FOURTH ANNUAL REPORT

AVIAN STUDIES FOR THE ALPINE SATELLITE DEVELOPMENT PROJECT, 2006

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EXECUTIVE SUMMARY

Avian aerial surveys were conducted in the Colville Delta and northeastern NPRA in 2006 in support of the Alpine Satellite Development Project (ASDP) for ConocoPhillips, Alaska, Inc. and Anadarko Petroleum Corporation. The surveys continued long-term data acquisition begun in 1992 on the Colville Delta. Surveys focused on the abundance, distribution, and habitat use of 5 focal species: Spectacled Eider, King Eider, Tundra Swan, Yellow-billed Loon, and Brant. Aerial surveys for eiders, swans, and Brant were conducted from fixed-wing airplanes. Surveys for loons were conducted from a helicopter. In 2006, the ASDP comprised 5 satellite well pads (3 proposed, 2 under construction) that would send oil for processing to the existing Alpine Facility on the Colville Delta.

The Colville Delta study area (552 km²) encompassed the entire delta from the East Channel of the Colville River to the westernmost distributary of the Niġliq Channel. The Alpine Facility began oil production on the Colville Delta in 2000. Two ASDP satellite well pads were built in the winter of 2005: CD-3, a roadless pad on the outer delta, and CD-4, a pad in the southern part of the Colville Delta connected by road to the Alpine Facility. The CD-3 pad began producing oil in August 2006 and CD-4 began producing in November 2006. The 2006 NPRA study area (1,571 km²) abutted the western edge of the Colville Delta and was located in the northeastern section of the NPRA. The NPRA study area encompassed 4 proposed development sites that are part of the ASDP: well pads CD-5, CD-6, and CD-7, and the Clover A gravel mine site. A proposed road will connect the 3 pads to the Alpine Facility.

Spectacled Eiders were more numerous (31 eiders) on the Colville Delta during the pre-nesting aerial survey in 2006 than during similar surveys in the previous 3 years. In the NPRA study area in 2006, we counted 31 Spectacled Eiders and densities were near the long-term mean. The indicated total density of Spectacled Eiders in the NPRA study area was half that observed on the Colville Delta.

King Eiders were twice as numerous as Spectacled Eiders on the Colville Delta during the pre-nesting aerial survey in 2006; most of the King Eiders were in the Northeast Delta subarea. In the NPRA study area in 2006, 320 King Eiders were recorded on the pre-nesting survey. The overall density of King Eiders in the NPRA study area in 2006 was the highest in 8 years of aerial surveys.

On the Colville Delta in 2006, we found 22 Yellow-billed Loon nests during the nesting aerial survey, which is the fourth highest count of nests recorded in 12 years of surveys. We recorded 12 Yellow-billed Loon broods for the Colville Delta study area in 2006. In the NPRA study area in 2006, 8 Yellow-billed Loon nests were recorded, 7 of which were in the Fish Creek Delta subarea. One Yellow-billed Loon nest was found in the northern part of the Alpine West subarea. The Development, Exploration, and Fish Creek West subareas were not surveyed for loons in 2006. During brood-rearing, 15 adult Yellow-billed Loons and 2 broods were observed in the Fish Creek Delta subarea, whereas no Yellow-billed Loons were seen in the Alpine West subarea.

Overall, 16 of 28 pairs of Yellow-billed Loons in the Colville Delta study area were observed with young for an apparent nesting success of 57%. One nest hatched between 4 and 11 July and 7 more hatched between 11 and 18 July. The remaining 8 successful nests hatched between 18 July and 7 August. The peak of Yellow-billed Loon nest failures occurred between 26/27 June and 4 July. One nest failure was attributed to abandonment and another nest may have had infertile or damaged eggs. Other causes of nest failure were unknown. The presence or absence of egg membranes and numerous (30) eggshell fragments was a good indicator of nest success and highly correlated with the presence or absence of broods.

Thirty-one nests and 14 broods of Pacific Loons were counted opportunistically in the Colville Delta study area in 2006. In the Alpine West and Fish Creek Delta subareas of the NPRA study area, 34 Pacific Loon nests and 26 broods were found. No nests or broods of Red-throated Loons were seen during aerial surveys in either study area.

Twenty-nine swan nests were found in the Colville Delta study area in 2006, somewhat less than the long-term mean of 34. The 35 Tundra Swan broods counted in the Colville Delta study area was the third-highest brood count since 1992.

Apparent nesting success was over 100%, because more broods than nests were counted. The mean brood size in 2006 was 2.0 young and 69 swan young were counted on the delta, the fifth highest number since 1992. In the NPRA study area in 2006, 72 Tundra Swan nests were found during the aerial survey. Swan nesting density in the NPRA study area in 2006 (0.05 nests/km²) was higher than the 18-year mean density in the Kuparuk Oilfield (0.04 nests/km²) and less than the 13-year mean density (0.06 nests/km²) in the Colville Delta study area. Fifty Tundra Swan broods were observed in the NPRA study area in 2006. Apparent nesting success was 69% and mean brood size in the NPRA study area was 2.1 young.

In the Colville Delta study area in 2006, we counted 438 Brant (296 adults and 142 young) in 4 brood-rearing groups. The total count was the second lowest recorded in the Colville Delta study area over a 16-year period of intermittent surveys. On the same survey in 2006, 997 Snow Geese (421 adults and 576 young) in 9 brood-rearing groups were counted in the Colville Delta study area. The previous high count was 972 Snow Geese in 2005. During the aerial survey of the NPRA study area in 2006, we counted 2,235 Brant (1,350 adults and 885 young) in 17 brood-rearing groups, and 713 Snow Geese (270 adults and 443 young) in 9 groups.

Forty-two Glaucous Gull nests and at least 13 broods were counted in the Colville Delta study area during aerial surveys in 2006. Counts have ranged from 18 to 46 nests during 8 years of surveys. Twenty-eight Glaucous Gull nests were counted in the NPRA study area (Alpine West and Fish Creek Delta subareas only) during aerial surveys for loons in 2006. A minimum of 5 Glaucous Gull broods were observed in the Alpine West subarea, and no broods were seen in the Fish Creek Delta subarea. A Sabine's Gull nesting colony of a minimum of 15 nests was found in the northwestern part of the Colville Delta study area in 2006 during the aerial survey for nesting loons. An additional 4 nests were located during the CD-3 ground searches. In the NPRA study area in 2006, three small nesting colonies of Sabine's Gulls were found in the Alpine West (10 nests) and Fish Creek Delta subareas (3 and 4 nests each).

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ACKNOWLEDGMENTS

The 2006 avian studies in the Colville Delta and NPRA study areas involved the combined efforts of a number of people. The ABR biologists and technicians who contributed to this project include Jim King, Tim Obritschkewitsch, Pam Seiser, and Alice Stickney. Pilots Bill Saathoff, Gary Brogdon, Dick Hawkins, and John Mertke of Maritime Helicopters safely conducted helicopter supported surveys. We thank our airplane pilots, Sandy Hamilton, Chris Zimmer, and Jan Rubbert of Arctic Air Alaska, for keeping aerial surveys safely on course. On the ground, Mary Mae Aschoff and Brent Veltcamp coordinated the helicopter flights. In our Fairbanks office, Allison Zusi-Cobb, Will Lentz, Matt Macander, Dorte Dissing, and Pam Odom provided expert support in data analysis, figure production, and report preparation. In all phases of this study, we were assisted by our tireless expeditors, Tony LaCortiglia and Davya Flaharty. This study was funded by ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corporation and was administered by Caryn Rea, Senior Staff Biologist and Environmental Studies Coordinator, for whose support and guidance we are grateful. We appreciate the review and comments on this report made by Caryn Rea, Bob Burgess, and Alice Stickney. We thank all the other ConocoPhillips Alaska staff and contractors in the Alpine Oilfield for their assistance in making 2006 a successful field season.

INTRODUCTION

During 2006, ABR, Inc., conducted wildlife surveys for selected birds and mammals in the Colville River Delta and adjacent Northeast Planning Area of the National Petroleum Reserve—Alaska (NPRA) in support of the Alpine Satellite Development Project (ASDP) of ConocoPhillips, Alaska, Inc. (CPAI). The wildlife studies in 2006 were a continuation of work initiated by CPAI's predecessors, ARCO Alaska, Inc., and Phillips Alaska, Inc., in the Colville River Delta in 1992 (Smith et al. 1993, 1994; Johnson 1995; Johnson et al. 1996, 1997, 1998, 1999a, 1999b, 2000a, 2000b, 2001, 2002, 2003a, 2003b, 2004, 2005, 2006a, 2006b; Burgess et al. 2000, 2002a, 2003a) and in the northeastern NPRA in 1999 (Anderson and Johnson 1999; Murphy and Stickney 2000; Johnson and Stickney 2001; Burgess et al. 2002b, 2003b; Johnson et al. 2004, 2005, 2006b). The ASDP studies augment long-term wildlife monitoring programs that have been conducted by CPAI (and its predecessors) across large areas of the central Arctic Coastal Plain since the early 1980s (see Murphy and Anderson 1993, Stickney et al. 1993, Anderson et al. 2006, Lawhead et al., 2007).

The primary goal of wildlife investigations in the region since 1992 has been to describe the distribution and abundance of selected species before, during, and after construction of oil development projects. We report here the results of avian surveys in 2006 that were conducted in the Colville River Delta and adjacent NPRA. CPAI began producing oil on the Colville River Delta in 2000 (the Alpine Development's CD-1 and CD-2 pads) and again in 2006 (CD-3 and CD-4) and plans additional oil and gas development sites as part of the Alpine Satellite Development Project (BLM 2004): CD-5 (Alpine West), CD-6 (Lookout), and CD-7 (Spark) (Figure 1). Readers are directed to prior reports for wildlife information from previous years.

Surveys in the Colville River Delta and in the northeastern NPRA in 2006 were designed to provide data on the distribution, abundance, and habitat use of 5 focal species: Spectacled Eider, King Eider, Tundra Swan, Brant, and Yellow-billed Loon (see Appendix A for list of scientific names). Habitat selection analyses will be presented in a later report; interested readers are referred to past summaries (see Johnson et al. 2005). Ground-based surveys for nesting birds were conducted only in the CD-3 area for a separate monitoring study of Spectacled Eiders in 2006 (Johnson et al., 2007). Required state and federal permits were obtained for authorized survey activities, including a Scientific or Educational Permit (Permit No. 06-039) from the State of Alaska and a Federal Fish and Wildlife Permit—Threatened and Endangered Species (Permit No. TE012155-0). Similar avian species were monitored in the Kuparuk Oilfield on the eastern border of the Colville River Delta in 2006 (Anderson et al. 2006). Studies of caribou and other large mammals in the ASDP area in 2006 are reported in Lawhead et al. (2007). Additional studies on the use of the ASDP area by grizzly bears were conducted by the Alaska Department of Fish and Game (ADFG) with support from CPAI in 2002–2006. CPAI also supported the Polar Bear Conservation Program (U.S. Geological Survey) in its efforts to capture, mark, and monitor polar bears in the central Beaufort Sea.

