BASELINE AVIAN SURVEYS IN FOUR LEASE BLOCKS WITHIN THE NATIONAL PETROLEUM RESERVE–ALASKA, 1999

FINAL REPORT

Prepared for

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EXECUTIVE SUMMARY

- In preparation for exploration activities in the National Petroleum Reserve–Alaska (NPR–A), ARCO Alaska, Inc., initiated baseline waterfowl surveys in summer 1999 to evaluate the distribution and abundance of important breeding species in the vicinity of four lease blocks (Clover, Lookout, Moose's Tooth, unnamed New Area). Spectacled (*Somateria fischeri*) and Steller's (*Polysticta stelleri*) eiders and Tundra Swans (*Cygnus columbianus*) were selected as the focus of these surveys, because of their special status (threatened status for Spectacled and Steller's eiders) or their interest to management agencies (Tundra Swans).

- We saw four Spectacled Eiders at three locations during the aerial survey on 13–14 June 1999: 1 male in the Clover lease block, and 1 pair and 1 male between the Clover and Lookout lease blocks. King Eiders (*S. spectablis*) were more numerous and occurred in both the Clover and Moose's Tooth lease blocks. For both species, we observed most eiders between the Clover and Lookout lease blocks (the New Area was not surveyed for breeding pairs). We saw no Steller's Eiders during the breeding-pair aerial survey.

- Density of Spectacled Eiders in the study area was 0.04 birds/km^2 (based on total indicated birds) in 1999. This density fell within the densities (≤0.05 birds/km^2) reported for the northeastern NPR–A by BLM (1998). King Eider density (0.11 birds/km^2) in the study area was at the lower end of the range (0.07–0.47 birds/km^2) reported for this area by BLM (1998).

- We searched suitable nesting habitats on the ground in each of the lease blocks and in areas where we saw Spectacled Eiders during the aerial survey. During late June, we searched 9 areas for nesting eiders and other large waterbirds and located 100 nests of 16 species. We did not find any nests of Spectacled Eiders, but we did locate six King Eider nests, two Yellow-billed Loon (*Gavia adamsii*) nests, one Tundra Swan nest, and one Brant nest.

- During the aerial survey for nesting Tundra Swans on 14 June 1999, we located 12 adults associated with 9 nests, and 22 adults without nests. Most (6 of 9) nests occurred outside the lease blocks, with only two nests in the Moose's Tooth and one in the Clover lease blocks. We found four swan nests during the eider breeding-pair survey that we did not relocate during the swan survey; one of these nests was in the Moose's Tooth lease block. Nest density of Tundra Swans was 0.06 nests/km^2 in the study area, which was slightly higher than the 10-year mean nest density recorded in the Kuparuk Oilfield (0.04 nests/km^2) but identical to the 6-year mean nest density recorded on the Colville Delta (0.06 nests/km^2). We observed more nonbreeding swans than breeding swans in the study area in 1999 (22 and 12 adults, respectively). Densities of breeding adults (0.06 birds/km^2), nonbreeders (0.11 birds/km^2), and total swans (0.24 birds/km^2) were slightly lower than comparable densities in the Kuparuk Oilfield in 1998 (0.09, 0.16, and 0.25 birds/km^2, respectively).

- We counted 46 Tundra Swans in the study area during the brood-rearing aerial survey on 20 August 1999. We observed three broods comprising nine young and six adults; brood sizes were identical at three young each. Only one brood was inside a lease block (Clover). Of the two remaining broods, one was located immediately west of the southwestern corner of the Clover lease block and the other was just east of the Moose's Tooth lease block. We also observed 31 adult swans without broods, primarily in pairs scattered throughout the study area; we saw no flocks (³3 swans) of nonbreeding swans. We observed a pair and one single adult in the Clover lease block and three pairs in the Moose's Tooth lease block. Nesting success of Tundra Swans appeared to be poor in the study area in 1999, and brood density (0.02 broods/km^2) was lower than the mean densities recorded in the region in recent years (0.04, 0.03, and 0.03 broods/km^2 in the Colville Delta [6 years], Alpine Transportation Corridor [8 years], and Kuparuk Oilfield [9 years], respectively).

