AVIAN SURVEYS IN THREE EXPLORATION AREAS IN THE COLVILLE RIVER DELTA REGION, ALASKA, 2001

FINAL REPORT

Prepared for

PHILLIPS Alaska, Inc.
P.O. Box 100360
Anchorage, Alaska 99510

Prepared by

Charles B. Johnson

ABR, Inc.
P.O. Box 80410
Fairbanks, Alaska 99708

March 2002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACKNOWLEDGMENTS

This report is the summary of several years of eider and Tundra Swan surveys in the Colville Delta area. Many ABR employees have been involved with the aerial surveys over this time period. Most notably, Jim King, Bob Ritchie, and John Rose have provided long-term consistency over the years and have helped trained others in the conduct of aerial surveys. Other ABR employees who have assisted in these surveys include: Paul Banyas, Debbie Nigro, Brian Lawhead, Louise Smith, Ann Wildman, Julie Peterson, Pat Lovely, and Mike Knoche. Sandy Hamilton of Arctic Air Alaska has kept our surveys on track and always managed the impossible schedule of summer surveys. Jay Martin helped him with these surveys in 2001. Caryn Rea, Environmental Studies Coordinator, PHILLIPS, Alaska, Inc. has guided us through the exploration phase and we are grateful for her diligence and patience. I also thank Allison Zusi-Cobb, Tai Graham, and Will Lentz for their GIS wizardry, and Jennifer Felkay and Alice Stickney for exceptional report preparation.

INTRODUCTION

In September 2001, ABR, Inc. (ABR) was requested to provide information about use by important waterfowl species of 3 new areas in the Colville River area of northern Alaska where PHILLIPS Alaska, Inc. (PHILLIPS) proposes to conduct exploration drilling during the winter of 2001–2002. These proposed exploration areas are Callisto, Ganymede, and Sunrise, and together they are referred to as the Colville exploration areas.

The decision to conduct exploratory drilling in these 3 areas was made after the 2001 breeding season; therefore, surveys were not conducted specifically for these exploration sites. Instead, current and historical data collected for other projects were summarized where available. The primary source of historical data on waterfowl populations in the proposed exploration areas comes from baseline studies conducted by ABR on the Colville Delta (Smith et al. 1993, 1994; Johnson 1995; Johnson et al. 1996, 1997, 1998, 1999, 2000; Burgess et al. 2000), but also in Alpine West (ABR 2001), which overlapped a portion of the Sunrise exploration area.

For 15 years, ABR has been studying the distribution, abundance, and productivity of Spectacled Eiders (*Somateria fischeri*), Tundra Swans (*Cygnus columbianus*), and other waterfowl that breed annually on the Arctic Coastal Plain during summer (see Murphy and Anderson 1993, Stickney et al. 1993, Anderson et al. 2001). As the oilfields have expanded westward into the Colville Delta, these same species have been monitored to determine baseline populations prior to oil exploration activities and any subsequent oilfield development (Smith et al. 1994, Burgess et al. 2000, Johnson et al. 2000). ABR has been conducting avian studies on the Colville Delta since 1992 and began conducting aerial surveys for eiders and Tundra Swans in the National Petroleum Reserve–Alaska (NPRA) in 1999 (Anderson and Johnson 1999, Murphy and Stickney 2000, Johnson and Stickney 2001). Eiders and Tundra Swans were selected as the focus of these surveys, because of their special status (i.e., threatened status for Spectacled and Steller's [*Polysticta stelleri*] eiders) or interest expressed by management agencies (Tundra Swans). The goals of these aerial surveys were to monitor eiders and swans in a broad area spanning potential oil prospects. We had 2 specific objectives for the aerial surveys reported here:

- determine the abundance and distribution of eiders (primarily Spectacled Eider, but also any Steller's and King [*Somateria spectabilis*] eiders present) during pre-nesting;
- locate and count Tundra Swan adults, nests, and broods and determine annual productivity.

BACKGROUND

Although the aerial surveys focused primarily on Spectacled Eiders and Tundra Swans, other tundra-nesting species, such as King and Steller's eiders, also were recorded opportunistically during the field activities. The following section provides an overview of the agency concerns regarding these species and aspects of their life history that are relevant to development planning in the proposed exploration areas.

SPECTACLED EIDER

The Spectacled Eider population in Alaska has declined substantially in recent years, primarily on the Yukon-Kuskokwim Delta, and was listed by the U.S. Fish and Wildlife Service (USFWS) as "threatened" under the Endangered Species Act on 10 June 1993 (58 FR 27474-27480). This special status mandates protection on their breeding grounds in areas of development and in areas of oil exploration. Recent surveys estimate the current size of the northern breeding population of Spectacled Eiders to be at least 6,000–7,000 birds, and the population trend is stable to slightly declining (Larned et al. 2001). These recent estimates also suggest that the Arctic Coastal Plain now supports the main breeding population of Spectacled Eiders in Alaska (USFWS 1996).

Spectacled Eiders are uncommon nesters (i.e., they occur regularly but are not found in all suitable habitats) on Alaska's Arctic Coastal Plain, and tend to concentrate on large river deltas (Johnson and Herter 1989). Their breeding range extends east to Bullen Point and Barter Island, near the western edge of the Arctic National Wildlife Refuge. Derksen et al. (1981) described them as common breeders in the NPRA, but uncommon

east of there at Storkersen Point. Recent studies have shown, however, that Spectacled Eiders also are relatively frequent breeders in the Prudhoe Bay and Kuparuk oilfields and on the Colville River Delta, although they do not use all the habitat available (TERA 1996, Johnson et al. 2000, Anderson et al. 2001).

Spectacled Eiders arrive on the coastal plain in late May and initiate nests by mid-June (Warnock and Troy 1992, Anderson and Cooper 1994). Males do not participate in incubation or rearing of young and leave the area by late June. Eggs begin hatching in mid-July, and brood-rearing continues until late August or early September, when the young can fly. Spectacled Eider broods have been seen in the Prudhoe Bay area until late August (TERA 1996). No data are available on departure dates from the Arctic Coastal Plain, but most birds probably leave by mid-September, when lakes and ponds begin to freeze. Pre-nesting habitats used by Spectacled Eiders vary somewhat among areas, but observations suggest that eiders primarily use open water, including both flooded tundra and permanent waterbodies, as well as salt-affected habitats, particularly on the Colville Delta (Anderson et al. 1997, Johnson et al. 2000). Nesting Spectacled Eiders also use a variety of habitats including Aquatic Sedge Marsh, Aquatic Sedge with Deep Polygons, Wet Sedge–Willow Meadow, Salt-killed Tundra, Brackish Water, Basin Wetland Complexes, and Nonpatterned Wet Meadow (Johnson et al. 2000, Anderson et al. 2001).

STELLER'S EIDER

The Alaska breeding population of Steller's Eider was listed as threatened in 1997 (62 FR 31748) because it had declined substantially in recent years (Kertell 1991, Quakenbush and Cochrane 1993). Steller's Eiders have essentially disappeared from the Yukon-Kuskokwim Delta, and the breeding range has contracted elsewhere in Alaska, likely contributing to the overall population decline. On the Arctic Coastal Plain, Steller's Eiders historically nested across most or all of the coastal plain (Kertell 1991, Quakenbush and Cochrane 1993), but currently, they nest primarily around Barrow, although the total breeding range probably extends from Point Lay to near the Colville River Delta (Day et al. 1995; Quakenbush et al. 1995). The Steller's Eider has been recorded periodically in the Prudhoe Bay, Kuparuk, and Colville River Delta areas (USFWS 1998, ABR unpubl. data).

In arctic Alaska, breeding Steller's Eiders nest and raise broods in areas dominated by low-centered polygons and shallow ponds with emergent grasses and sedges, flooded tundra (i.e., wet meadows), lakes, and drained lake basins; presence of emergent plants seems to be important during brood-rearing (Quakenbush and Cochrane 1993). In the Barrow area, waterbodies with pendant grass (*Arctophila fulva*) received considerable use (greater than their availability) during the pre-nesting, nesting, and brood-rearing periods (Quakenbush et al. 1995). Timing of breeding activities for Steller's Eiders is similar to that of other eiders.

KING EIDER

Although King Eiders are not listed as threatened in Alaska, their breeding population does appear to be declining at the eastern edges of their breeding range (primarily in western Canada) (Dickson et al. 1997). King Eiders nest in high densities in the Prudhoe Bay area (Troy 1988) and at Storkersen Point (Bergman et al. 1977). In the late 1970s, Derksen et al. (1981) suggested that King Eider densities appeared to decline west of the Colville River, but BLM (1998) reported that some of the highest densities of King Eiders on the coastal plain occur in the NPRA planning area. On the Colville Delta, they are common visitors but uncommon or rare nesters (Simpson et al. 1982, North et al. 1984, Johnson 1995). Nesting phenology is similar to that of the Spectacled Eider, but King Eiders tend to nest in drier tundra habitats farther from waterbodies (Anderson et al. 2001).