STUDY AREAS

The place names used throughout this report are those depicted on U.S. Geological Survey (USGS) 1:63,360-scale topographic maps, because they are the most widely available published maps of the region. The corresponding local Iñupiaq names for drainages also are provided in parentheses at the first usage in text and on the study area map (Figure 1). Iñupiaq names are presented out of respect for local residents, to facilitate clear communication with Iñupiaq speakers, and because they pre-date the English names used on USGS maps. We acknowledge that the Iñupiaq names presented are not comprehensive, and we understand that the published USGS names for some streams (notably the Ublutuoch and Tingmeachsiovik rivers) do not correctly reflect local usage. The Iñupiaq names we use for Fish and Judy creeks in northeastern NPRA are taken from the *Iñupiat–English Map of the North Slope Borough* (NSB Planning Department, Barrow, Alaska, May 1997). Additional information was supplied to CPAI in recent years by Nuiqsut elders. Even in cases

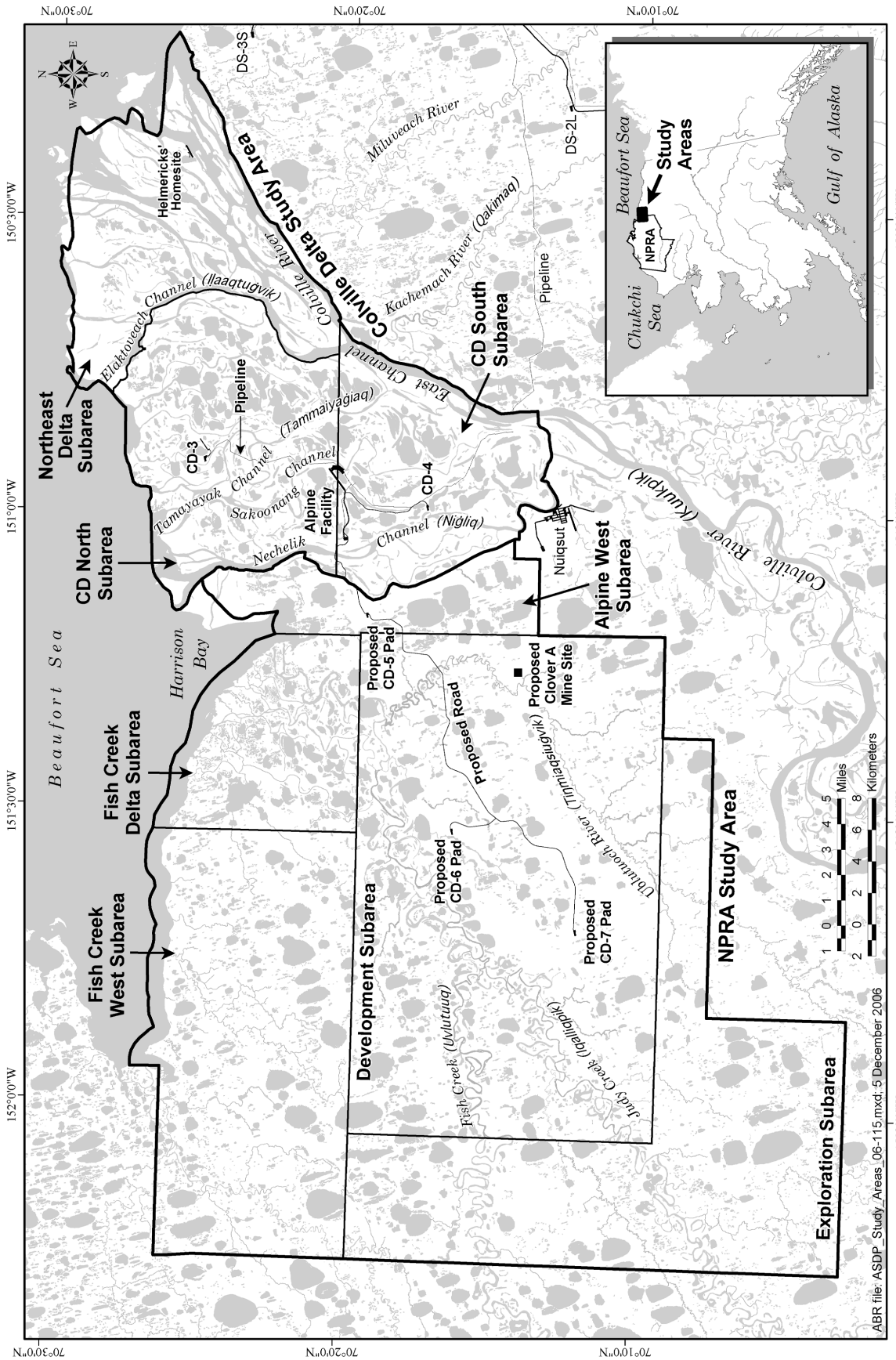

Figure 1. Wildlife study areas and subareas for the Alpine Satellite Development Project, northern Alaska, 2006.

where USGS attempted to use the correct Iñupiaq names, the anglicized spellings are outdated and so have been corrected to the modern Iñupiaq spellings through consultation with Emily Ipalook Wilson and Dr. Lawrence Kaplan of the Alaska Native Language Center (ANLC) at the University of Alaska Fairbanks. Marjorie Kasak Ahnupkanna and Archie Ahkiviana were consulted to confirm the names of other channels on the Colville River Delta (E. Wilson, ANLC, pers. comm.).

COLVILLE DELTA

The Colville Delta is one of the most prominent and important landscape features on the Arctic Coastal Plain of Alaska, both because of its large size and because of the concentrations of birds, mammals, and fish that are found there. Two permanent human settlements occur on the Colville Delta—the Iñupiat village of Nuiqsut and the Helmericks' family home site.

The Colville River Delta (or Colville Delta) includes the Alpine Facility (2 well pads, CD-1 and CD-2), at present the only producing oilfield on the Colville Delta and 2 new sites under construction, CD-3 and CD-4 (Figure 1). The CD-3 pad began producing oil in August 2006 and is a roadless development accessed via an all-season landing strip and a winter ice road. An all-season road connects CD-4 to the Alpine Facility.

As used in this report, the Colville Delta study area (552 km²) comprises the CD North, CD South, and the Northeast Delta subareas (Figure 1). These subareas are useful in describing the distribution of birds on the delta, and together they encompass the entire delta from the east bank of the East Channel of the Colville River to the west bank of the westernmost distributary of the Nechelik (Niġliq) Channel and inland to the juncture of these channels.

NPRA

The NPRA study area (1,571 km²) abuts the western edge of the Colville Delta and comprises 5 subareas: the Development, Exploration, Alpine West, Fish Creek Delta, and Fish Creek West subareas (Figure 1). The NPRA study area is located in the northeastern section of the NPRA, 6–39 km west of the village of Nuiqsut and 1–43 km west of the Alpine Facility. In 2005, the study area was expanded westward from the Fish Creek Delta to encompass what we call the Fish Creek West subarea. The NPRA study area encompasses 4 proposed development sites that are part of the ASDP: CD-5, CD-6, CD-7, and the Clover A gravel mine site (Figure 1). A proposed road connects the 3 well pads and also connects the CD-5 pad to the Alpine Facility at CD-2.

Three major streams flow through the NPRA study area (Figure 1). On USGS topographic maps (Harrison Bay 1:63,360 series, 1955) these drainages are labeled as Fish Creek, Judy Creek, and the Ublutuoch River, but they are commonly known by other names by Iñupiat residents: Fish Creek is called Uvlutuuq, Judy Creek is called Iqalliqpik, and the Ublutuoch River is called Tiŋmiaqsiuġvik (Figure 1).

METHODS

EIDER AERIAL SURVEYS

Regional abundance and distribution of eiders were evaluated with data collected on aerial surveys flown during the pre-nesting period (Table 1), while male eiders (the more visible of the 2 sexes in breeding plumage) were still present on the breeding grounds. The pre-nesting survey in 2006 (Figure 2) covered the same areas in the Colville Delta and NPRA study areas as in 2005 (Figure 1). The pre-nesting survey was conducted on 10–11 and 13–14 June using the same methods that were used in previous years on the Colville Delta (1993–1998 and 2000–2005) and in the NPRA study area (1999–2005), although the survey areas and survey coverage differed among years (see Anderson and Johnson 1999; Murphy and Stickney 2000; Johnson and Stickney 2001; Burgess et al. 2003b; Johnson et al. 2003b, 2004, 2005, 2006b). Surveys were flown in a Cessna 185 airplane at 30–35 m above ground level (agl) and approximately 145 km/h. A Global Positioning System (GPS) receiver was used to navigate pre-determined east–west transect lines that were spaced 800 m apart (50% coverage) in the NPRA study area and 400 m apart (100% coverage) over the Colville Delta study area (Figure 2). An observer on each side of the airplane (in addition to the pilot) counted eiders in a 200-m-wide transect (delimited by tape on windows and wing struts, see

Table 1. Avian surveys conducted in the Colville Delta and NPRA study areas, Alaska, 2006.

Survey Type Study Area	Season	Survey Dates	Aircraft [a]	Transect Width (km)	Transect Spacing (km)	Aircraft Altitude (m)	Notes
Eider surveys							
Colville Delta	Pre-nesting	11, 13 June	C185	0.4	0.4	30–35	100% coverage
NPRA	Pre-nesting	10, 13, 14 June	C185	0.4	0.8	30–35	50% coverage
Yellow-billed Loon surveys [bc]							
Colville Delta–NPRA	Nesting	26–28 June	206L	–	–	60	All lakes ≥10 ha
Colville Delta–NPRA	Brood-rearing	21–22 August	206L	–	–	60	All lakes ≥10 ha
Tundra Swan surveys							
Colville Delta–NPRA	Nesting	21–24 June	C206	1.6	1.6	150	100% coverage
Colville Delta–NPRA	Brood-rearing	16–18 August	C206	1.6	1.6	150	100% coverage
Brant and Snow Goose survey							
Colville Delta–NPRA	Brood-rearing	29 July	B8GCBC	–	–	75–150	Coastal and lake-to- lake pattern

[a] C185 = Cessna 185 fixed-wing airplane; C206 = Cessna 206 fixed-wing airplane; B8GCBC = Bellanca "Scout" fixed-wing airplane; 206L = Bell "Long Ranger" helicopter

[b] Glaucous Gull nests were recorded during surveys for Yellow-billed Loons

[c] Pacific and Red-throated loons and colonies of Sabine's Gulls were recorded incidentally

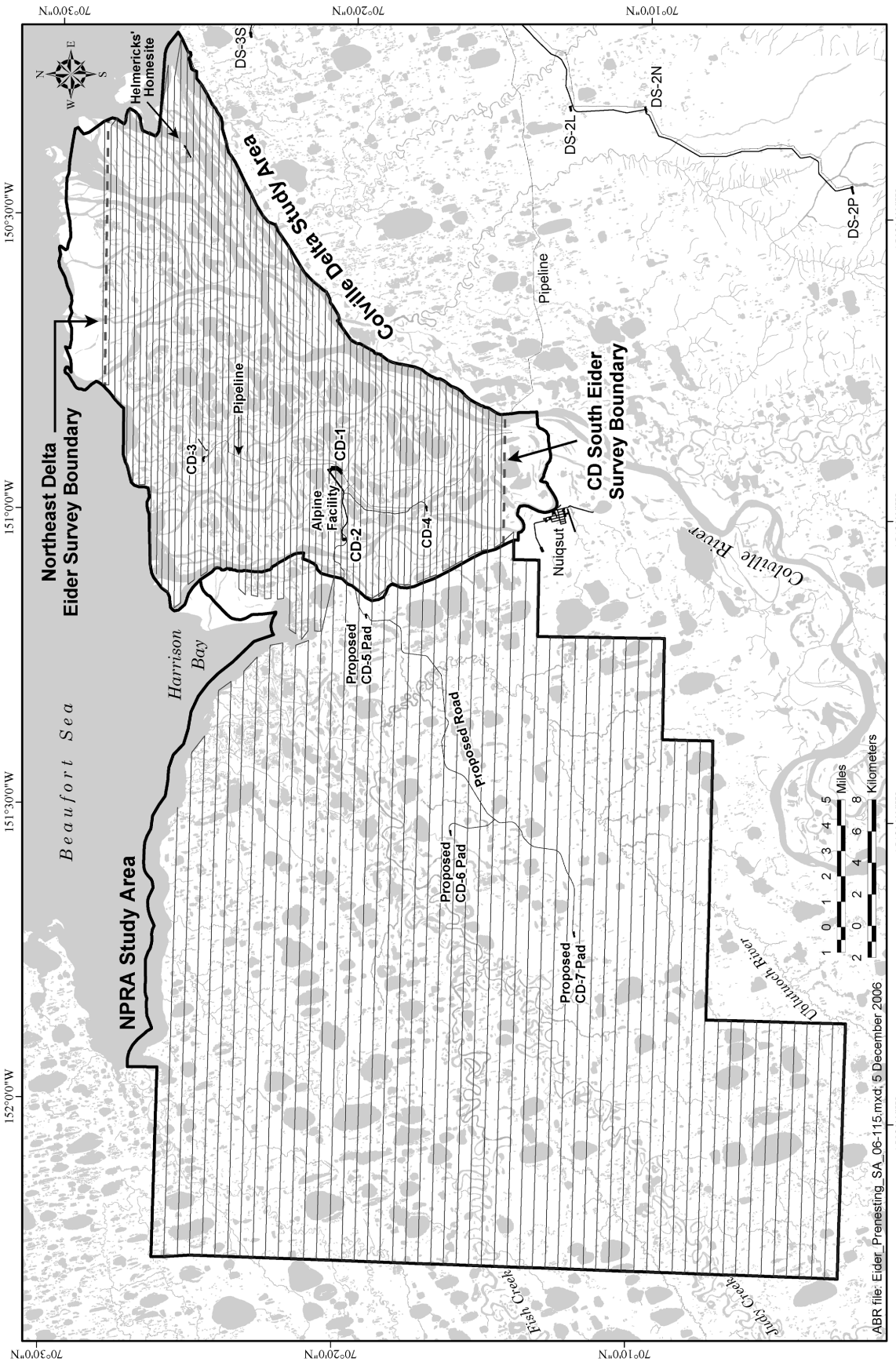

Figure 2. Transect lines and survey areas for aerial surveys of pre-nesting eiders, Colville Delta and NPRA study areas, Alaska, 2006.

