of Steller's Eiders in Alaska. Western Birds 33: 99–120.

Raveling, D. G. 1984. Geese and hunters of Alaska's Yukon Delta: management problems and political dilemmas. Transactions of the North American Wildlife and Natural Resources Conference 49: 555–575.

Ritchie, R. J., R. M. Burgess J. E. Shook, and T. Obritschewitsch. 2008. Surveys for nesting and brood-rearing Brant and Lesser Snow Geese, Barrow to Fish Creek Delta, and Lesser Snow Goose banding near the Ikpikpuk River Delta, Alaska, 2007. Annual Report, prepared for North Slope Borough, Department of Wildlife Management, Barrow, AK, by ABR, Inc.--Environmental Research & Services, Fairbanks, AK. 62 pp.

Roth, J. E., P. F. Loomis, M. Emers, A. A. Stickney, and W. Lentz. 2007. An ecological land survey in the central Kuparuk study area, 2006. Final report prepared for ConocoPhillips Alaska, Inc., Anchorage, AK, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 57 pp.

Sedinger, J. S., C. J. Lensink, D. H. Ward, R. M. Anthony, M. L. Wege, and G. V. Byrd. 1993. Current status and recent dynamics of the Black Brant *Branta bernicla* breeding population. Wildfowl 44: 49–59.

Stehn, R. A., C. P. Dau, B. Conant, and W. I. Butler, Jr. 1993. Decline of Spectacled Eiders nesting in western Alaska. Arctic 46: 264–277.

U.S. Fish and Wildlife Service (USFWS). 1987a. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America. Unpubl. rep., Migratory Bird and Habitat Res. Lab., Patuxent Wildlife Research Center, Laurel, MD. 96 pp.

U.S. Fish and Wildlife Service (USFWS). 1987b. Trumpeter and Tundra swan survey protocol update. Unpublished memorandum. prepared by Office of Migratory Bird Management, Juneau, AK. 8 pp.

U.S. Fish and Wildlife Service (USFWS). 1991. Trumpeter and Tundra swan survey protocol. Unpublished memorandum prepared by Office of Migratory Bird Management, Juneau, AK. 4 pp.

U.S. Fish and Wildlife Service (USFWS). 1996. Spectacled Eider recovery plan. U.S. Fish and Wildlife Service, Anchorage, AK. 157 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Steller's Eider recovery plan. U.S. Fish and Wildlife Service, Fairbanks, AK. 27 pp.

Appendix 1. Methods for avian surveys in the Kuparuk Oilfield, Alaska, 2008.

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.

Appendix 1. Continued.

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 2007. 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. Three time-lapse digital cameras (Reconyx R-75) were deployed at active Spectacled Eider nests and located within 30 m of the nest and programmed to record 1 image every 30 seconds.

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. The time-lapse cameras were also retrieved when the nests were checked for nest fate and the data (jpeg files) downloaded to DVDs for later review in the office to determine incidences of nest predation and to calculate incubation constancy. 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.

Tundra Swan Analyses

For the analysis of the Tundra Swan survey data, some assumptions were made to determine comparative data. One assumption is that a pair of swans is associated with each nest or brood. The raw survey data includes many observations of single swans with either a nest or brood, but it is likely that the other swan is out of view at the time of the survey. Therefore, the summaries presented include both the raw survey data and an estimation of the actual number of breeding and non-breeding swans. Breeders are estimated by multiplying the number of nests (or broods) by two and non-breeders are estimated by subtracting the estimated number of breeders from the total number of adult swans seen. Annual nesting success is defined by three categories: good, fair, or poor, and is estimated by the number of broods seen divided by the number of nests. Good nesting success is ≥80%, fair nesting success is ≥ 60% and <80%, and poor nesting success is <60%.

Data Management and GIS Protocols

After the field surveys are completed all data are entered into databases and proofed. Data collected without accompanying GPS locations (generally all field-mapped data, such as from road surveys and aerial surveys) are provided to the GIS staff for digitizing using the Kuparuk basemap. Final maps are prepared for proofing by the field project leader and standard CPAI protocols are followed in the preparation of databases, metadata, and other map products that are submitted to CPAI for addition to their centralized geodatabase. All field photographs are also compiled following CPAI protocols and submitted along with the databases and GIS products.