TUNDRA SWAN

Tundra Swans are common breeders across the Arctic Coastal Plain of Alaska, and because they are sensitive to human disturbance, they have been used as indicators of the general ecosystem health within the region (Anderson et al. 2001). Breeding pairs of Tundra Swans mate for life and defend a nesting territory to which they return annually. Because of their fidelity to nesting territories, changes in the distribution and

abundance of swans can be used as a measure of the effects of development projects on waterbird populations (King 1973, Ritchie et al. 1990).

Swans begin arriving on the Arctic Coastal Plain while the ground is mostly snow-covered (late-May), and as snow melt progresses, breeding pairs move to territories and begin nesting by early June. After eggs hatch in early July, the family groups remain together during brood-rearing, although they may range widely to find suitable foraging habitat (Johnson and Herter 1989). While the young are flightless, adults molt their flight feathers and become flightless for about 3 weeks. This flightless period is the time when swans are most vulnerable to predators and when broods are sensitive to disturbance. Although brood-rearing swans remain in single family flocks until departure in fall, nonbreeding swans may form large staging flocks of up to several hundred birds during September (Rothe et al. 1983, Smith et al. 1994, Johnson et al. 1998). The young are ready to fledge by mid-to-late September, and fall migration peaks along the Beaufort Sea coast in late September and early October (Johnson and Herter 1989).

STUDY AREA

The 3 exploration areas on and adjacent to the Colville Delta—Callisto, Ganymede, and Sunrise—respectively encompassed 3 proposed exploration well sites (i.e., drilling locations) scheduled for drilling in winter 2001–2002: Callisto 1, Ganymede 1, and Sunrise 3 (Figure 1). We delineated the exploration areas so that generally they contained a minimum 1.6-km buffer around each proposed well site. The combined survey areas contain 82 km². The Callisto exploration area (30.7 km²) is located on the Colville River Delta (hereafter, Colville Delta or the delta). The Callisto 1 well site is ~11 km south of the Alpine airstrip and ~3 km northeast of the Iñupiaq village of Nuiqsut (Figure 1). Both the Ganymede (28.5 km²) and Sunrise (22.9 km²) exploration areas are in the National Petroleum Reserve–Alaska (NPRA) west of the Colville Delta. The Ganymede 1 well site is ~4 km northwest of Nuiqsut, and the Sunrise 3 well site is ~10 km northwest of Nuiqsut.

Landforms, vegetation, and wildlife habitats are similar to those of the Colville Delta and the Alpine Transportation Corridor (Jorgenson et al. 1997, Johnson et al. 1998, Burgess et al. 2000). The delta contains 2 primary channels, which transport 90% of the water during normal flows (Walker 1983). Delta landforms are primarily influenced by marine and riverine processes and are characterized by numerous lakes and ponds, channels, sandbars, mudflats, sand dunes, and low- and high-centered polygons. The Colville delta contains more waterbodies and a greater diversity of water habitats—Brackish Water, Open Water (Deep and Shallow lakes), Tapped Lakes (with Low-water and High Water connections), and River or Stream than do adjacent areas off the delta. Outside the delta, landforms are influenced by the predominately northeastern winds during summer, which produce oriented thaw lakes on the coastal plain (Walker et al 1980, Jorgenson et al. 1997). Habitats included Open Water (Deep and Shallow lakes), River or Stream, Aquatic Marshes (Sedge [*Carex*] and Grass [*Arctophila*]), wet meadow tundra (Nonpatterned and Wet Sedge–Willow), moist meadow tundra (Moist Sedge–Shrub and Moist Tussock Tundra) and Basin Wetland Complexes (Johnson et al. 1997).

The climate of the Colville exploration areas is typical of other coastal areas in the Arctic. Winters are cold and summers are cool; the thaw period lasts only about 90 days during summer (1 June–31 August) and the average summer air temperature is 5° C (43° F; Kuparuk Oilfield records: National Oceanic and Atmospheric Administration, unpubl. data). Average summer precipitation is under 7.5 cm (3 in), most of which falls as rain in August. The soils are cold and underlain by permafrost, and temperature of the active layer of thawed soil above permafrost ranges from 0–10° C (32–50° F) during the growing season.

METHODS

Historical data for the waterfowl species discussed in this report were compiled from aerial surveys flown for avian studies on the Colville Delta between 1992 and 2001 (Smith et al. 1993, 1994; Johnson 1995; Johnson et al. 1996, 1997, 1998, 1999, 2000; Burgess et al. 2000; ABR, Inc.,

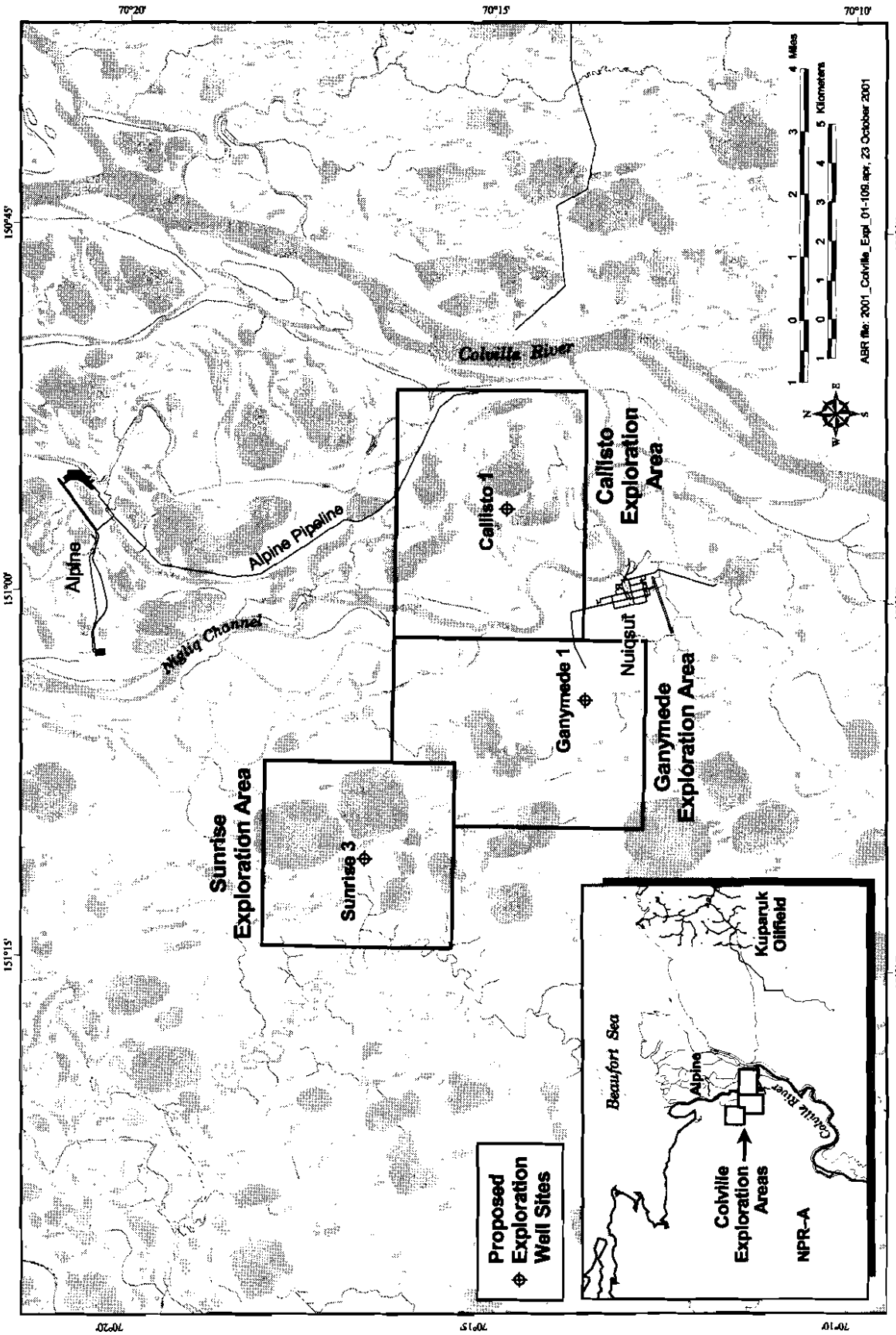

Figure 1. The Callisto, Ganymede, and Sunrise exploration areas on the Arctic Coastal Plain of Alaska, 2001.

unpubl. data) and aerial and ground surveys conducted in Alpine West (ABR 2001). Because no surveys were flown specifically for the 3 exploration areas, survey coverage of the areas was sometimes incomplete.