Pennycuick and Western 1972). Three areas were not surveyed on the Colville Delta: the extensive tidal flats and marine waters on the northernmost delta were not included because eiders rarely use those habitats, a 2.4-km radius circle around the Helmericks' home site was avoided to reduce disturbance to its residents, and similarly, the extreme southern delta was avoided to limit disturbance to Nuiqsut residents (Figure 2). Eider locations were recorded on color photomosaic maps (1:63,360-scale) and tape recorders were used to record species, number of identifiable pairs and individuals of each sex, and location (flying or on the ground). Eider locations on survey maps were digitized into a geographic information system (GIS) database.

We recorded the observed number of birds and pairs and calculated the "indicated" number of birds and densities (number/km²). Following the USFWS (1987a) protocol, the total indicated number of birds excludes flying birds and is twice the number of males not in groups (groups are defined as >3 birds of mixed sex that cannot be separated into singles or pairs) plus the number of birds in groups (see USFWS 1987a for exceptions to the rule).

LOON AERIAL SURVEYS

Aerial surveys for nesting Yellow-billed Loons were conducted on 26–28 June 2006 and for brood-rearing loons on 21–22 August 2006 (Table 1). The surveys were flown in the CD North and CD South subareas and over 2 lakes in the Northeast Delta subarea of the Colville Delta study area and in the Alpine West and Fish Creek Delta subareas of the NPRA study area (Figure 3). Both nesting and brood-rearing surveys were conducted in a helicopter flying at ~60 m agl in a lake-to-lake pattern covering most lakes ≥10 ha in size and immediately adjacent smaller lakes and aquatic habitats, which comprise the typical breeding habitats for nesting Yellow-billed Loons (Sjolander and Agren 1976, North and Ryan 1989). Tapped Lakes with Low-water Connections (lakes whose levels fluctuate with river levels) were excluded because Yellow-billed Loons do not use such lakes for nesting (North 1986, Johnson et al. 2003b). Observations of Pacific and Red-throated loons were recorded incidentally. All locations of loons and their nests were recorded on color photomosaics (~1: 1,500 or 1:30,000 scale) and later digitized into a GIS database. The total numbers of adults, nests, broods, and young counted on aerial surveys were summarized for each species of loon. Densities of adults, nests, and broods were calculated only for Yellow-billed Loons because the smaller lakes that typically are used by Pacific and Red-throated loons were not included in the survey.

Weekly surveys were conducted to monitor the status of Yellow-billed Loon nests in the Colville Delta study area. Traditional nest lakes without an active nest during the nesting survey were revisited to search for nests for 2 weeks after the nesting survey if loons were present on the lake during the nesting survey and for one week if no loons were present. Each nest was surveyed weekly from a helicopter until it was noted as inactive. Active nests had either an incubating adult, or contained at least 1 egg. Inactive nests were either failed or hatched. Nests were assumed failed when adults were not incubating, eggs were not present, and a brood was not seen. Nests were assumed successful if a brood was present. When a nest appeared inactive, the nesting lake was immediately searched for broods by flying along the shoreline. Adjacent lakes known from previous surveys to be brood-rearing locations also were surveyed. Inactive nests were visited on the ground to inspect contents. The nest and the surrounding area within 5 m, including the water around the nest, were examined for the presence of egg fragments and egg membranes. Loons may reuse nests from previous years, so only the current year's layer of loose vegetation on top of the nest was inspected, to avoid recording evidence from previous years. If egg fragments were found, they were counted and, based on the length of their longest side, placed into 5 size categories: 5-, 10-, 15-, 20-, 25-, and 30-mm. Egg membranes or pieces of membranes also were counted and measured.

TUNDRA SWAN AERIAL SURVEYS

Aerial surveys for nesting and brood-rearing Tundra Swans were flown during 21–24 June and 16-18 August 2006, respectively (Table 1). Aerial surveys covered the entire Colville Delta and

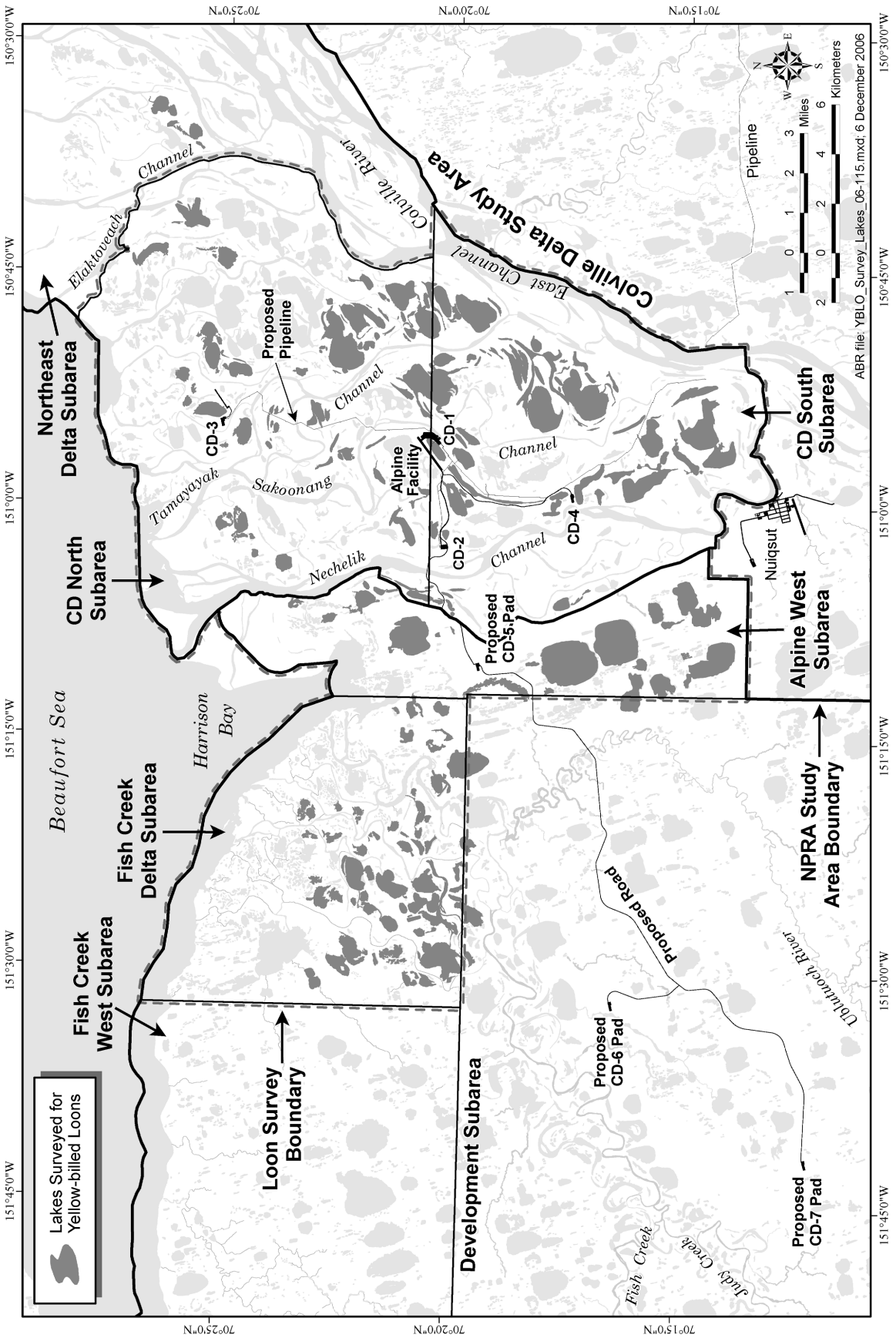

Figure 3. Lakes included in aerial surveys for nesting Yellow-billed Loons, Colville Delta and NPRA study areas, Alaska, 2006.

NPRA study areas (Figure 4). Surveys were conducted in accordance with USFWS protocols (USFWS 1987b, 1991). East-west transects spaced 1.6 km apart were flown in a Cessna 206 fixed-wing airplane that was navigated with the aid of a GPS receiver. Flight speed was 145 km/h and altitude was 150 m agl. Two observers each searched 800-m-wide transects on opposite sides of the airplane while the pilot navigated and scanned for swans ahead of the airplane, providing 100% coverage of the surveyed area. Locations and counts of swans and their nests were recorded on color photomosaics (1:63,360-scale). Each nest on the Colville Delta was photographed with a 35-mm camera for site verification. Swan locations on survey maps were digitized into a GIS database.

Numbers of swans, nests, and broods were summarized and densities calculated for each study area. Apparent nesting success was estimated from the ratio of broods to nests counted during aerial surveys only. The accuracy of these estimates can be affected by differential detection, predation, and movements of broods; therefore, the calculated estimates of nesting success should be considered relative indices.

BRANT AND SNOW GOOSE AERIAL SURVEYS

In 2006, 1 aerial survey was flown on 29 July for brood-rearing and molting Brant and Snow Geese in the coastal zone of the Colville Delta and NPRA study areas (Table 1). The survey was flown in a Bellanca Scout 8GCBC aircraft at 75–150 m agl and approximately 100–120 km/h along the coast and in a lake-to-lake pattern (Figure 5). One pilot and 1 observer searched appropriate habitats (excluding tidal flats and marine water) along the coast, rivers, channels, and lakes. The numbers of adults and young were recorded and their locations were placed on USGS 1:250,000 or 1:63,360-scale maps and saved on a GPS receiver. Geese in small groups (<50) were counted from the airplane, whereas larger groups were counted on photographs taken with a 35-mm camera, 135-mm lens, and 200 ASA slide film. Goose locations on survey maps were digitized into a GIS database.

GULL AERIAL SURVEYS

Glaucous Gulls nests and broods were recorded in the Colville Delta and NPRA study areas during aerial surveys for Yellow-billed Loons (see Loon Aerial Surveys above for methods). Colonies of Sabine's Gulls also were recorded during the nesting survey for Yellow-billed Loons, and the number of nests at each colony was estimated from the number of adults observed (Sabine's Gull nests are difficult to confirm from aerial surveys). All nest and brood observations were recorded on color photomosaics (1:30,000 scale) and later digitized into a GIS database.