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INTRODUCTION

As part of long-term monitoring of avian species in the oilfields, ABR, Inc., has been studying the distribution, abundance, and productivity of Spectacled Eiders (*Somateria fischeri*), Tundra Swans (*Cygnus columbianus*), and other waterfowl that annually use the Arctic Coastal Plain during summer (see Murphy and Anderson 1993, Stickney et al. 1993, Anderson et al. 1999). As the oilfields have expanded westward into the Colville River 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, Johnson et al. 1999). In 1999, ARCO Alaska, Inc. (ARCO), purchased leases in the National Petroleum Reserve–Alaska (NPR–A). In preparation for exploration activities, ARCO initiated baseline waterfowl surveys to evaluate the distribution and abundance of important breeding species in the vicinity of the lease blocks. Eiders and Tundra Swans were selected as the focus of these surveys, because of their special status (threatened status for Spectacled and Steller's [*Polysticta stelleri*] eiders) or their interest to management agencies (Tundra Swans). This report presents the results of the baseline avian surveys conducted by ABR in the study area in 1999.

Spectacled Eiders were listed as a threatened species over their range in Alaska in 1993. This special status mandates habitat protection on their breeding grounds in areas of development and in areas of oil exploration, such as within the NPR–A. In conjunction with the surveys for Spectacled Eiders, we recorded locations of the other eider species of interest that can occur in the area: Steller's Eiders, which were listed as threatened in 1997, and King Eiders (*Somateria spectabilis*), which appear to be declining in numbers in western Canada.

Tundra Swans are recognized both as a valuable resource worthy of special consideration in development planning and as an indicator of overall health of the tundra ecosystem. Acquiring a pre-development baseline of swan nests and broods is useful for site planning and for documenting pre-development conditions. Brant (*Branta bernicla*) colonies and brood-rearing areas also have received special consideration during oilfield planning because of declining populations of this species throughout its range in Alaska and the importance of these traditional sites for the long-term maintenance of the breeding population. Accordingly, we also searched for Brant colonies on an opportunistic basis during the course of our eider and swan surveys.

The goals of these surveys in 1999 were to determine the distribution, abundance, and productivity of selected avian species in the lease blocks in the northeastern planning area of the NPR-A. We had three specific objectives for the baseline surveys:

- determine the abundance and distribution of eiders (primarily Spectacled, but also any Steller's and King eiders present in the survey areas) during pre-nesting;
- locate eider nests in suitable habitats (keyed primarily to habitats used by nesting Spectacled Eiders); and
- locate and count Tundra Swan nests, pairs, flocks, and broods and determine annual productivity.

STUDY AREA

Three lease blocks (Clover, Lookout, Moose's Tooth) were located in the northeastern section of the NPR-A, approximately 7–30 km west of the village of Nuiqsut, Alaska (70° 15'N, 151° 15'–152 ° W) and approximately 110 km west of Prudhoe Bay on the Arctic Coastal Plain of northern Alaska (Figure 1). A fourth lease block (New Area) was added during the ground-search phase of the study; this block was approximately 36 km west of Nuiqsut (Figure 1). Although ARCO Alaska, Inc., later dropped this fourth area from consideration, we did collect data at this site and report that data in this report

Landforms, vegetation, and wildlife habitats in the northeastern NPR–A were described in the recent EIS (BLM 1998) and are similar those of the western Kuparuk Oilfield and the Alpine Transportation Corridor (Johnson et al. 1999, Jorgenson et al. 1997). Landforms in the northeastern section of the NPR–A are influenced by the predominately northeastern winds during summer which control the development of oriented thaw lakes on the coastal plain and also affect aeolian deposition from the