EIDERS

Aerial surveys were conducted for pre-nesting eiders on the Colville Delta, typically between 10 and 20 June every year since 1992, excluding 1999 (Smith et al. 1994, Burgess et al. 2000, Johnson et al. 2000). In 1992, 6 plots were surveyed (Smith et al. 1993), none of which overlapped with the 3 exploration areas. In 1993, the survey area extended west of the Colville Delta encompassing all of the Callisto, Ganymede, and ~67% of the Sunrise exploration areas (Figure 2, Appendix A). In 1994 and 2000, the eider surveys stopped north of the Callisto area boundary, so none of the exploration areas were surveyed those years except a small corner of Sunrise in 2000. Survey boundaries in other years (1995–1998, 2001) generally followed the outermost channels of the Colville River, but the southern boundary varied among years (Figure 2). The Callisto area was surveyed almost entirely in 1996–1998, except for the southwest corner that was off the delta (Appendix A). In 1995 and 2001, only the northern portions of Callisto were surveyed for eiders (Figure 2). The Ganymede area was surveyed entirely in 1993, but only the northeast corner of Ganymede was surveyed in 1995–1998 and 2001. A corner of Sunrise was surveyed in 1995–1998, 2000, and 2001, but that area represented <1% of the Sunrise exploration area (Figure 2).

During the pre-nesting aerial surveys, the pilot navigated a Cessna 185 aircraft along east–west transect lines using a global positioning system (GPS) receiver and topographic maps. An observer on each side of the aircraft counted eiders in fixed-width strips (200 m on each side of the aircraft) along transect lines that were spaced 400 m (~0.25 mi) apart for 100% coverage. In 1993 only, transects were spaced 800 m (0.5 mi) to achieve 50% coverage (Smith et al. 1994). Marks on the airplane's struts and windows were used to visually delimit the outer edges of the transect strip (Pennycuick and Western 1972). Flight altitude for each survey was 30–50 m above ground level (agl) and flight speed was approximately 145 km/h. For each observation, the species of eider, number of each sex, number of identifiable pairs, transect number, and whether the birds were flying or on the ground were noted on a tape recorder. Each observer also marked their eider locations on 1:63,360-scale USGS maps of the study area. Unadjusted densities (i.e., without a sightability correction factor) for eiders were calculated based on the total area covered during the survey. Total indicated birds were calculated following the procedures of the USFWS survey protocol (Appendix B). All observations were digitized and added to a geographical information system (GIS) database that contained eider observations from aerial surveys since 1992. Observations from all years were summarized for the Colville exploration areas using GIS techniques to identify eider locations in the areas of interest.

In 2000, 2 additional surveys of previously proposed exploration sites in the Alpine West area (ABR, Inc. 2001) overlapped the Sunrise exploration area. An aerial survey was conducted from a helicopter (Bell 206 Long Ranger) on 29 June, and a ground-based search for nests was conducted on 30 June. Because the surveys were conducted late in the nesting season after most male eiders had departed the breeding grounds, we could not use these surveys to measure eider abundance in the area. Instead, the objective was to identify as many large nesting birds and their locations as possible and describe the habitat in the area. The aerial survey was conducted with a single observer and pilot flying at 50–70 m agl and at 60–100 km/h. East–west transects 0.8 km apart were flown in part of the area, and a lake-to-lake route was flown over several basin complexes. Ground-based nest searches were conducted with 5 people walking within 10 m of the shorelines of lakes and waterbodies. The proposed well sites in 2000 were located north and east of Sunrise 3, so most of the survey effort was concentrated there. Nest locations were recorded on 1:63,360-scale USGS maps and later transferred to a GIS database.

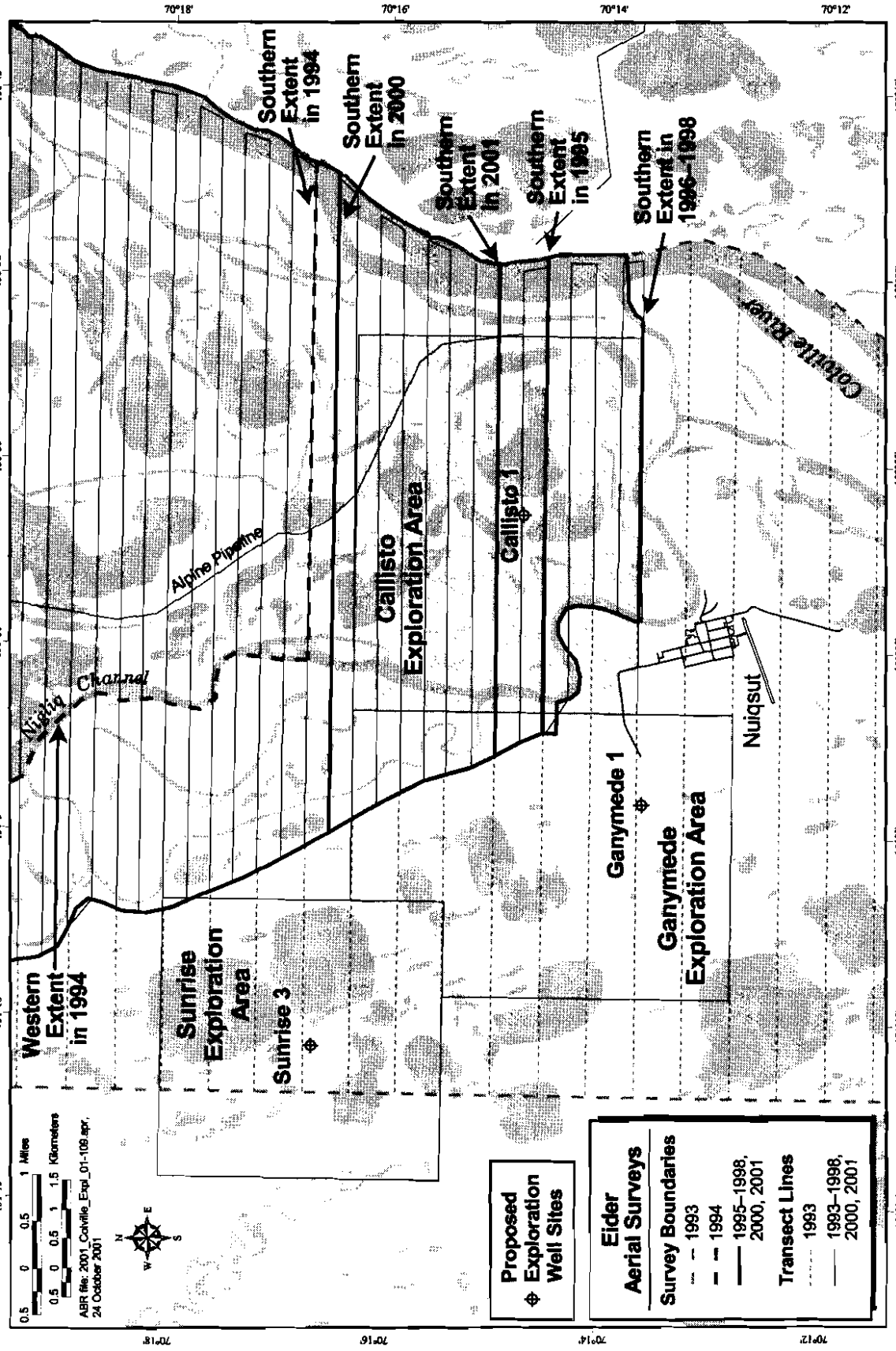

Figure 2. Aerial survey lines for pre-nesting Spectacled Eiders in the Callisto, Ganymede, and Sunrise exploration areas on the Arctic Coastal Plain of Alaska, 1993–1998, 2000, and 2001.

TUNDRA SWANS

In each year since 1992, aerial surveys for Tundra Swans on the Colville Delta (Smith et al. 1994, Burgess et al. 2000, Johnson et al. 2000) have followed the USFWS Tundra Swan Survey Protocol (USFWS 1987b, 1991). In 1993 only, the survey lines extended farther west, covering all of Callisto and Ganymede and ~67% of Sunrise (Figure 3). There were no surveys for Tundra Swans on the delta in 1994 or 1999. With the exception of those years, the entire delta was surveyed from 1992 to 2001, thereby covering all but the southwest corner of Callisto (considered complete coverage for the purposes of density calculation), only the northeast corner of Ganymede (<25% of the area), and virtually none (<1%) of Sunrise (Figure 3).