RESULTS

CONDITIONS IN THE STUDY AREAS

Birds returning to Colville Delta encountered warmer than average spring conditions in 2006. Mean monthly temperatures in 2006 in the nearby Kuparuk Oilfield were almost 2° warmer than the 19-year mean during May and 3° warmer than the 19-year mean during June (www.ncdc.noaa.gov/oa/ncdc.html). The number of thawing-degree days during the waterfowl arrival and peak nest initiation period (15 May–15 June) was the third highest recorded in 19 years at Kuparuk and the highest in 10 years at Colville Village on the outer Colville Delta. Breakup on the Colville River in 2006 was characterized by high water surface elevations throughout the delta. While the date of peak discharge (30 May 2006) was considered average, the peak surface elevation and peak discharge were the second and fourth highest recorded, respectively (Michael Alexander, pers. comm.). Snow cover in the NPRA and Kuparuk Oilfield was still about 50% in early June, but was mostly gone by 10 June (ABR, unpubl. data). The outer Colville Delta was about 80% snow-covered at the end of May, but was essentially snow-free by 12 June. Deep lakes on the Colville Delta retained 80% ice cover through 12 June, but only the northernmost deep lakes still retained a small amount of thin ice (<30%) by 26 June, the least amount of ice cover observed on deep lakes during late June since we began monitoring conditions in 1993. Other indicators of a warm spring were the early bloom of tundra flowers, early emergence of

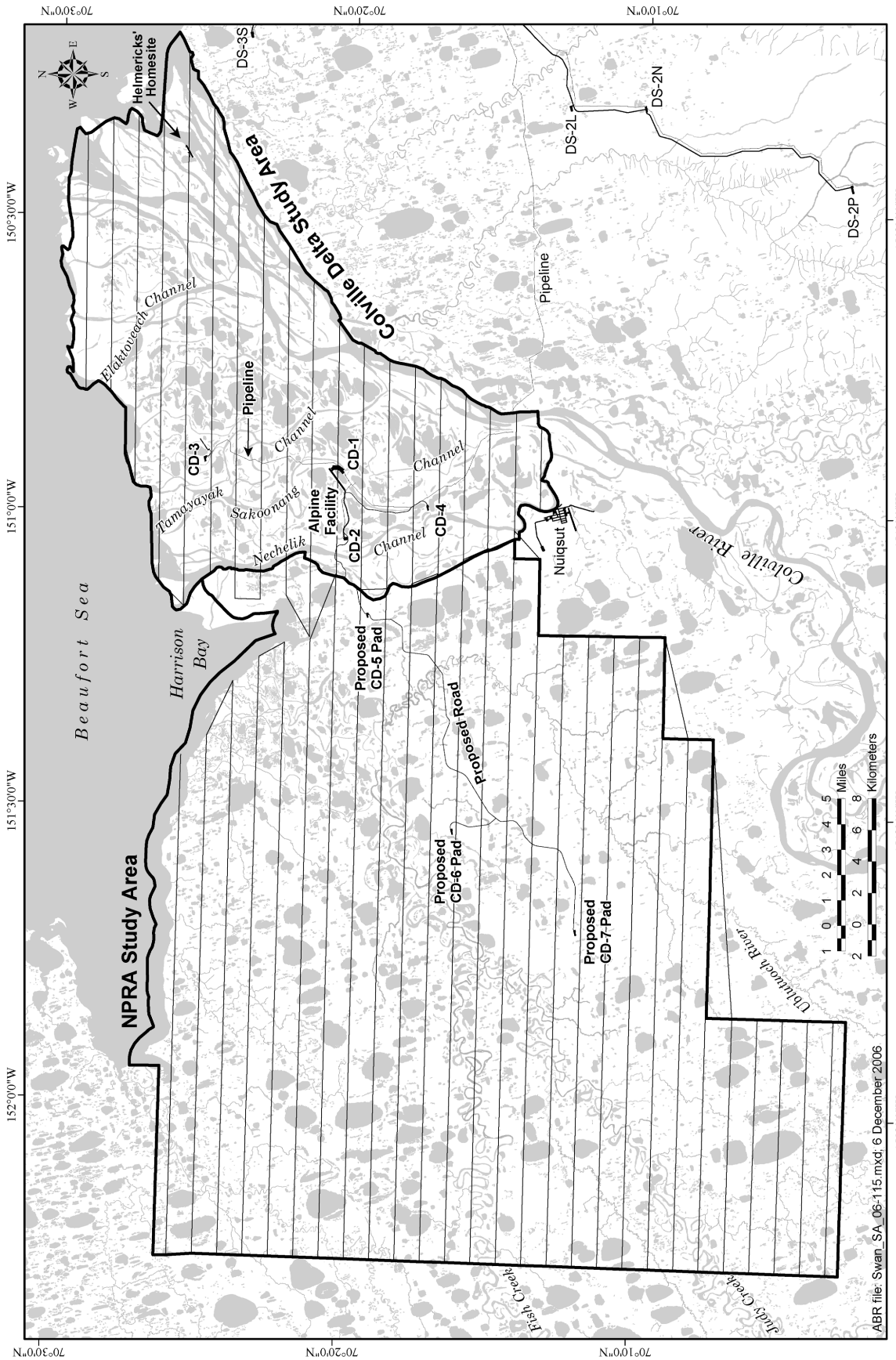

Figure 4. Transect lines and survey areas for aerial surveys of nesting and brood-rearing Tundra Swans, Colville Delta and NPRA study areas, Alaska, 2006.

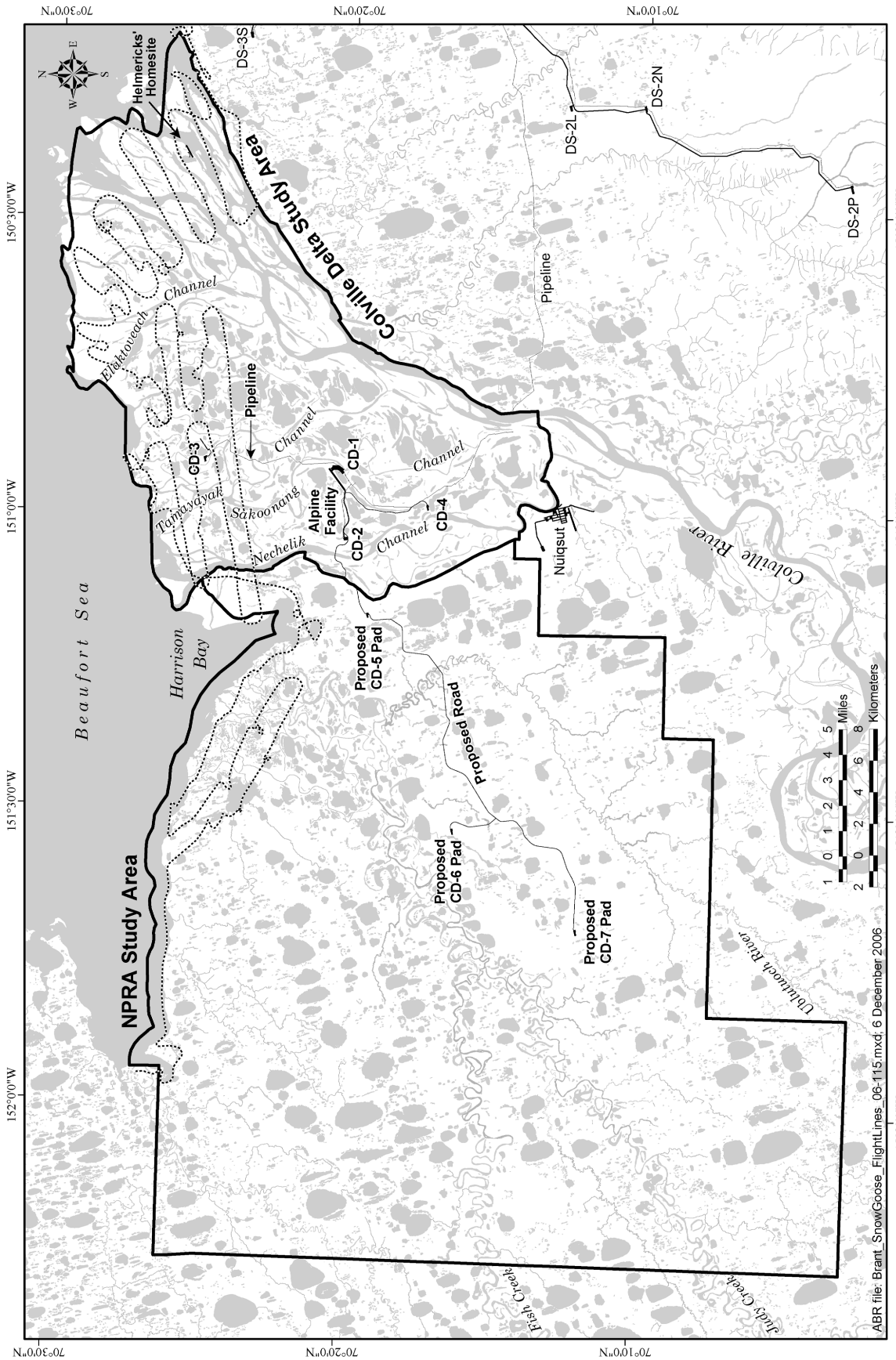

Figure 5. Flight lines for Brant and Snow Goose brood-rearing aerial surveys, Colville Delta and NPRA study areas, Alaska, 2006.

mosquitos, and early hatch of nests in the CD-3 area where ground surveys were conducted for another study (Johnson et al., 2007). *Parrya nudicaulus*, *Caltha palustris*, *Primula borealis*, and *Petasites frigidus* had bloomed and *Salix glauca* had leafed out by 20 June. Mosquitos were first noted on 20 June and were moderately abundant on 22 June. The emergence of mosquitos coincided with our first observation of a group of 6 caribou, presumably seeking refuge from higher concentrations of mosquitos to the south of the Colville Delta. On 25 June, we found the first hatching nests of Greater White-fronted Geese and the first Lapland Longspur chicks. On 27 June, we found the first shorebird fledgling, a Pectoral Sandpiper. Whereas these dates may not be early for the same events in other locations on the Arctic Coastal Plain, the outer Colville Delta remains cool with ice-choked deep lakes until early to mid-July in most years and conditions are rarely warm enough for mosquitos to emerge before the end of June. From these many indicators, we estimate that the breeding season conditions were advanced 4 to 7 days over a normal year on the Colville Delta, and presume a similar condition existed in the adjacent NPRA study area.

EIDERS

Of the 2 species of eiders that commonly occur in the Colville Delta and NPRA study areas, the Spectacled Eider has received the most attention because it was listed as "threatened" under the Endangered Species Act in 1993 (58 FR 27474-27480). The Spectacled Eider nests at low densities across the outer Colville Delta and nests in even lower numbers in inland parts of the delta and in scattered wetland basins in the NPRA study area (Burgess et al. 2003a, 2003b; Johnson et al. 2004, 2005). The King Eider is more widespread and generally more numerous than the Spectacled Eider, although their relative abundance varies geographically. Steller's Eiders (also a threatened species, listed in 1997) and Common Eiders are rare in the Colville Delta and NPRA study areas, and none were seen on surveys in 2006.

SPECTACLED EIDER

Colville Delta

All sightings of Spectacled Eiders in the Colville Delta study area during the pre-nesting survey in 2006 were of groups of 1–4 birds, and all Spectacled Eiders but 2 pairs of flying birds were in the CD North subarea (Figure 6, Table 2). We counted 31 Spectacled Eiders of which 25 were observed on the ground and 6 were in flight (Table 2). The count in the Colville Delta study area in 2006 was an increase in Spectacled Eiders over the counts from the previous 3 years.

Nest and brood searches for Spectacled Eiders were conducted in 2006 as part of a monitoring study of construction in the area of CD-3. Readers should see Johnson et al. (2007) for a report on nesting in that part of the delta.

NPRA

During the breeding period, lower densities of Spectacled Eiders are found in the NPRA study area than in the Colville Delta study area. Relative to the previous 3 years of pre-nesting surveys, the number of Spectacled Eiders in the NPRA study area increased in 2006, just as they did in the Colville Delta study area. In 2006, 31 Spectacled Eiders were counted, with low numbers in each of the 5 subareas (Table 3). The indicated total density of Spectacled Eiders in 2006 was the same as the 8-year mean (0.03 birds/km²). The indicated total density of Spectacled Eiders in the NPRA study area was 50% of that in the Colville Delta study area in 2006 (0.06 birds/km²), a relationship that has been consistent since we began conducting surveys in both locations.

KING EIDER

Colville Delta

In 2006, King Eiders (63 total birds) were approximately twice as numerous as Spectacled Eiders (31 total birds) in the Colville Delta study area. The largest percentage of King Eiders (46%) was seen in the Northeast Delta subarea (Figure 6, Table 2). The Northeast Delta subarea is highly dissected by distributary channels and in past years has been used by large flocks of King Eiders, probably in transit to breeding areas (Johnson et al. 2003b).