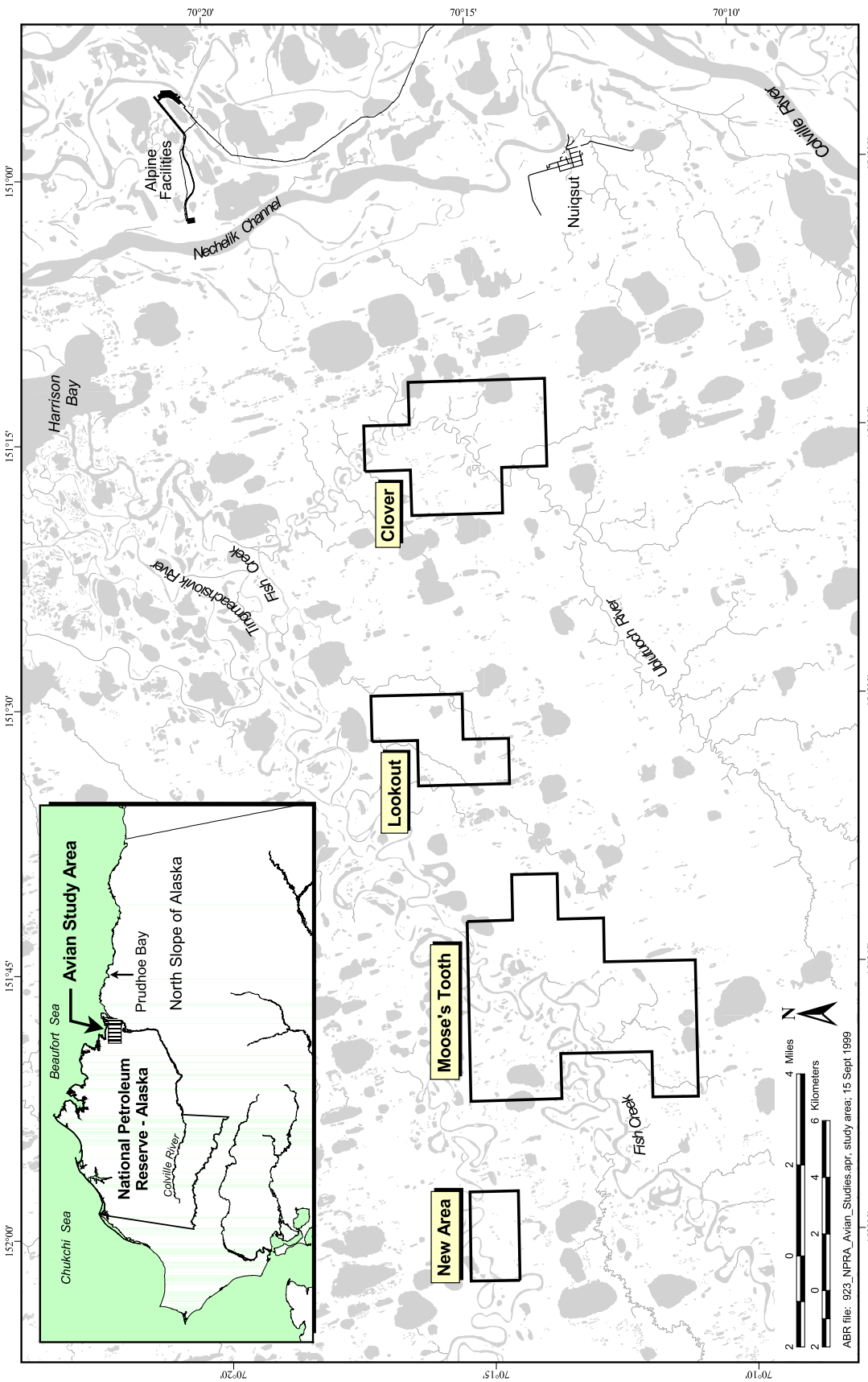

Figure 1. Locations of lease blocks surveyed for selected avian species in the northeastern National Petroleum Reserve–Alaska, June–August 1999.