During the aerial surveys, a Cessna 185 aircraft was flown along fixed-width, east–west transects. Transects were oriented along township and section lines, and all observations were mapped on 1:63,360-scale USGS maps. During the surveys, the aircraft was flown at a speed of 145 km/h and an altitude of 150 m agl. Transects were spaced at 1.6-km (1-mi) intervals and each of the 2 observers scanned a strip 800 m wide on his/her side of the aircraft to achieve 100% coverage, while the pilot navigated and scanned ahead of the aircraft. The age (adult or young) and number (single, pair, flock [flock size]) of swans seen and whether the adults were attending a nest or a brood were recorded on the USGS maps. When observers located a nest, the aircraft left the transect line and circled the nest so that they could plot an accurate location and take photographs with a 35-mm camera of the nest site. During the brood-rearing survey, an identical procedure was used for recording data, but the plane did not circle and photographs were not taken.

The nesting surveys typically were flown between 17 and 26 June and the brood-rearing surveys between 16 and 24 August in each year. After each survey, we entered all location data into digital maps in a GIS system. Summary statistics for nesting surveys followed the format established for the Kuparuk Oilfield in 1988 and modified in 1990 (Ritchie et al. 1989, 1991), which categorized adults as either with nests or broods or without nests or broods. The latter 2 categories include nonbreeding subadults, as well as failed or nonbreeding adults. These individuals will be referred to collectively as "nonbreeders."

RESULTS AND DISCUSSION

EIDER PRE-NESTING SURVEYS

In the 4 years that aerial surveys were conducted over nearly the entire Callisto exploration area (1993, 1996–1998), and the 2 years the northern portions were surveyed (1995 and 2001), no eiders were found during pre-nesting. Similarly, no eiders were seen in the Ganymede exploration area, but it was surveyed only in 1993. Sunrise received the least survey coverage of the 3 exploration areas, yet 2 pairs of King Eiders were seen in the northern portion of that area—1 in 1993 and 1 in 1998 (Figure 4). Although the small number and incomplete coverage of surveys in Ganymede and Sunrise were inadequate to estimate annual use by eiders of these areas, surveys of Callisto were sufficient to determine annual use of that area. The lack of eiders in Callisto is consistent with the low numbers seen in the Colville Delta (CD) South survey area on the southern half of the delta (Burgess et al. 2000). Both Spectacled and King eiders tend to be concentrated near the coast on the Colville Delta, and Spectacled Eiders prefer coastal habitats during pre-nesting (Johnson et al. 2000). The farthest from the coast that Spectacled and King eiders have been recorded on the Colville Delta since 1993 has been 14.3 km and 14.2 km, respectively (Johnson et al. 2000). The 3 Colville exploration well sites range from ~10 km (Sunrise) to ~16 km (Callisto) from the nearest coastline. Therefore, Callisto is near the limit of distance from the coast for eider distribution on the delta. Ganymede and Sunrise, on the other hand, are off the delta and adjacent to PHILLIPS' NPRA exploration area, where Spectacled Eiders have been recorded at low densities (Anderson and Johnson 1999, Murphy and Stickney 2001, Johnson and Stickney 2001). Based on the reported distribution and density of eiders in the adjacent portion of NPRA, we would expect that each of these exploration areas supports small numbers of King Eider nests, and few if any Spectacled Eider nests. Of the latter 2 areas,

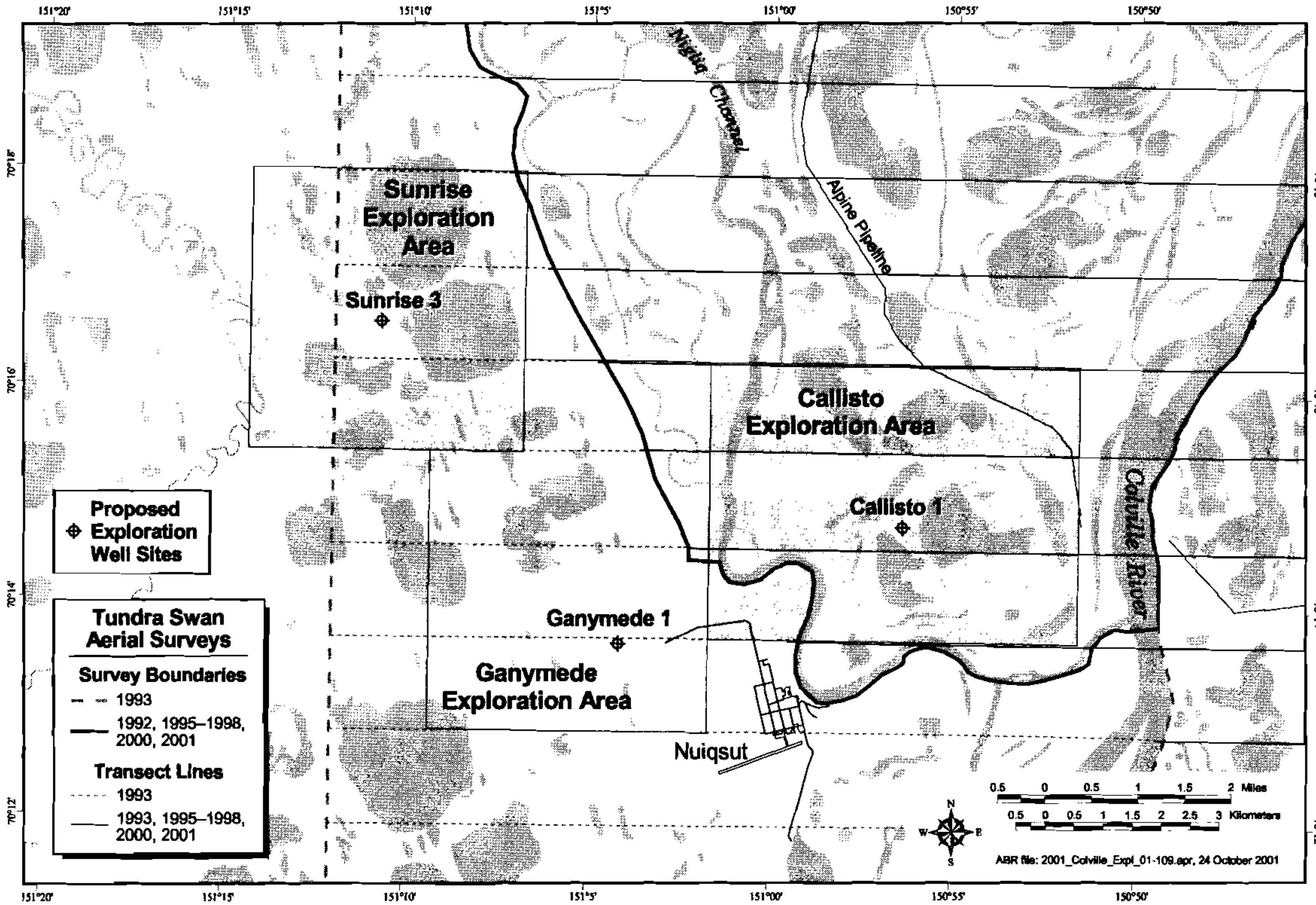

Figure 3. Aerial survey lines for nesting and brood-rearing Tundra Swans in the Callisto, Ganymede, and Sunrise exploration areas on the Arctic Coastal Plain of Alaska, 1992, 1993, 1995–1998, 2000, and 2001.