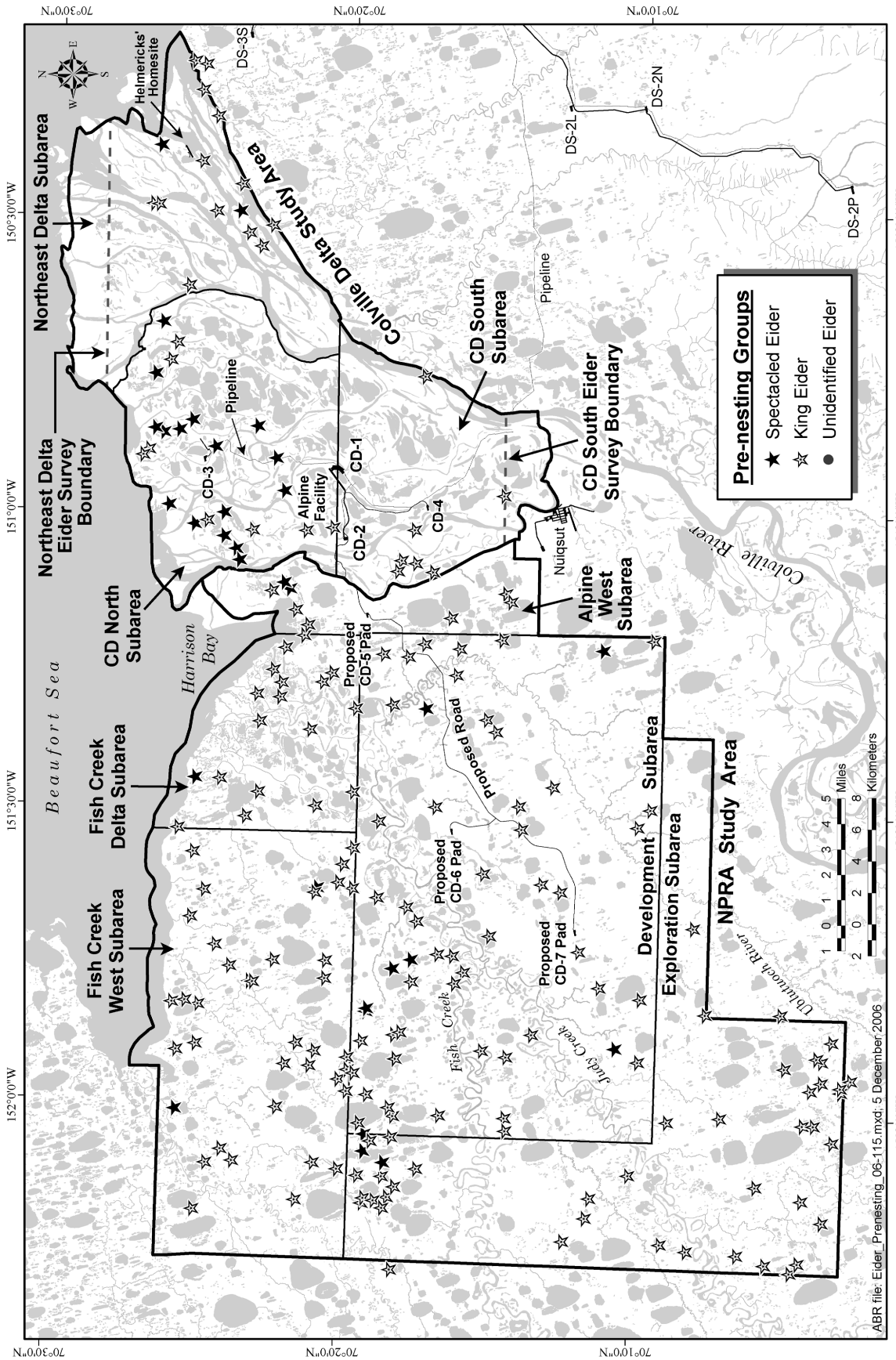

Figure 6. Spectacled and King eider groups during pre-nesting, Colville Delta and NPRA study areas, Alaska, 2006.

Table 2. Number and density of eiders during pre-nesting aerial surveys, Colville Delta study area, Alaska, 2006.

SPECIES Subarea Location	Number of Eiders					Density (birds/km²) [a]	
	Observed				Indicated Total [b]	Observed Total	Indicated Total [b]
	Males	Females	Total	Pairs			
SPECTACLED EIDER							
CD North							
On ground	15	10	25	10	30	0.12	0.15
In flight	1	1	2	1	–	0.01	–
All birds	16	11	27	11	–	0.13	–
Northeast Delta							
On ground	0	0	0	0	0	0	0
In flight	2	2	4	2	–	0.03	–
All birds	2	2	4	2	–	0.03	–
Total (subareas combined)							
On ground	15	10	25	10	30	0.05	0.06
In flight	3	3	6	3	–	0.01	–
All birds	18	13	31	13	–	0.06	–
KING EIDER							
CD North							
On ground	8	7	15	7	16	0.07	0.08
In flight	0	0	0	0	–	0	–
All birds	8	7	15	7	–	0.07	–
Northeast Delta							
On ground	15	12	27	12	30	0.17	0.19
In flight	1	1	2	1	–	0.01	–
All birds	16	13	29	13	–	0.18	–
CD South							
On ground	7	6	13	5	14	0.09	0.10
In flight	6	0	6	0	–	0.04	–
All birds	13	6	19	5	–	0.14	–
Total (subareas combined)							
On ground	30	25	55	24	60	0.11	0.12
In flight	7	1	8	1	–	<0.01	–
All birds	37	26	63	25	–	0.13	–

[a] Density based on 100% coverage of subareas: CD North = 206.7 km²; Northeast Delta = 157.6 km², CD South = 137.2 km², all subareas combined = 501.4 km²; numbers were not corrected for sightability

[b] Total indicated birds was calculated according to standard USFWS protocol (USFWS 1987a)

Table 3. Number and density of eiders during pre-nesting aerial surveys, NPRA study area, Alaska, 2006.

SPECIES Subarea Location	Number of Eiders					Density (birds/km²) [a]	
	Observed				Indicated Total [b]	Observed Total	Indicated Total [b]
	Males	Females	Total	Pairs			
SPECTACLED EIDER							
Development							
On ground	6	4	10	4	12	0.03	0.04
In flight	1	0	1	0	–	<0.01	–
All birds	7	4	11	4	–	0.04	–
Alpine West							
On ground	2	2	4	2	4	0.10	0.10
In flight	0	0	0	0	–	0	–
All birds	2	2	4	2	–	0.10	–
Fish Creek Delta							
On ground	0	0	0	0	0	0	0
In flight	1	1	2	1	–	0.03	–
All birds	1	1	2	1	–	0.03	–
Fish Creek West							
On ground	3	3	6	3	6	0.04	0.04
In flight	0	0	0	0	–	0	–
All birds	3	3	6	3	–	0.04	–
Exploration							
On ground	2	2	4	2	4	0.02	0.02
In flight	2	2	4	2	–	0.02	–
All birds	4	4	8	4	–	0.04	–
Total (subareas combined)							
On ground	13	11	24	11	26	0.03	0.03
In flight	4	3	7	3	–	0.01	–
All birds	17	14	31	14	–	0.04	–
KING EIDER							
Development							
On ground	52	36	88	35	104	0.29	0.34
In flight	13	7	20	7	–	0.07	–
All birds	65	43	108	42	–	0.35	–
Alpine West							
On ground	6	5	11	5	12	0.26	0.29
In flight	1	1	2	1	–	0.05	–
All birds	7	6	13	6	–	0.31	–
Fish Creek Delta							
On ground	17	15	32	15	34	0.56	0.59
In flight	2	1	3	1	–	0.05	–
All birds	19	16	35	16	–	0.61	–

Table 3. Continued.

SPECIES Subarea Location	Number of Eiders					Density (birds/km²) [a]	
	Observed				Indicated Total [b]	Observed Total	Indicated Total [b]
	Males	Females	Total	Pairs			
Fish Creek West							
On ground	46	35	81	35	92	0.54	0.61
In flight	4	3	7	3	–	0.05	–
All birds	50	38	88	38	–	0.58	–
Exploration							
On ground	45	24	69	24	90	0.34	0.45
In flight	6	1	7	1	–	0.03	–
All birds	51	25	76	25	–	0.38	–
Total (subareas combined)							
On ground	166	115	281	114	332	0.37	0.44
In flight	26	13	39	13	–	0.05	–
All birds	192	128	320	127	–	0.42	–

[a] Surveys conducted at 50% coverage. Density based on area surveyed: Development subarea = 304.6 km² surveyed, Alpine West = 41.8 km², Fish Creek = 57.3 km², Fish Creek West =151.2 km², Exploration = 200.2 km², all subareas combined = 755.0 km². Numbers were not corrected for sightability

[b] Total indicated birds was calculated according to standard USFWS protocol (USFWS 1987a)

NPRA

During breeding, King Eiders are many times more abundant in the NPRA study area than they are in the Colville Delta study area. On the pre-nesting aerial survey in the NPRA in 2006, 320 King Eiders were recorded, of which 39 were in flight (Figure 6, Table 3). The highest densities of King Eiders were observed in the Fish Creek Delta (0.59 indicated total birds/km²) and Fish Creek West subareas (0.61 indicated total birds/km²). The overall density of King Eiders in the NPRA study area in 2006 (0.44 indicated total birds/km²) was the highest in 8 years of surveys.

LOONS

YELLOW-BILLED LOON

Colville Delta

Abundance and Distribution

During nesting in 2006, 61 Yellow-billed Loons were observed in the Colville Delta study area (Table 4), which was the most adults seen during nesting in 12 years of surveys (Burgess et al. 2003a; Johnson et al. 2003b, 2004, 2005, 2006b). Twenty-two Yellow-billed Loon nests were found in the Colville Delta study area (CD North and CD South subareas combined) during the aerial survey in 2006, which was the fourth highest record in 12 years of aerial surveys (Figure 7, Table 4). An additional 6 nests were found that were not included in the study area total because they were found either in an area or with a method that was inconsistent with past surveys. Two nests and 4 adults were found in the Northeast Delta subarea, an area where survey effort has differed between years, and 4 nests were found after the nesting survey during the weekly monitoring surveys in July, which were first flown in 2005. These last 4 nests were found on lakes that had been surveyed during the nesting survey and may not have been active at the time of that survey. As in previous years, Yellow-billed Loon nests in 2006 were concentrated in the central part of the delta (Figure 7), and all nests were on lakes where Yellow-billed Loons have nested previously (Rothe et al. 1983; North 1986; Burgess et al. 2003a; Johnson et al. 2003b, 2004, 2005, 2006b).

Table 4. Number and density of loons and their nests, broods, and young during aerial surveys, Colville Delta and NPRA study areas, Alaska, 2006.

STUDY AREA	Yellow-billed Loons					Pacific Loons [a]			Red-throated Loons [a]		
	Number			Density (number/km²)		Number			Number		
Subarea [b] / Survey Type	Adults	Nests/ Broods	Young	Adults	Nests/ Broods	Adults	Nests/ Broods	Young	Adults	Nests/ Broods	Young
COLVILLE DELTA											
CD North											
Nesting	35	13	–	0.17	0.06	72	18	–	9	0	–
Brood-rearing	45	8	8	0.22	0.04	49	6	7	0	0	0
CD South											
Nesting	26	9	–	0.17	0.06	68	13	–	9	0	–
Brood-rearing	20	4	4	0.13	0.03	26	8	9	0	0	0
Northeast Delta [c]											
Nesting	4	2	–	–	–	11	0	–	0	0	–
Brood-rearing	1	1	1	–	–	4	2	2	0	0	0
Subtotal (CD North and CD South subareas combined) [d]											
Nesting	61	22	–	0.17	0.06	140	31	–	18	0	–
Brood-rearing	65	12	12	0.18	0.03	75	14	16	0	0	0
NPRA											
Alpine West											
Nesting	2	1	–	0.03	0.01	56	9	–	1	0	–
Brood-rearing	0	0	0	0	0	55	13	18	0	0	0
Fish Creek Delta											
Nesting	21	7	–	0.16	0.05	57	25	–	0	0	–
Brood-rearing	15	2	2	0.11	0.02	61	13	16	3	0	0
Total (subareas combined) [d]											
Nesting	23	8	–	0.11	0.04	113	34	–	1	0	–
Brood-rearing	15	2	2	0.07	0.01	116	26	34	3	0	0

[a] Densities of Pacific and Red-throated loons were not calculated because detectability differed from that of Yellow-billed Loons and surveys did not include smaller lakes (<10 ha) where those species commonly nest

[b] CD North = 206.7 km², CD South = 155.9 km², Alpine West = 79.7 km², Fish Creek Delta = 130.5 km²; see Figure 3

[c] Densities for Northeast Delta were not calculated because entire area was not surveyed

[d] Total number and density includes CD North and CD South for Colville Delta (362.6 km² total) , and Alpine West and Fish Creek Delta for NPRA (210.2 km² total)

In 2006, we recorded 12 broods and 65 adult Yellow-billed Loons in the Colville Delta study area during the brood-rearing aerial survey (excluding 1 brood and 1 adult in the Northeast Delta subarea; Figure 7, Table 4). Mean brood size was 1.0 young/brood. An additional 3 broods were observed during the weekly monitoring surveys in July.

Nest Fate

Overall, 16 of 28 nesting pairs of Yellow-billed Loons in the Colville Delta study area were observed with young for an apparent nesting success of 57% (Table 5). Hatch was relatively asynchronous in 2006, occurring over nearly a 4-week period. The earliest recorded hatching occurred between 4 and 11 July (Table 5).