Appendix 2. Numbers of Spectacled Eiders counted on road surveys in the Kuparuk Oilfield, Alaska, 6–18 June 2008. Eiders seen ≤500 m 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*
6 June	5	5	10	5	5	3	1	4	1	1	8	6	14	6	6
7 June	2	2	4	2	2	1	0	1	0	1	3	2	5	2	3
8 June	10	9	19	9	10	2	1	3	1	1	12	10	22	10	11
9 June	2	1	3	1	2						2	1	3	1	2
10 June	5	4	9	4	5						5	4	9	4	5
11 June	1	1	2	1	1						1	1	2	1	1
12 June	6	5	11	5	6						6	5	11	5	6
13 June	1	0	1	0	1						1	0	1	0	1
14 June	10	7	17	7	9	1	1	2	1	1	11	8	19	8	10
15 June	1	1	2	1	1						1	1	2	1	1
16 June	3	2	5	2	3						3	2	5	2	3
17 June	0	0	0	0	0						0	0	0	0	0
18 June[a]	3	0	3	0	2						3	0	3	0	2
Total	49	37	86	37	47	7	3	10	3	4	56	40	96	40	51

[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, 2008.

							Distance to Nearest (m)		
Species	General Location	Nest Fate	Clutch Size	Number of Membranes	Habitat	Waterbody Type	Waterbody	Water	Oilfield Facility
Spectacled Eider	DS-1E	Failed	3	0	Sedge Marsh	Basin Wetland Complex	50	0.3	142
	DS-2C	Failed	3	0	Nonpatterned Wet Meadow	Basin Wetland Complex	0.4	0.4	369
	DS-2T	Failed	3	0	Sedge Marsh	Basin Wetland Complex	0.5	45	244
Probable Spectacled Eider	DS-2V	Failed	1	0	Nonpatterned Wet Meadow	Deep Open Water	0.1	0.1	502
	DS-2V	Failed	3	0	Nonpatterned Wet Meadow	Deep Open Water	0.2	0.2	422
	South of Pit E	Failed	2	0	Nonpatterned Wet Meadow	Basin Wetland Complex	1	1	510
King Eider	DS-1E	Successful	?	5	Nonpatterned Wet Meadow	Basin Wetland Complex	0.3	0.3	263
	DS-1E	Successful	9	4	Sedge Marsh	Basin Wetland Complex	0.2	0.2	365
	DS-1E	Successful	5	5	Nonpatterned Wet Meadow	Basin Wetland Complex	1	1	420
	DS-2C	Successful	10	4	Nonpatterned Wet Meadow	Basin Wetland Complex	0.2	0.2	615
	DS-2C	Successful	?	7	Nonpatterned Wet Meadow	Basin Wetland Complex	0.2	0.2	593
	DS-2C	Successful	?	3	Nonpatterned Wet Meadow	Basin Wetland Complex	0.3	0.3	486
	DS-2C	Successful	?	5	Nonpatterned Wet Meadow	Basin Wetland Complex	0.2	0.2	418
	DS-2T	Successful	?	4	Sedge Marsh	Basin Wetland Complex	2	2	367
	CPF-3 Brant Colony	Successful	5	5	Sedge Marsh	Basin Wetland Complex	35	0.5	249
	CPF-3 Brant Colony	Successful	5	5	Old Basin Wetland Complex	Basin Wetland Complex	0.3	0.3	588
	CPF-3 Brant Colony	Successful	?	5	Old Basin Wetland Complex	Basin Wetland Complex	3	3	630
	CPF-3 Brant Colony	Successful	6	4	Old Basin Wetland Complex	Basin Wetland Complex	0.2	0.2	688
	CPF-3 Brant Colony	Successful	4	4	Nonpatterned Wet Meadow	Basin Wetland Complex	0.1	0.1	244
	CPF-3 Brant Colony	Successful	5	5	Nonpatterned Wet Meadow	Basin Wetland Complex	0.1	0.1	258
	DS-1E	Failed	5	0	Sedge Marsh	Basin Wetland Complex	0.1	0.1	750
	DS-2C	Failed	0	0	Sedge Marsh	Basin Wetland Complex	0.25	0.25	403
	DS-2C	Failed	4	0	Sedge Marsh	Basin Wetland Complex	2	2	445
	CPF-3 Brant Colony	Failed	0	0	Old Basin Wetland Complex	Basin Wetland Complex	10	10	617
	CPF-3 Brant Colony	Failed	0	0	Sedge Marsh	Basin Wetland Complex	20	0.1	373
	DS-2X	Unknown[a]	4	?	Old Basin Wetland Complex	Basin Wetland Complex	2	2	633
	CPF-3 Brant Colony	Unknown	6	?	Patterned Wet Meadow	Basin Wetland Complex	10	0.3	375
Probable King Eider	DS-1E	Failed	?	0	Shallow Open Water with Is.	Basin Wetland Complex	0.1	0.1	376
	DS-2C	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	1	1	229
	DS-2V	Failed	1	0	Nonpatterned Wet Meadow	Basin Wetland Complex	0.1	0.1	71
	CPF-3 Brant Colony	Failed	1	0	Sedge Marsh	Basin Wetland Complex	0.6	0.6	640
	CPF-3 Brant Colony	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	0.8	0.8	637
	CPF-3 Brant Colony	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	25	1.2	391
	South of Pit E	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	1	1	471
	South of Pit E	Failed	0	0	Nonpatterned Wet Meadow	Basin Wetland Complex	2	2	552
	South of Pit E	Failed	0	0	Moist Sedge-Shrub Meadow	Basin Wetland Complex	40	40	323
	South of Pit E	Failed	0	0	Moist Sedge-Shrub Meadow	Basin Wetland Complex	0.1	0.1	442
	South of Pit E	Failed	1	0	Sedge Marsh	Basin Wetland Complex	200	0.2	48
	South of Pit E	Failed	0	0	Sedge Marsh	Basin Wetland Complex	0.4	0.4	133