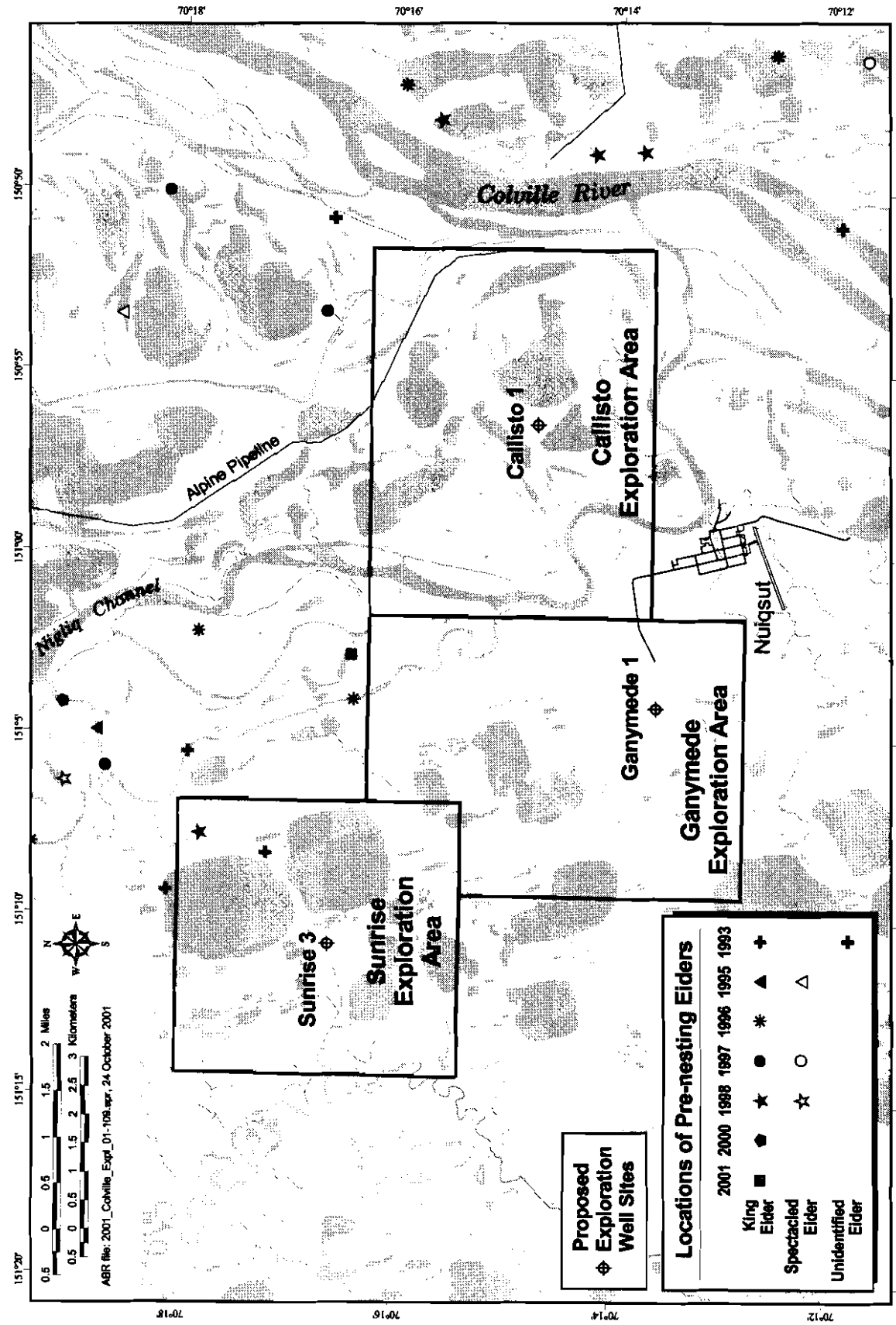

Figure 4. Pre-nesting eider locations recorded on aerial surveys during mid-June in the Callisto, Ganymede, and Sunrise exploration areas on the Arctic Coastal Plain of Alaska, 1993–1998, 2000, and 2001.

Sunrise appears to contain more suitable habitat, in the form of basin complexes and shallow and deep lakes, than does Ganymede, so Sunrise has a higher probability of attracting nesting Spectacled and King eiders.

No Steller's Eiders have ever been recorded during aerial surveys of the Colville Delta or the Colville exploration areas and sightings have been rare. One male was seen flying in the NPRA exploration area during an aerial survey in June 2001 (Johnson and Stickney 2001), and a pair was observed on the ground during the same month on the Colville Delta (Johnson et al., in prep.). In 1995, 5 Steller's Eiders were seen on the outer Colville Delta (J. Bart, Boise State University, pers. comm.). To our knowledge, no Steller's Eider nests have been found on the delta or adjacent to it. Generally, observations of Steller's Eiders are uncommon east of their primary nesting area around Barrow.

NESTING TUNDRA SWANS

In the 8 years for which ABR has been conducting aerial surveys on the Colville Delta, swan nests have been recorded in all but 2 years in the Callisto area (Table 1, Figure 5). The greatest number of nests seen in 1 year was 2 (0.07 nests/km²), and the average was 1 nest/year (0.03 nests/km²). The density of nests in Callisto was half the density on the Colville Delta ($\bar{x}$ = 0.06 nests/km², n = 7; Johnson et al. 2000) and the same as the density in the NPRA exploration area in

Table 1. Numbers of Tundra Swans and nests observed during June on aerial surveys in the Callisto, Ganymede, and Sunrise exploration areas, Colville Delta region, Alaska, 1992–2001. Only years in which surveys occurred are presented for each area. Dashes indicate values that could not be calculated because survey coverage was incomplete.

	Numbers				Density (/km²)[a]	
Area/Year	Nests	Adults with Nests	Adults without Nests	Total Swans	Nests	Swans
Callisto						
1992	1	1	1	2	0.03	0.07
1993	1	1	8	9	0.03	0.29
1995	0	0	3	3	0	0.10
1996	2	3	1	4	0.07	0.13
1997	1	2	14	16	0.03	0.52
1998	1	2	4	6	0.03	0.20
2000	2	3	2	5	0.07	0.16
2001	0	0	49	49	0	1.60
Mean	1	1.5	10.2	11.8	0.03	0.38
Ganymede						
1992[b]	0	0	5	5	–	–
1993	0	0	1	1	0	0.01
1995[b]	0	0	0	0	–	–
1996[b]	0	0	3	3	–	–
1997[b]	0	0	0	0	–	–
1998[b]	0	0	0	0	–	–
2000[b]	0	0	0	0	–	–
2001[b]	1	2	0	2	–	–
Sunrise						
1993[b]	0	0	3	3	–	–

[a] Densities based on 30.7 km² in Callisto, 28.5 km² in Ganymede, and 22.9 km² in Sunrise.
[b] Area incompletely surveyed.

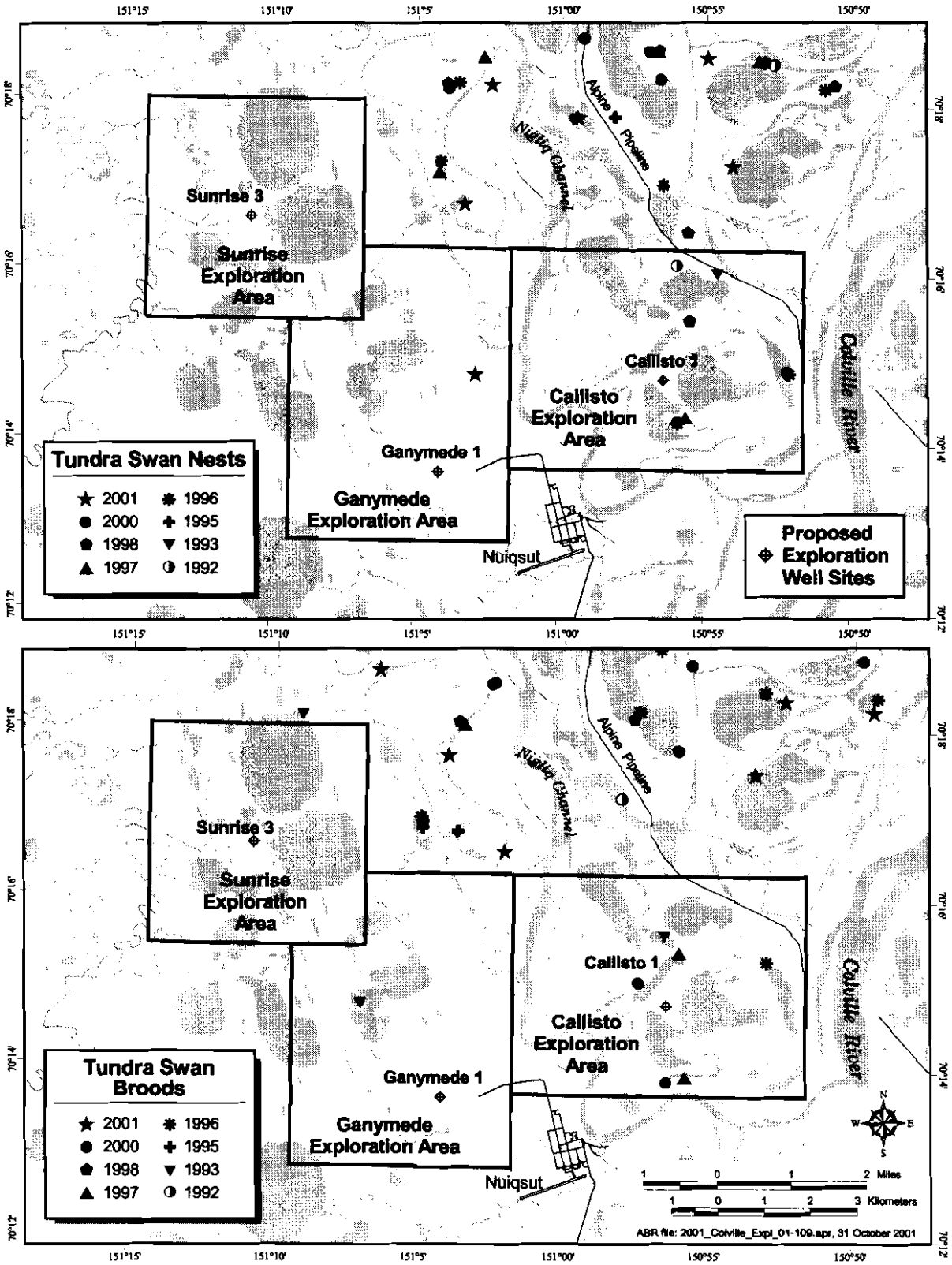

Figure 5. Nest (above) and brood (below) locations recorded on aerial surveys (during late-June and late-August, respectively) in the Callisto, Ganymede, and Sunrise exploration areas on the Arctic Coastal Plain of Alaska, 1992, 1993, 1995–1998, 2000, and 2001.