nearby Colville River (BLM 1998). Vegetative cover within the northeastern NPR–A has been analyzed by satellite imagery (Landsat TM) and large-scale cover classes include water, aquatic (*Carex* or *Arctophila* dominant), flooded tundra (nonpatterned, low-centered polygons), wet tundra, moist tundra (sedge/grass meadow, tussock tundra, moss/lichen), shrub (dwarf, low, tall), and barren ground (sparsely vegetated, dunes/dry sand, other) (BLM 1998). Wildlife habitats include those defined for waterbirds by Derksen et al. (1981) for the Teshekpuk Area (e.g., shallow *Carex*, deep *Arctophila*; based primarily on water depth and dominant emergent vegetation).

The Moose's Tooth and New Area lease blocks include portions of Fish and Judy creeks (just above their confluence), as well as numerous oxbow lakes and smaller wetlands that have developed between these two drainages. The Clover lease block also contains numerous wetlands and a portion of the Ublutuoch River drainage, whereas the Lookout lease block contains drier habitats with only a few larger lakes.

The climate of the northeastern NPR–A 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). Mean 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 temperatures of the active layer of thawed soil above permafrost range from 0–10° C (32–50° F) during the growing season.

METHODS

EIDERS

AERIAL SURVEY FOR BREEDING PAIRS

We conducted one aerial survey for breeding pairs of eiders on 13–14 June 1999, following the same methods used on the Colville Delta (Johnson et al. 1999). The aerial survey employed two observers (in addition to the pilot) in a fixed-wing aircraft (Cessna 185). During the survey, the pilot navigated along east–west transect lines using a global positioning system (GPS) receiver and topographic maps. We counted all eiders seen in a fixed–width strip (200 m on each side of the aircraft) along the transects, which were spaced 400 m (~0.25 mi) apart, for 100% coverage of the study area (Figure 2). We used marks on the airplane's struts and windows to visually delimit the outer edges of the transect strip (Pennycuick and Western 1972). We surveyed a larger total area (143.4 km^2) than just that within the lease blocks so that potential transportation routes between and outside the blocks would be included (Figure 2); hereafter this survey area will be referred to as the study area. Flight altitude for each survey was 30–50 m above ground level (agl) and flight speed was approximately 145 km/h. For each observation, we noted on a tape recorder the species of eider, number of each sex, number of identifiable pairs, transect number, and whether the birds were flying or on the ground. Each observer also marked their eider locations on 1:63,360 USGS maps of the study area. We calculated unadjusted densities (i.e., without a sightability correction factor) for eiders based on the total area covered during the survey and for each lease block. We calculated the total indicated birds following the procedures of the USFWS survey protocol (Appendix 1). All observations were digitized and added to a geographical information system (GIS) database that contains all aerial-survey observations in the adjacent Kuparuk and Colville River areas since 1992.

GROUND-BASED NEST SEARCHES

We selected locations for ground-based nest searches where Spectacled Eiders occurred on the aerial survey and where suitable habitats for eider (and other waterfowl) nesting (i.e., areas with mixtures of waterbodies, basin wetland complexes, and other small ponds and wetlands) were located within the lease blocks. We searched around the perimeters of all waterbodies within each designated search area. Because Spectacled Eiders tend to locate their nests near water (Anderson et al. 1998, Johnson et al. 1998), we searched only within 25 m of the edge of all waterbodies.