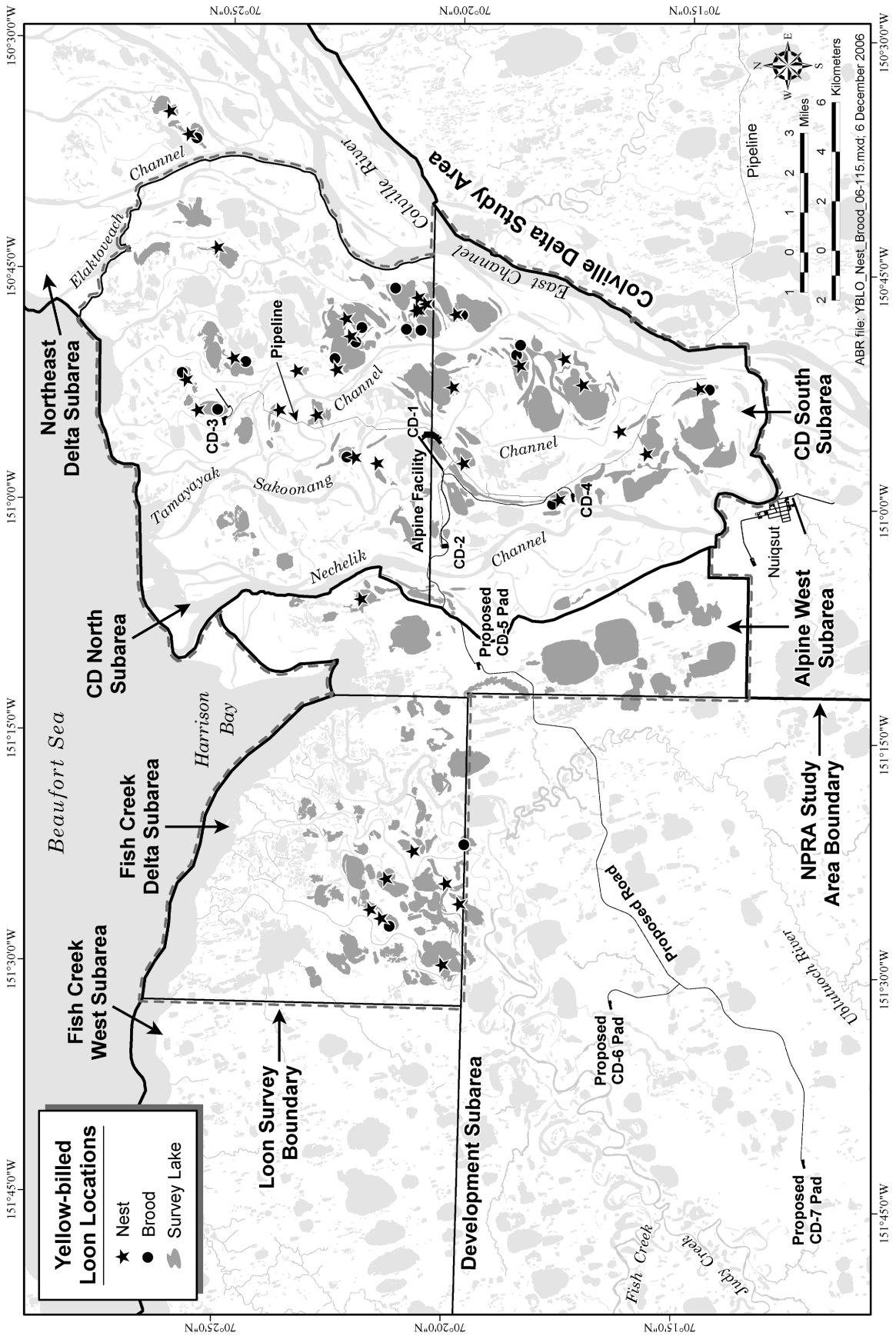

Figure 7. Yellow-billed Loon nests and broods, Colville Delta and NPRA study areas, Alaska, 2006.

Table 5. Weekly status and fate of Yellow-billed Loon nests, Colville Delta study area, Alaska, 2006.

Nest No.	Visit Date								Fate/Total
	26–27 Jun	4 Jul	11 Jul	18 Jul	24 Jul	31 Jul	7 Aug	14 Aug	
3	Active	Active	Active	Inactive					Hatched
5	Active	Inactive							Failed
31	Active	Active	Active	Inactive					Hatched
43	Active	Active	Active	Active	Active	Active	Active	Inactive	Failed
46	Active	Active	Inactive						Failed
53	Active	Active	Active	Inactive					Hatched
55	Active	Inactive							Failed
81	Active	Active	Active	Inactive					Hatched
91	Active	Active	Active	Inactive					Failed
100	Active	Active	Active	Active	Inactive				Hatched
107	Active	Inactive							Failed
108	Active	Active	Active	Inactive					Hatched
110	Active	Active	Active	Active	Inactive				Hatched
112	Active	Active	Active	Inactive					Hatched
123	Active	Active	Inactive						Hatched
129	Active	Active	Active	Active	Inactive				Hatched
130	Active	Active	Active	Inactive					Hatched
141	Active	Active	Active	Active	Inactive				Hatched
157	Active	Inactive							Failed
158	Active	Inactive							Failed
163	Active	Inactive							Failed
170	Active	Active	Active	Active	Inactive				Hatched
189	Active	Active	Active	Active	Active	Inactive			Hatched
201	Active	Active	Inactive						Failed
650		Active	Active	Active	Active	Active	Inactive		Hatched
654		Active	Inactive						Failed
655		Active	Inactive						Failed
656			Active	Active	Active	Active	Inactive		Hatched
No. Active	24	21	17	9	4	3	1	0	28
No. Hatched	0	0	1	7	5	1	2	0	16
No. Failed	0	6	4	1	0	0	0	1	12

Three nests were first found active on 4 July and another was found on 11 July. The peak of hatch (7 nests) occurred between 11 and 18 July. Five nests hatched by 24 July, and 1 nest hatched by 31 July. The remaining 2 nests, both of which were found in early July, hatched by 7 August. In comparison, hatch in 2005 occurred over a 3-week period between 12 July and 1 August (Johnson et al. 2006b). Three broods observed during weekly monitoring surveys in 2006 were lost by the time of the brood-rearing aerial survey (21–22 August).

The peak in Yellow-billed Loon nest failures on the Colville Delta occurred during the week following the nesting survey with 21% (6 of 28) of the nests failing by 4 July. Four more nests failed during the next week (by 11 July), while only 2 nest failures were recorded after 11 July (Table 5). Causes of nest failure were unknown. However, 1 nest failure was attributed to abandonment. This nest was found with an incubating adult on 26 June. No adults were seen on the nest lake on 4 and 11 July and whole eggs were lying next to the nest

bowl. Another nest failure may be attributed to infertile or damaged eggs. An adult was recorded incubating during visits from 26 June to 7 August, a minimum of 43 days, or ~16 days longer than their reported incubation period (North and Ryan 1988). The nest probably was abandoned or depredated by 14 August when the nest was observed without an incubating adult. We were not able to visit the nest to confirm its status until 21 August, when no Yellow-billed Loons were observed on the nesting lake or adjacent lakes in the area and no evidence of hatch was found at the nest.

The contents of 27 of 28 Yellow-billed Loon nests were examined after nests were no longer active. Each of 16 successful nests (those associated with broods) contained more than 30 eggshell fragments inside the nest. Of 997 eggshell fragments found in successful nests, 80% were 5–10 mm in length. Although a few fragments were loosely attached to bits of egg membrane, most were free of membrane. All but 1 hatched nest contained at least 1 piece of thickened egg membrane ranging in length from 5 to 100 mm. The majority of egg membranes and eggshell fragments were found in nest bowls, but occasionally some were found in the water or on shore adjacent to nests. Aside from one nest abandoned with whole eggs, the remaining 11 nests, where broods were not seen and presumed failed, were empty and contained no sign of egg membranes or eggshell fragments.

NPRA

Abundance and Distribution

During the nesting survey in 2006, 23 Yellow-billed Loons and 8 nests were recorded in the NPRA study area (Figure 7, Table 4). One additional nest was indicated by the observation of a brood in a traditional nest lake in the Fish Creek Delta subarea where a nest was not found in 2006. Most birds and nests were found in the Fish Creek Delta subarea and the number of birds and nests was similar to the number recorded in the subarea in 2005 (Johnson et al. 2006b). A pair of Yellow-billed Loons and a nest was found in the northern part of Alpine West on a lake where nesting had been recorded in previous years (Burgess et al. 2003b; Johnson et al. 2004, 2005). The Fish Creek Delta and Alpine West subareas were the only subareas surveyed for loons in the NPRA study area in 2006.

During brood-rearing in 2006, 15 adult Yellow-billed Loons and 2 broods were observed in the Fish Creek Delta subarea (Figure 7, Table 4). No adults or broods were seen in the Alpine West subarea in 2006.

PACIFIC AND RED-THROATED LOON

Colville Delta

One hundred forty adults and 31 nests of Pacific Loons were counted opportunistically in the Colville Delta study area during the Yellow-billed Loon nesting survey in 2006 (Figure 8, Table 4). Eighteen Red-throated Loons were seen during that survey. During the brood-rearing survey in 2006, 75 adult Pacific Loons and 14 broods were observed in the Colville Delta study area (Figure 8, Table 4). No Red-throated Loons were seen during that survey. In the CD-3 search area, 7 additional Pacific Loon and 7 additional Red-throated Loon nests were found during ground searches conducted as part of another study (Figure 8; see Johnson et al., 2007). One Red-throated Loon brood was found during ground searches in July. Opportunistic counts of Pacific and Red-throated loons reflect their general distribution on the Colville Delta but are not indicative of the relative abundance of these species (due to differences in species detectability). Nests of Red-throated Loons are not easily detected from the air. Because the survey focused on lakes larger than those typically occupied by Pacific and Red-throated loons for nesting and brood-rearing, densities have not been calculated for these 2 species. Nonetheless, Pacific Loons were clearly the most abundant loon on the delta in 2006 and in previous years.

NPRA

Pacific Loons also were the most abundant and widespread loon species breeding in the Alpine West and Fish Creek Delta subareas in 2006 (Figure 8, Table 4). During the loon nesting survey in 2006, 113 adult Pacific Loons and 34 nests were found (Table 4). One Red-throated Loon adult was seen during that same survey. During the brood-rearing survey in 2006, 116 adult Pacific Loons (26 broods) and 3 adult Red-throated Loons were counted (Figure 8, Table 4).