2001 (Johnson and Stickney 2001). Only 1 nest has been seen in the Ganymede area and that nest was recorded in 2001, although the only year Ganymede was completely surveyed was in 1993. No nests were recorded in Sunrise, which was surveyed partially in 1993.

Swans were recorded on nest surveys in every year that surveys were conducted in Callisto (Table 1). The number of adult swans during aerial nest surveys in Callisto varied from 2 to 49 (0.07–1.6 birds/km²). The numbers of swans in Callisto was inflated by high numbers of non-breeders (Table 1). The average annual density was 0.38 swans/km², which was about twice the density seen in the NPRA exploration area and in the Kuparuk Oilfield (Johnson and Stickney 2001, Anderson et al., in prep.). In Ganymede, only 1 swan was recorded in 1993, the only year the area was completely surveyed, but numbers varied from 0 to 5 during years of partial surveys (Table 1). Sunrise contained 3 swans during a partial survey of the area in 1993. Given the relatively small areas these 3 exploration areas cover, high annual variation in numbers and densities is to be expected. Both Ganymede and Sunrise, on average, probably support similar numbers of Tundra Swans and swan nests as does the adjacent NPRA exploration area, based on similarities in location and habitats among these areas.

TUNDRA SWAN BROODS

Over the 8 years that aerial surveys were conducted for Tundra Swan broods on the Colville Delta, broods were recorded in the Callisto exploration area during half the years (Table 2, Figure 5). Up to 2 broods (0.07 broods/km²) were seen each year for an average of 0.8 broods/year (0.02 broods/km²). The density of broods was identical to that in the nearby NPRA exploration area (Johnson and Stickney 2001) and half the density on the Colville Delta ($\bar{x}$ = 0.04 broods/km², n = 7; Johnson et al. 2000). Only 1 brood (0.01 broods/km²) was recorded in Ganymede, and that was in 1993, the only year that area was completely surveyed. No broods were seen in Sunrise, although 1 brood was seen outside the Sunrise exploration area boundary in 1993 (Figure 5).

Adult swans were recorded on every brood-rearing aerial survey conducted in Callisto (Table 2). The number of adult swans during brood-rearing in Callisto ranged from 1 to 11 (0.03–0.36 swans/km²). The average density of adult swans in Callisto (0.18 swans/km²) was similar to the density recorded in the nearby NPRA exploration area (0.21 swans/km²; Johnson and Stickney 2001). In 1993, 7 adult swans (0.04 swans/km²) were recorded in Ganymede and 7 also were recorded in Sunrise. As with nest numbers, the low brood counts in Ganymede and Sunrise probably are an artifact of few surveys and incomplete coverage; both areas likely support similar densities of broods as does the adjacent NPRA exploration area, which appears to have similar habitat.

OTHER AVIAN SPECIES

A reconnaissance-level survey conducted from a helicopter in the Alpine West area covered the northeast half of the Sunrise exploration area on 29 June 2000 (Figure 6; ABR, Inc. 2001). A ground search for nests was conducted on 30 June in 2 areas outside the Sunrise area. These 2 surveys were conducted late in the nesting season after male Spectacled Eiders normally depart nesting areas, so breeding pairs of eiders could not be tallied and some nests of large waterbirds probably had been abandoned already or taken by predators. Nonetheless, these 2 surveys provide some insight into what species use the vicinity of Sunrise and Ganymede. The aerial survey recorded 6 species of bird nests—Pacific Loon (6 nests), Canada Goose (6 nests), Tundra Swan (4 nests), Glaucous Gull (4 nests), Sabine's Gull (1 nest), and Arctic Tern (1 nest). All 6 species occurred within the Sunrise exploration area (Figure 6). During ground-based nest searching, 1 King Eider nest was found, but the most abundant nests belonged to Greater White-fronted Geese (8 nests) and Canada Geese (4 nests). The richest areas for nests were wetland complexes, of which there are several. One crescent-shaped wetland complex north of Sunrise that contained 1 Brant nest and 3 Canada Goose nests in 2001 (Figure 6) also contained 5 Brant nests in 1995, 10 Canada Goose nests in 1996, and 2 Brant nests in 1998 (Johnson et al. 1999).

Table 2. Numbers of Tundra Swans, broods, and young observed during August on aerial surveys in the Callisto, Ganymede, and Sunrise exploration areas, Colville Delta region, Alaska, 1992–2001. Only years in which surveys occurred are presented for each area. Dashes indicate values that could not be calculated because survey coverage was incomplete.

	Numbers							Density (/km²)[a]	
Area/Year	Broods	Adults with Broods	Young	Mean Brood Size	Adults without Broods	Total Adults	Total Swans	Broods	Adult Swans
Callisto									
1992	0	0	0	–	1	1	1	0	0.03
1993	1	2	3	3	9	11	14	0.03	0.36
1995	0	0	0	–	6	6	6	0	0.20
1996	1	2	1	1	0	2	3	0.03	0.07
1997	2	3	5	2.5	3	6	11	0.07	0.20
1998	0	0	0	–	3	3	3	0	0.10
2000	2	4	3	1.5	0	4	7	0.07	0.13
2001	0	0	0		11	11	11	0	0.36
Mean	0.8	1.4	1.5	2.0	4.1	5.5	7.0	0.02	0.18
Ganymede									
1992[b]	0	0	0	–	0	0	0	–	–
1993	1	2	4	4	1	3	7	0.04	0.11
1995[b]	0	0	0	–	0	0	0	–	–
1996[b]	0	0	0	–	0	0	0	–	–
1997[b]	0	0	0	–	0	0	0	–	–
1998[b]	0	0	0	–	3	3	3	–	–
2000[b]	0	0	0	–	0	0	0	–	–
2001[b]	0	0	0	–	0	0	0	–	–
Sunrise									
1993[b]	0	0	0	–	7	7	7	–	–

[a] Densities based on 30.7 km² in Callisto, 28.5 km² in Ganymede, and 22.9 km² in Sunrise.
[b] Area incompletely surveyed.

SUMMARY AND CONCLUSIONS

The Colville exploration areas in 2001 comprised 3 separate exploration areas, of which only 1 was surveyed more than once completely. The Callisto exploration area was surveyed completely for eiders during 4 years and for swans during 8 years. The Ganymede exploration area was surveyed completely for eiders and swans in 1993, and a major portion of the Sunrise exploration area was surveyed in 1993 but not in any other year.

No Spectacled Eiders were seen in any of the exploration areas. The only eiders recorded on aerial surveys were 2 pairs of King Eiders in the Sunrise area. One King Eider nest was found during 2000 in a wetland basin immediately north of Sunrise, which suggests that the exploration areas are suitable habitat for nesting eiders. However, the low numbers of eiders in the NPRA exploration area, which is immediately west of Sunrise and Ganymede, and the similarity of habitats between these 3 areas suggests that Spectacled Eiders probably are less abundant than King Eiders and that neither species is abundant in Sunrise and Ganymede. The Callisto area is on the southern edge of the distribution of Spectacled Eiders recorded over 8 years of surveys on the Colville Delta and probably supports few if any eiders.