For each waterfowl, loon, or gull nest found, we recorded the species and nest location on a color infrared aerial photograph (1:63,000) of the area and noted the disposition (active, failed) of the nest. To avoid additional disturbance at nests, we did not intentionally flush females from the nest. If a female flushed upon approach, we noted the contents of the nest and covered the eggs with down or vegetation before

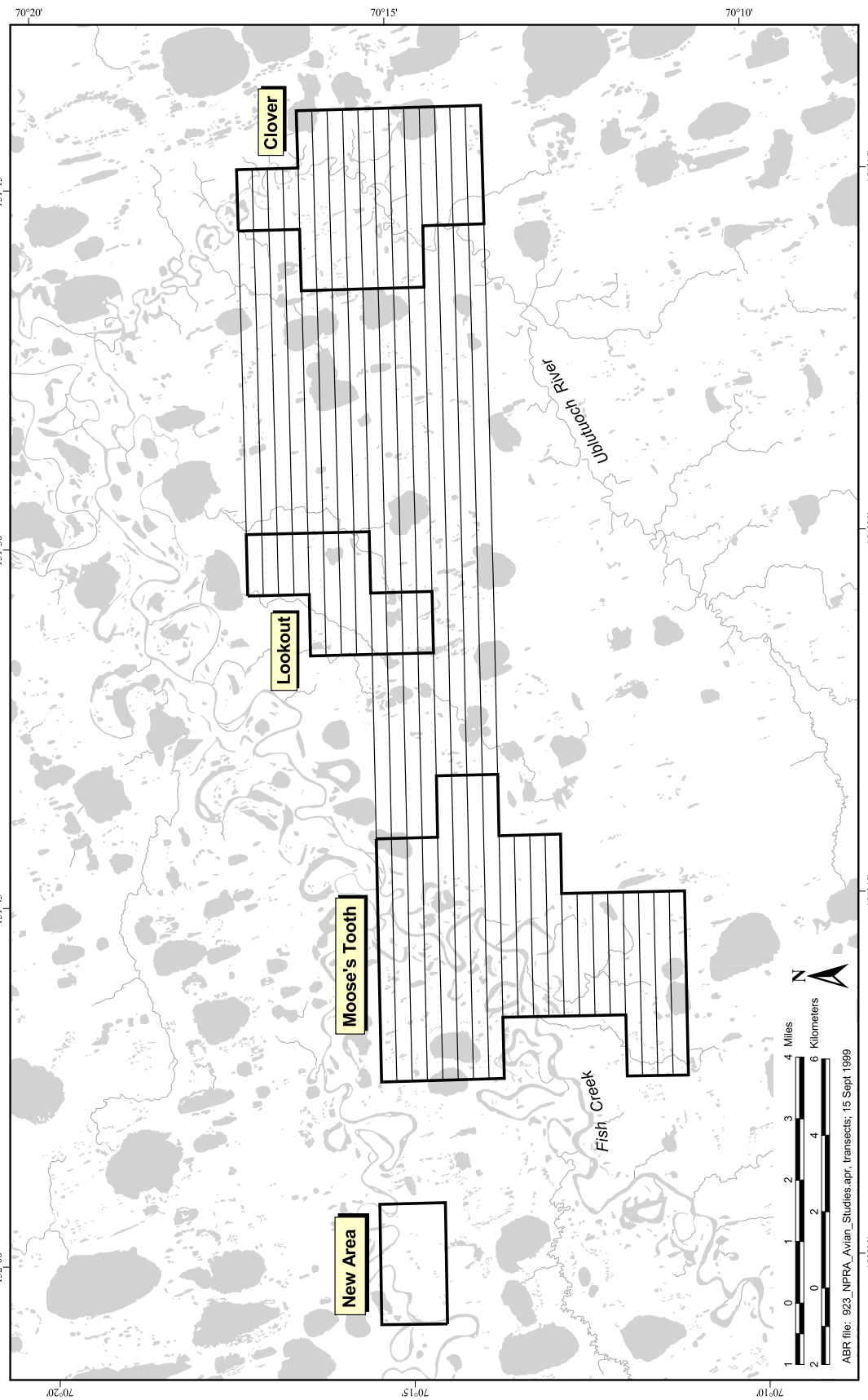

Figure 2. Transect lines for the aerial survey for breeding pairs of eiders in the northeastern National Petroleum Reserve–Alaska, 13–14 June 1999. The westernmost lease block (New Area) was added after the aerial survey had been flow and was not covered by this survey.

departing. All nest locations were summarized and the nests of selected species were digitized and added to a GIS database for the lease blocks.