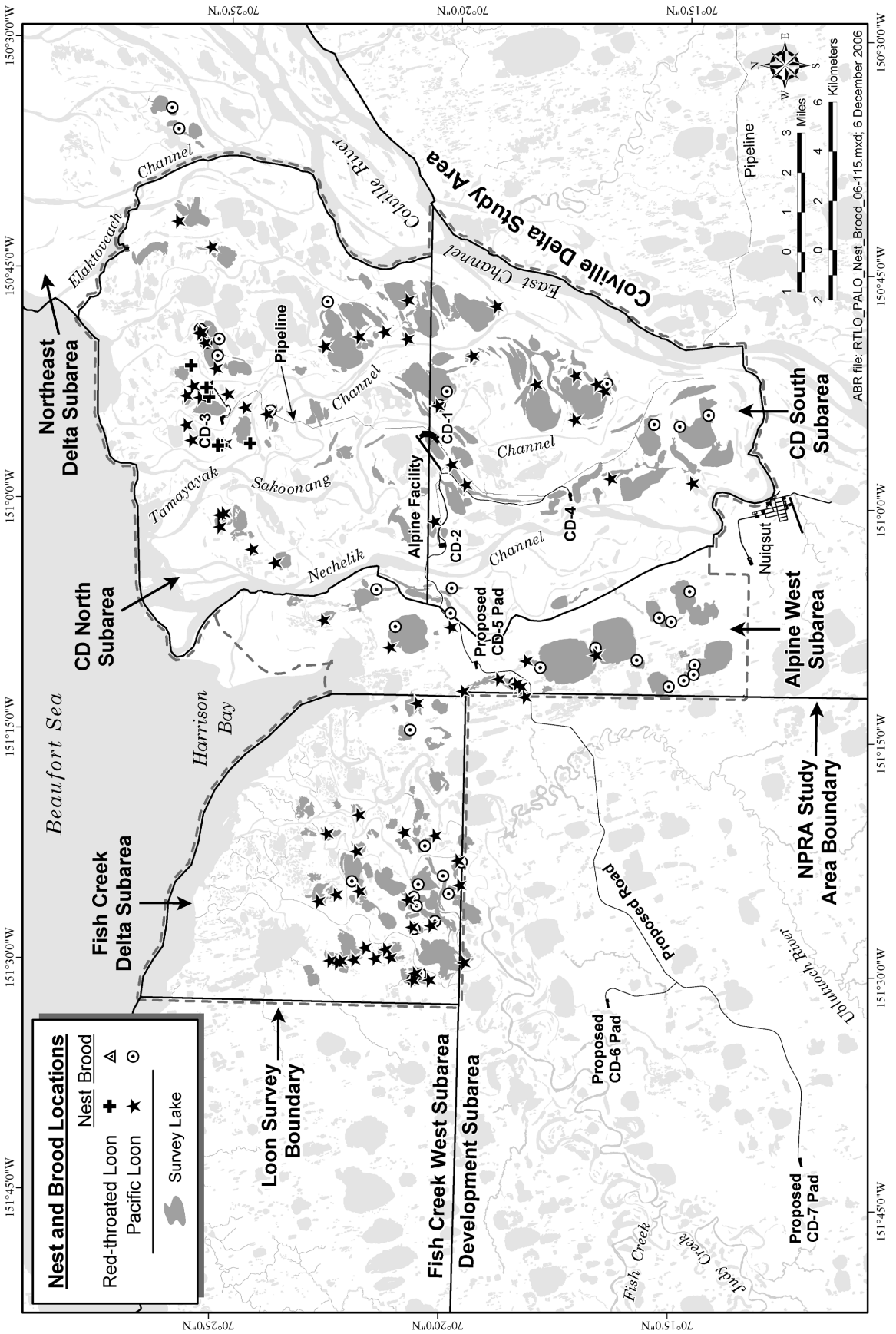

Figure 8. Pacific and Red-throated loon nests and broods, Colville Delta and NPRA study areas, Alaska, 2006.

TUNDRA SWAN

COLVILLE DELTA

During the 2006 nesting aerial survey, 279 swans, including 55 pairs, were counted in the Colville Delta study area. The total number of adults was almost 100 fewer than the 12-year mean of 370; the number of pairs counted was also lower than the 13-year mean of 68. Twenty-nine swan nests were found in the Colville Delta study area in 2006 (Table 6), also less than the long-term mean (34 nests) for the delta. Fourteen nests were in the CD North subarea, 8 were in the CD South subarea, and 7 were in the Northeast Delta subarea. Not included in the aerial swan survey total (Table 6) were 20 additional swan nests (all swan nests are shown in Figure 9) discovered during helicopter-based loon surveys or during ground-searches in the CD-3 search area conducted for another study (Johnson et al., 2007).

The 35 Tundra Swan broods counted across the entire Colville Delta study area was the third-highest brood count since aerial Tundra Swan surveys were initiated on the Colville Delta in 1992. Apparent nesting success was over 100%, because more broods than nests were counted (Table 6). The mean brood size of 2.0 in 2006 was less than the 13-year mean of 2.5 young/brood; however, the total of 69 young counted on the delta has been exceeded in only 4 years since 1992. The mean number of young observed over the 13 years of surveys is 64.

NPRA

In 2006, 336 swans, including 127 pairs, were counted during the aerial survey of the NPRA study area (Figure 9). Seventy-two Tundra Swan nests were found during the survey (Table 6), and an additional 18 nests were found during helicopter-based surveys for nesting Yellow-billed Loons. Swan nesting density in the NPRA study area in 2006 (0.05 nests/km²) was higher than the 18-year mean density in the Kuparuk Oilfield (0.04 nests/km²; Anderson et al. 2006) and less than the

Table 6. Number and density of Tundra Swan nests and broods during aerial surveys, Colville Delta and NPRA study areas, Alaska, 2006.

STUDY AREA Subarea	Nests		Apparent Nesting Success [a] (%)	Broods		Mean Brood Size
	Number	Density (nests/km²)		Number	Density (broods/km²)	
COLVILLE DELTA [b]						
CD North	14	0.07	114	16	0.08	2.0
CD South	8	0.05	100	8	0.05	2.3
Northeast Delta	7	0.04	157	11	0.06	2.0
Total (subareas combined)	29	0.06	121	35	0.07	2.0
NPRA [c]						
Development	36	0.06	47	17	0.03	2.1
Alpine West	5	0.06	40	2	0.03	3.0
Fish Creek Delta	4	0.03	150	6	0.05	3.5
Fish Creek West	16	0.05	88	14	0.04	1.6
Exploration	11	0.03	100	11	0.03	1.8
Total (subareas combined)	72	0.05	69	50	0.03	2.1

[a] Apparent nesting success = (broods / nests) × 100

[b] CD North subarea = 206.7 km², CD South subarea = 155.9 km², Northeast Delta subarea = 189.6 km², and Colville Delta study area (subareas combined) = 552.2 km²

[c] Development subarea = 615.8 km², Alpine West subarea =79.7 km², Fish Creek Delta subarea = 130.5 km², Fish Creek West subarea =340.4 km², Exploration subarea = 404.7 km², NPRA study area (subareas combined) = 1,571.1 km²

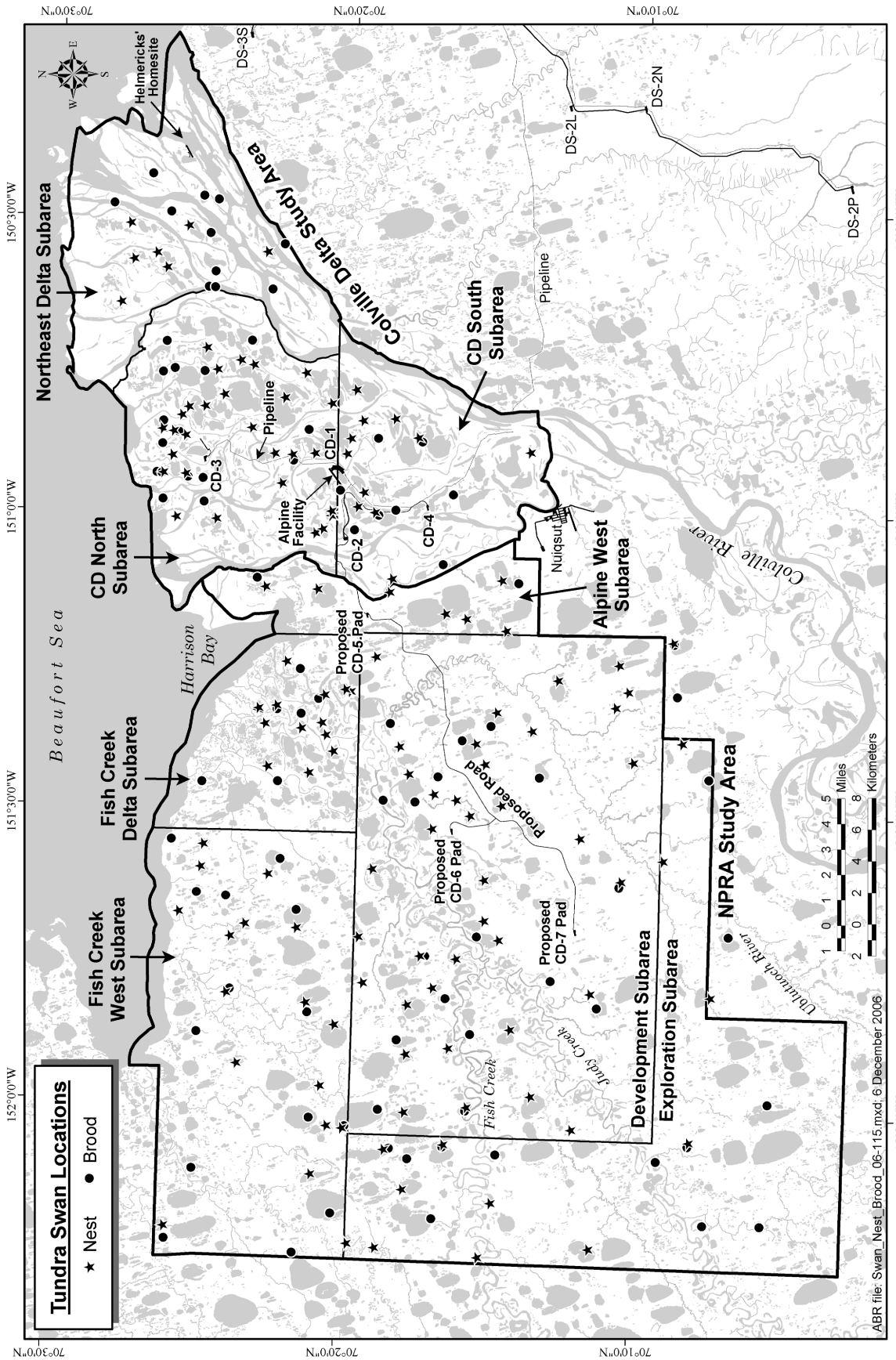

Figure 9. Tundra Swan nests and broods, Colville Delta and NPRA study areas, Alaska, 2006.

13-year mean density (0.06 nests/km²) in the Colville Delta study area.

Fifty Tundra Swan broods were observed in the NPRA study area in 2006 (Figure 9, Table 6). The mean brood size in the NPRA study area in 2006 was 2.1 young (Table 6). Apparent nesting success was 69% (50 broods/72 nests). Comparable brood-rearing surveys in the Kuparuk Oilfield resulted in apparent nesting success of 89% (Anderson et al. 2006).

BRANT AND SNOW GOOSE

COLVILLE DELTA

During the aerial survey in 2006, we counted 438 Brant (296 adults and 142 young) in 4 groups in the Colville Delta study area (Table 7, Figure 10). All Brant groups except one included broods, and goslings comprised 32% of the total number of birds. All Brant brood-rearing groups were located in the CD North subarea, and none were located in the Northeast Delta subarea. The total count was the second lowest recorded along the same survey route in the Colville Delta study area among the years 1988, 1990–1993, 1995, and 2005 (range = 45–3,847 Brant; Bayha et al. 1992, Johnson et al. 1999a, Johnson et al. 2006b), when the same methodology was used.

In 2006, 997 Snow Geese (421 adults and 576 young) in 9 brood-rearing groups were counted in the Colville Delta study area (Figure 10, Table 7). The previous high counts were 972 Snow Geese in 2005 and 97 in 1998 (Johnson et al. 1999a, Johnson et al. 2006b). All Snow Goose groups contained broods, and goslings comprised 58% of the total number of birds. Seven groups were located in the CD North subarea (760 total birds), and 2 were located in the Northeast Delta subarea (237 total birds).

Table 7. Numbers of Brant and Snow Goose adults and young during brood-rearing aerial surveys, Colville Delta and NPRA study areas, Alaska, 2006.