Tundra Swan nest and brood densities in the Callisto exploration area were half the densities recorded on the Colville Delta and the same as the

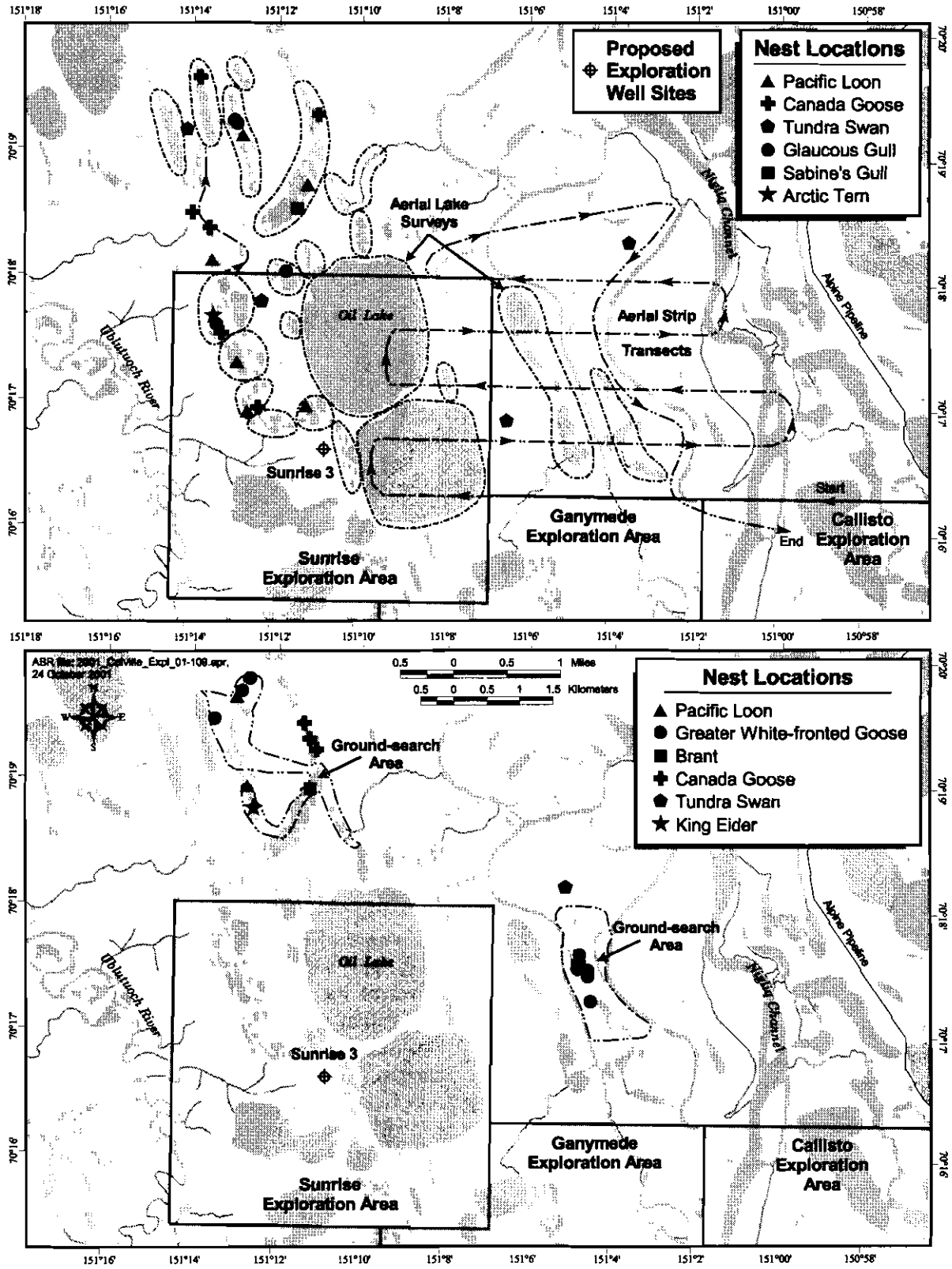

Figure 6. Nest locations of large waterbirds recorded on a helicopter survey (above) on 29 June and ground-based nest searches (below) on 30 June in the Alpine West area, Arctic Coastal Plain of Alaska, 2000. Data from ABR, Inc. 2001.

density recorded in the NPRA exploration area. Although too few surveys were conducted in Ganymede and Sunrise to make firm conclusions, we suspect that nest and brood densities in these 2 exploration areas are the same as in NPRA, on average, because the 2 areas are adjacent to the NPRA survey area and the habitat suitability in all 3 areas appears to be similar.

All 3 exploration areas are used by waterfowl and other waterbirds for nesting and brood-rearing. Although moderate densities of birds use these areas during the summer breeding season, exploration drilling is scheduled for the winter of 2001–2002, when the breeding species considered in this report are elsewhere on their wintering areas. The exploration schedule and the reliance on ice roads and ice pads to support exploration activities should reduce any potential impacts from exploration to seasonal effects that should not disrupt use of the area by breeding birds.

LITERATURE CITED

ABR, Inc. 2001. Avian surveys of the Alpine West region, 2000. Final rep. prepared for PHILLIPS Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 6 pp.

Anderson, B. A., and B. A. Cooper. 1994. Distribution and abundance of Spectacled Eiders in the Kuparuk and Milne Point oilfields, Alaska, 1993. Final report prepared for ARCO Alaska, Inc., and the Kuparuk River Unit, Anchorage, by Alaska Biological Research, Inc., Fairbanks, AK. 71 pp.

Anderson, B. A. and C. B. Johnson. 1999. Baseline avian surveys in 4 lease blocks within the National Petroleum Reserve–Alaska, 1999. Final report prepared for ARCO Alaska, Inc. by ABR, Inc., Fairbanks, AK. 18 pp.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, and A. M. Wildman. 2001. Avian studies in the Kuparuk Oilfield, Alaska, 2000. Final rep. prepared for PHILLIPS Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK. 88 pp.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, and A. M. Wildman. In prep. Avian studies in the Kuparuk Oilfield, Alaska, 2001. Draft report prepared for PHILLIPS Alaska, Inc., and the Kuparuk River Unit, Anchorage, AK, by ABR, Inc., Fairbanks, AK. 120 pp.

Anderson, B. A., A. A. Stickney, and R. J. Ritchie. 1997. Avian studies in the Kuparuk Oilfield, Alaska, 1996. Final report prepared for ARCO Alaska, Inc., and the Kuparuk River Unit, Anchorage, by ABR, Inc., Fairbanks, AK. 70 pp.

Bergman, R. D., R. L. Howard, K. F. Abraham, and M. W. Weller. 1977. Waterbirds and their wetland resources in relation to oil development at Storkersen Point, Alaska. U.S. Fish and Wildlife Service Resource Publication. No. 129. 38 pp.

Bureau of Land Management (BLM). 1998. Northeast National Petroleum Reserve–Alaska: Final Integrated Activity Plan / Environmental Impact Statement. Vol. 1. U.S. Dep. Interior, Bureau of Land Management and Minerals Management Service, Anchorage, AK.

Burgess, R. M., C. B. Johnson, B. E. Lawhead, A. M. Wildman, A. A. Stickney, and J. R. Rose. 2000. CD South Wildlife Studies, 2000. Final report prepared for PHILLIPS Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks, AK. 84 pp.

Day, R. H., R. J. Ritchie, and D. A. Flint. 1995. Spectacled and Steller's eider surveys at remote Air Force sites in Alaska, 1994. Unpublished report prepared for EA Engineering, Science, and Technology, Redmond, WA, and The United States Air Force, Elmendorf AFB, AK by ABR, Inc., Fairbanks, AK. 81 pp.

Derksen, D. V., T. C. Rothe, and W. D. Eldridge. 1981. Use of wetland habitats by birds in the National Petroleum Reserve–Alaska. U.S. Fish and Wildlife Service Resource Publication No. 141. 25 pp.

Dickson, D. L., R. C. Cotter, J. E. Hines, and M. F. Kay. 1997. Distribution and abundance of King Eiders in the western Canadian Arctic. Pages 29–39 in Dickson, D. L. (ed.). King and Common Eiders of the western Canadian Arctic. Environment Canada, Canadian Wildlife Service, Ottawa. Occasional Paper No. 94.

Johnson, C. B. 1995. Abundance and distribution of eiders on the Colville River Delta, Alaska, 1994. Final report prepared for ARCO Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks, AK. 12 pp.

Johnson, C. B. and A. A. Stickney. 2001. Avian surveys for Exploration sites within the National Petroleum Reserve–Alaska, 2001. Final report prepared for PHILLIPS Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 16 pp.

Johnson, C. B., R. M. Burgess, B. E. Lawhead, J. R. Rose, P. E. Seiser, A. A. Stickney, and A. M. Wildman. In prep. Wildlife studies in the CD North study area, 2001. Draft report prepared for PHILLIPS Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK.

Johnson, C. B., R. M. Burgess, B. E. Lawhead, J. R. Rose, A. A. Stickney, and A. M. Wildman. 2000. Wildlife studies in the CD North study area, 2000. Final report prepared for PHILLIPS Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 96 pp.

Johnson, C. B., M. T. Jorgenson, R. M. Burgess, B. E. Lawhead, J. R. Rose, and A. A. Stickney. 1996. Wildlife studies on the Colville River Delta, Alaska, 1995. Fourth annual report prepared for ARCO Alaska, Inc., Anchorage, and Kuukpik Unit Owners by ABR, Inc., Fairbanks, AK. 154 pp.

Johnson, C. B., B. E. Lawhead, J. R. Rose, A. A. Stickney, and A. M. Wildman. 1997. Wildlife studies on the Colville River Delta , Alaska, 1996. Fifth annual report prepared for ARCO Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks, AK. 138 pp.