[a] Unknown fate nests were active when found but not checked for final nest fate due to logistical constraints.

Appendix 4. Numbers of Tundra Swans, nests, and broods observed during June aerial surveys in the South Kuparuk study area, Alaska, 1989–2008.

	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
2008	0	0	7	7	2	6	4	3	7	13

Appendix 5. Numbers of Tundra Swans and nests recorded (by USGS quadrangle) during aerial surveys in the Kuparuk and South Kuparuk study area, Alaska, 23–25 June 2008.

Location (USGS Quadrangle)	Adults with Nests: Pairs	Adults with Nests: Single Adults	Adults with Nests: Total	Number of Nests	Adults without Nests: Pairs	Adults without Nests: Single Adults	Adults without Nests: Flocks	Adults without Nests: Flocked Swans	Adults without Nests: Total	Total Swans
Beechey Point										
A-4	7	4	18	11	17	8	1	3	45	63
A-5	6	2	14	8	9	7	0	0	25	39
B-4	7	11	25	18	36	26	3	14	112	137
B-6	23	8	54	31	28	37	5	18	111	165
C-6	1	0	2	1	0	1	0	0	1	3
Harrison Bay										
A-1	5	5	15	10	8	9	0	0	25	40
A-2	2	1	5	3	9	1	0	0	19	24
B-1	10	5	25	15	20	28	1	3	71	96
B-2	3	1	7	4	5	3	0	0	13	20
Total	64	37	165	101	132	120	10	38	422	587

Appendix 6. Densities (number/km²) of Tundra Swan nests and adults observed during June aerial surveys in the Kuparuk study area (2380 km²), Alaska, 1989–2008. Densities are not calculated for the smaller South Kuparuk study area (375 km²).

		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
2008	0.04	0.07	0.17	0.24

Appendix 7. Numbers of Tundra Swans and broods recorded (by quadrangle) during aerial surveys in the Kuparuk and South Kuparuk study areas, Alaska, 17–20 August 2008.

Location	Brood Groups						Non-brood Groups					Total		
(USGS Quadrangle)	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	9	0	18	9	28	3.1	11	10	1	3	35	53	81	34.6
A-5	3	0	6	3	8	2.7	7	14	2	9	25	31	39	20.5
B-4	16	2	34	18	40	2.2	35	16	6	24	110	144	184	21.7
B-5	31	5	67	36	106	2.9	19	37	9	34	169	236	342	31.0
C-5	1	0	2	1	3	3.0	0	0	0	0	0	2	5	60.0
Harrison Bay														
A-1	7	1	15	8	20	2.5	3	7	2	6	19	34	54	37.0
A-2	2	2	6	4	10	2.5	7	4	0	0	18	24	34	29.4
B-1	15	1	31	16	37	2.3	30	19	8	45	124	155	192	19.3
B-2	3	1	7	4	10	2.5	5	4	0	0	14	21	31	32.3
Total	87	12	186	99	262	2.6	117	111	28	121	514	700	962	0.27