SPECIES Study Area Subarea	Total Birds	Adults	Young	% Young	No. of Groups
BRANT					
Colville Delta [a]					
CD North	438	296	142	32	4
NPRA [b]					
Fish Creek Delta	2,235	1,350	885	40	17
SNOW GEESE					
Colville Delta [a]					
CD North	760	321	439	58	7
Northeast Delta	237	100	137	58	2
Total (subareas combined)	997	421	576	58	9
NPRA [b]					
Fish Creek Delta	662	250	412	62	8
Fish Creek West	51	20	31	61	1
Total (subareas combined)	713	270	443	62	9

[a] Only the CD North and Northeast Delta subareas were surveyed
[b] Only the Fish Creek Delta, Fish Creek West, and Alpine West subareas were surveyed, but no Brant or Snow Geese were observed in the Alpine West subarea

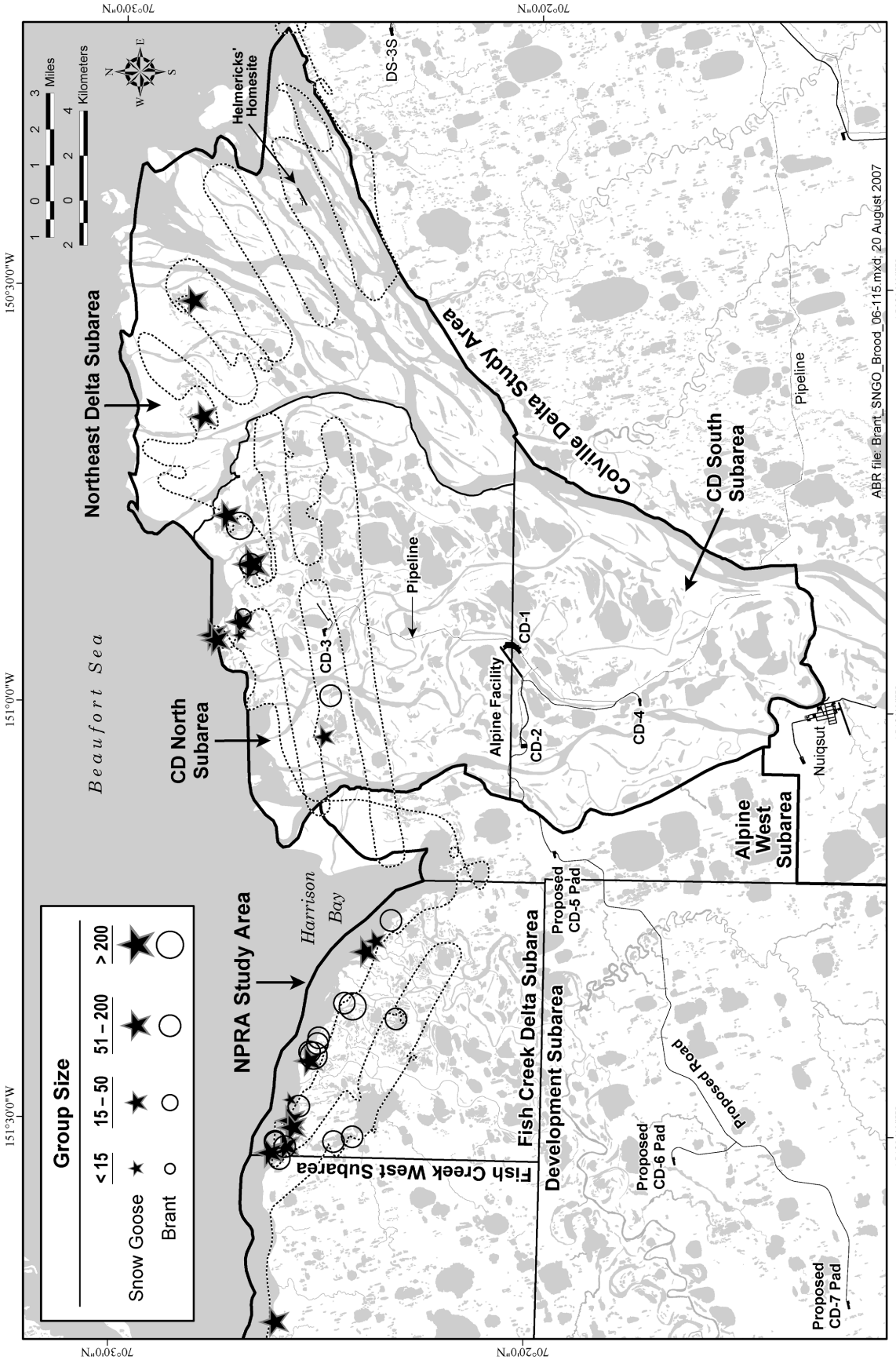

Figure 10. Brant and Snow Goose brood-rearing and molting groups, Colville and NPRA study areas, Alaska, 2006.

NPRA

During the aerial survey of the NPRA study area in 2006, we counted 2,235 Brant (1,350 adults and 885 young) in 17 groups (Figure 10, Table 7). All Brant groups except one included broods, and goslings comprised 40% of the total birds. All Brant brood-rearing groups were located in the Fish Creek Delta subarea, and no groups were located in the Fish Creek West subarea.

In 2006, 713 Snow Geese (270 adults and 443 young) were counted in the NPRA study area, in 9 brood-rearing groups. Eight groups were located in the Fish Creek Delta subarea (662 total birds), and 1 was located in the Fish Creek West subarea (51 total birds; Figure 10, Table 7). Goslings comprised 62% of the total number of birds.

GLAUCOUS AND SABINE'S GULL

COLVILLE DELTA

Forty-two Glaucous Gull nests were counted in the Colville Delta study area during aerial surveys for Yellow-billed Loons in 2006 (Table 8, Figure 11). Counts have ranged from 18 to 46 nests during 8 years of surveys (Burgess et al. 2003a, Johnson et al. 2004, 2005, 2006b). Four of 19 nests in the CD North subarea in 2006 were located together in a colony, where 1–2 nests were observed in 2001–2003, and 7 and 5 nests were recorded in 2004 and 2005, respectively (Johnson et al. 2005, 2006b). Sixteen of 23 nests in the CD South subarea in 2006 were in a colony located ~5 km southeast of the Alpine Facility (Figure 11), where counts have ranged from 10 to 18 nests since that site was first surveyed in 1998 (Johnson et al. 2005, 2006b). Because Glaucous Gulls were counted on aerial surveys designed to survey other species, some nests probably were missed in each year.

Glaucous Gull adults with young were recorded incidentally in 2006 during the aerial survey for brood-rearing loons. Twenty adults and 26 young in a minimum of 13 broods were recorded in the Colville Delta study area, of which 12 adults and 14 young (7 broods) were in the CD North subarea and 8 adults and 12 young (6 broods) were in the CD South subarea (Figure 11). On additional Glaucous Gull brood was found during ground searches in CD-3 during July.

Table 8. Number and density of Glaucous Gull nests, Colville Delta and NPRA study areas, Alaska, 2006.

STUDY AREA Subarea [a]	Number of Nests [b]	Nest Density (nests/km²)
COLVILLE DELTA		
CD North	19	0.09
CD South	23	0.15
CD Northeast [c]	1	–
Total (subareas combined)	42	0.12
NPRA		
Alpine West	17	0.21
Fish Creek Delta	11	0.08
Total (subareas combined)	28	0.13

[a] CD North subarea = 206.7 km², CD South subarea = 155.9 km², Alpine West subarea = 79.7 km², Fish Creek Delta subarea = 130.5 km²; see Figure 3

[b] Data for Colville Delta and NPRA study areas were collected during aerial surveys for nesting Yellow-billed Loons

[c] Densities for Northeast Delta were not calculated because entire area was not surveyed

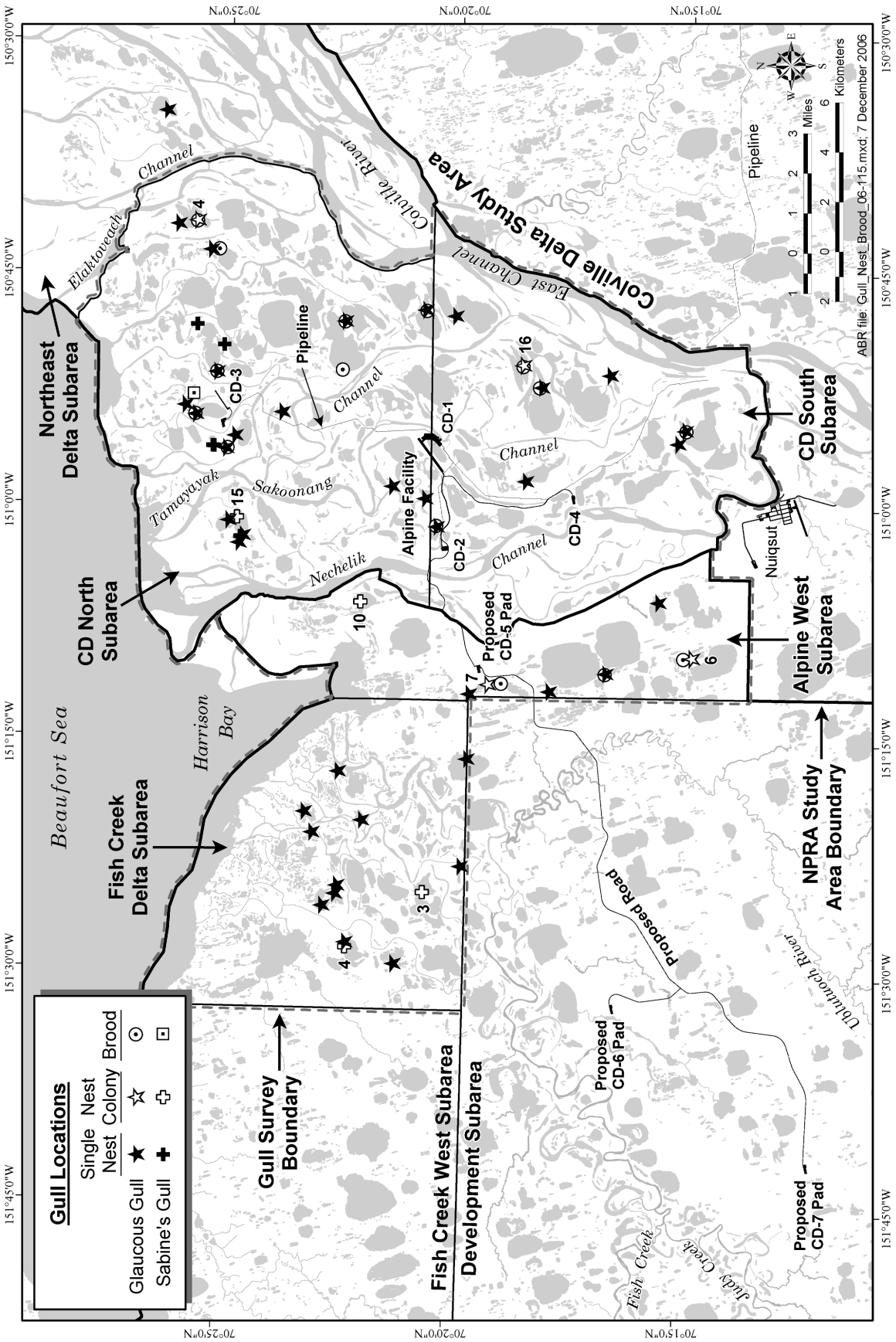

Figure 11. Glaucous and Sabine's gull nests and broods, Colville Delta and NPRA study areas, Alaska, 2006.

Thirty Sabine's Gulls, counted as a minimum of 15 nests, flushed up from a nesting colony in the northwestern part of the Colville Delta study area during the aerial survey for nesting loons. An additional nest was observed about 800 m away. During the CD-3 ground searches, 4 Sabine's Gull nests were found and 1 brood (Figure 11).

NPRA

Twenty-eight Glaucous Gull nests were counted in the Alpine West and Fish Creek Delta subareas during aerial surveys for loons in 2006 (Figure 11, Table 8). The remaining subareas in the NPRA study area were not surveyed for gulls in 2006. Most of the 17 nests in Alpine West were in 2 colonies—1 colony of 6 nests and another of 7 nests (Figure 11). These colonies were active in 2002–2005, when 4–7 nests were found at each location (Burgess et al. 2003b, Johnson et al. 2004, 2005, 2006b). In the Fish Creek Delta subarea, 11 Glaucous Gull nests were observed during the loon survey in 2006 (Figure 11).

Four Glaucous Gull adults and 11 young in a minimum of 5 broods were observed in the Alpine West subarea during the brood-rearing survey in 2006 (Figure 11). No broods were seen in the Fish Creek Delta subarea.

Three small nesting colonies of Sabine's Gulls were found in the Alpine West and Fish Creek Delta subareas during aerial surveys for loons in 2006 (Figure 11). Ten nests were located on an island in a large lake in Alpine West. One colony of 3 nests and another of 4 nests were found in the Fish Creek Delta subarea.

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Appendix A. Common and scientific names of birds and mammals referenced in this report.

COMMON NAME	SCIENTIFIC NAME
BIRDS	
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Brant	*Branta bernicla*
Tundra Swan	*Cygnus columbianus*
Steller's Eider	*Polysticta stelleri*
Spectacled Eider	*Somateria fischeri*
King Eider	*Somateria spectabilis*
Common Eider	*Somateria mollissima*
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Yellow-billed Loon	*Gavia adamsii*
Pectoral Sandpiper	*Calidris melanotos*
Glaucous Gull	*Larus hyperboreus*
Sabine's Gull	*Xema sabini*
Lapland Longspur	*Calcarius lapponicus*
MAMMALS	
Brown (Grizzly) Bear	*Ursus arctos*
Polar Bear	*Ursus maritimus*
Caribou	*Rangifer tarandus*