Johnson, C. B., B. E. Lawhead, J. R. Rose, M. D. Smith, A. A. Stickney, and A. M. Wildman. 1998. Wildlife studies on the Colville River Delta , Alaska, 1997. Sixth annual report prepared for ARCO Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks, AK. 144 pp.

Johnson, C. B., B. E. Lawhead, J. R. Rose, M. D. Smith, A. A. Stickney, and A. M. Wildman. 1999. Wildlife studies on the Colville River Delta , Alaska, 1998. Seventh annual report prepared for ARCO Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks, AK. 102 pp.

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

Jorgenson, M. T., J. E. Roth, E. R. Pullman, R. M. Burgess, M. K. Raynolds, A. A. Stickney, M. D. Smith, and T. M. Zimmer. 1997. An ecological land survey for the Colville River Delta , Alaska, 1996. Final report prepared for ARCO Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 160 pp.

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

King, J.G. 1973. The use of small airplanes to gather swan data in Alaska. Wildfowl 24: 15–20.

Larned, W., R. Platte, and R. Stehn. 2001. Eider breeding population survey, Alaska Arctic Coastal Plain, Alaska, 1999-2000. Unpubl. rep., by U. S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 20 pp. + figures pp.

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 report prepared for ARCO Alaska, Inc., Anchorage, by Alaska Biological Research, Inc., Fairbanks. 202 pp.

Murphy, S. M. and A.A. Stickney. 2000. Baseline Avian Surveys within the National Petroleum Reserve—Alaska, 2000. Final report prepared for PHILLIPS Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 28 pp.

North, M. R., J. L. Schwerin, and G. A. Hiemenz. 1984. Waterbird studies on the Colville River Delta, Alaska: 1984 summary report. U.S. Fish and Wildlife Service, Anchorage, AK. 18 pp.

Pennycuick, C. J., and D. Western. 1972. An investigation of some sources of bias in aerial transect sampling of large mammal populations. East African Wildlife. Journal 10: 175–191.

Quakenbush, L., and J. Cochrane. 1993. Report on the conservation status of the Steller's Eider (*Polysticta stelleri*), a candidate threatened and endangered species. Report with recommendations for listing as a threatened species submitted by U.S. Fish and Wildlife Service, Ecological Services, Fairbanks, Alaska, and Anchorage, Alaska, to U.S. Fish and Wildlife Service, Office of Endangered Species, Washington, D.C. 26 pp.

Quakenbush, L., R. Suydam, K. M. Fluetsch, and C. L. Donaldson. 1995. Breeding biology of Steller's Eiders nesting near Barrow, Alaska, 1991–1994. Unpublished report prepared by U.S. Fish and Wildlife Service, Fairbanks, AK. 53 pp.

Ritchie, R. J., P. W. Banyas, A. A. Stickney, R. M. Burgess, and J. G. King. 1990. Tundra Swan and Brant surveys on the Arctic Coastal Plain, Colville River to Staines River, 1989. Final report prepared for ARCO Alaska, Inc., and BP Exploration (Alaska) Inc., Anchorage, AK, by Alaska Biological Research, Inc., Fairbanks, AK. 138 pp.

Ritchie, R. J., J. G. King, and P. W. Banyas. 1989. Aerial waterfowl surveys in the Kuparuk River Unit and Oil and Gas Lease Sale 54. Unpublished report prepared for ARCO, Alaska, Inc., Anchorage, AK, by Alaska Biological Research, Inc., Fairbanks, AK. 26 pp.

Ritchie, R. J., A. A. Stickney, P. W. Banyas, and J. G. King. 1991. Tundra Swan and Brant surveys on the Arctic Coastal Plain, Colville River to Staines River, 1990. Final report prepared for ARCO Alaska, Inc. and BP Exploration (Alaska) Inc., Anchorage, AK. by Alaska Biological Research, Inc., Fairbanks, AK. 103 pp.

Rothe, T. C., C. J. Markon, L. L. Hawkins, and P. S. Koehl. 1983. Waterbird populations and habitats of the Colville River Delta , Alaska. 1981 Summary Report. U.S. Fish and Wildlife Service, Special Studies, Anchorage, Alaska. 67 pp.

Simpson, S. G., J. Barzen, L. Hawkins, and T. Pogson. 1982. Waterbird studies on the Colville River Delta, Alaska: 1982 summary report. U.S. Fish and Wildlife Service, Anchorage, AK. 24 pp.

Smith, L. N., L. C. Byrne, and R. J. Ritchie. 1993. Wildlife studies on the Colville River delta, Alaska, 1992. Final report prepared for ARCO Alaska, Inc., Anchorage, Alaska, by Alaska Biological Research, Inc., Fairbanks. 69 pp.

Smith, L. N., L. C. Byrne, C. B. Johnson, and A. A. Stickney. 1994. Wildlife studies on the Colville River Delta , Alaska, 1993. Final report prepared for ARCO Alaska, Inc., Anchorage, Alaska, by Alaska Biological Research, Inc., Fairbanks, AK. 95 pp.

Stickney, A. A., R. J. Ritchie, B. A. Anderson, and D. A. Flint. 1993. Tundra Swan and Brant surveys on the Arctic Coastal Plain, Colville River to Sagavanirktok River, 1993. Final report prepared for ARCO Alaska, Inc., Anchorage, AK, by Alaska Biological Research, Inc., Fairbanks, AK. 83 pp.

Troy, D. M. 1988. Bird use of the Prudhoe Bay Oil Field during the 1986 nesting season. Report prepared for Alaska Oil and Gas Association., Anchorage, by LGL Alaska Research Associates, Anchorage. 96 pp.

Troy Ecological Research Associates (TERA). 1996. Distribution and abundance of Spectacled Eiders in the vicinity of Prudhoe Bay, Alaska: 1995 status report. Unpublished report to BP Exploration (Alaska) Inc., Anchorage. 17 pp.

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

U.S. Fish and Wildlife Service (USFWS). 1987b. Trumpeter and Tundra swan survey protocol update. Unpublished memo 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 memo prepared by Office of Migratory Bird Management, Juneau, AK. 4 pp.

U.S. Fish and Wildlife Service. 1996. Spectacled Eider Recovery Plan. U.S. Fish and Wildlife Service, Anchorage, AK. 157 pp.

U.S. Fish and Wildlife Service (USFWS). 1998. Steller's Eider Draft Recovery Plan. Preliminary draft, Ecological Services, Fairbanks, AK.

Walker, D.A., K. R. Everett, P. J. Everett, P. J. Webber, and J. Brown. 1980. Geobotanical atlas of the Prudhoe Bay region, Alaska. CRREL Report. 80–14, U. S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Hanover, NH. 69 pp.

Walker, H. J. 1983. Guidebook to permafrost and related features of the Colville River Delta, Alaska. Guidebook 2. Alaska Div. Geol. and Geophys. Surv., Anchorage. 34 pp.

Warnock, N. D., and D. M. Troy. 1992. Distribution and abundance of Spectacled Eiders at Prudhoe Bay, Alaska: 1991. Unpublished report by Troy Ecological Research Associates to BP Exploration (Alaska) Inc., Anchorage, AK. 21 pp.

$\bar{x}$

Appendix A. The extent of surveys in the three proposed exploration areas in each year by the aerial surveys for Spectacled Eiders in the Colville exploration area, Alaska. Coverage within the areas surveyed was 100% in all years but 1993, which was 50%. nc = no coverage.

	Exploration Area		
Year	Callisto	Ganymede	Sunrise
1993	100%	100%	~67%
1994	nc	nc	nc
1995	~67%	<25%	<1%
1996	>90%	<25%	<1%
1997	>90%	<25%	<1%
1998	>90%	<25%	<1%
1999	nc	nc	nc
2000	nc	nc	<1%
2001	~50%	<25%	<1%

Appendix B. U. S. Fish and Wildlife Service protocol for determining indicated total birds from aerial breeding-pair surveys.

For aerial surveys of Spectacled Eiders, we calculated the density of the "indicated total breeding population" using the USFWS (1987a) breeding population survey protocol:

Total indicated birds = (lone males × 2) + (flocked males × 2) + (pairs × 2) + (group total × 1).

Each of these categories is defined in the USFWS protocol:

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).

Lone females are not counted using this protocol, because it is assumed they are accounted for by doubling the count of lone males. Flying birds are counted only if their flight originated or terminated within the transect boundaries; because we were unable to determine this on our survey, we have excluded all flying birds from the FWS calculations. The USFWS also uses a sightability correction factor of 3.58 to adjust actual counts for the probable number of eiders missed by observers (sightability is defined as "the probability that an animal within the observer's field of search will be seen by that observer" [Caughley 1974: 923]). We do not present totals or densities adjusted using this correction factor because there is some question as to whether this correction factor, which was developed for surveys on the Yukon-Kuskokwim Delta, is applicable to the Arctic Coastal Plain.