TUNDRA SWANS

In 1999, we used the USFWS Tundra Swan Survey Protocol (USFWS 1987, 1991) for our aerial surveys of Tundra Swans; these methods were identical to those used for the Kuparuk Avian Studies program and previous swan surveys in the area (Ritchie et al. 1990, 1991; Stickney et al. 1992, 1993, 1994; Anderson et al. 1995, 1996, 1997, 1998; Smith et al. 1993, 1994; Johnson et al. 1996, 1997, 1998, 1999).

During the aerial surveys, we flew in a Cessna 185 aircraft along fixed–width, east–west, 1.6–km-wide transects. Transects were oriented along township and section lines, and we mapped all observations on 1:63,360 USGS maps. The study area boundaries were identical to those used for the aerial survey for eider breeding pairs (Figure 2). When flying along the transects, the pilot maintained a speed of 145 km/h at an altitude of 150 m agl. Each of the two observers scanned within a zone approximately 800 m wide on his/her side of the aircraft, 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 by each observer were recorded on the USGS maps and whether the adults were attending a nest or with a brood. When either observer 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, we used an identical procedure for recording data but did not circle or photograph broods to limit disturbance.

We selected survey dates to be consistent with the timing of the surveys in adjacent areas (Kuparuk Oilfield). In 1999, we flew the nesting survey on 14 June and the brood-rearing survey on 20 August. After each survey, we entered all location data into digital maps (developed from 1:63,360 USGS maps by AeroMap, U.S., Inc.) 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 categorize adults as either with nests (or broods) or without nests (or broods). The latter two categories include nonbreeding subadults, as well as failed or nonbreeding adults. These individuals will be referred to collectively as "nonbreeders."

RESULTS AND DISCUSSION

EIDERS

BACKGROUND

Spectacled Eider

The Spectacled Eider population in Alaska has declined substantially in recent years and was listed by U.S. Fish and Wildlife Service (USFWS) as "threatened" under the Endangered Species Act on 10 June 1993 (58 FR 27474-27480). Recent surveys estimate the current population of the northern breeding population of Spectacled Eiders to be at least 11,000–21,000 breeding pairs (BLM 1998). These recent estimates also suggest that the Arctic Coastal Plain now supports the main breeding population of Spectacled Eiders in Alaska (BLM 1998).

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 NPR–A, but uncommon east of there at Storkersen Point. Recent studies have shown, however, that Spectacled Eiders are relatively common breeders in the Prudhoe Bay and Kuparuk oilfields and on the Colville River Delta (TERA 1996, Anderson et al. 1998, Johnson et al. 1999).

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. 1998). Nesting Spectacled Eiders also use a variety of habitats including Aquatic Sedge Marsh, Brackish Water, Basin Wetland Complexes, and Nonpatterned Wet Meadow (Warnock and Troy 1992, Anderson and Cooper 1994; Anderson et al. 1995, 1996, 1997; Johnson et al. 1997).

Steller's Eider

The Alaska breeding population of Steller's Eider was listed as threatened (59 FR 35896) in 1997 because of a substantial population decline in recent years (Kertell 1991, Quakenbush and Cochrane 1993). 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). Non- and post-breeding birds use nearshore waters of the northeastern Chukchi Sea and large lakes around Barrow for molting and summering and they also occasionally occur in summer as scattered birds along the coast as far east as the Yukon border. The Steller's Eider has been recorded periodically in the Prudhoe Bay, Kuparuk, and Colville River Delta areas (USFWS 1998).

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). A recent study in the Barrow area found that waterbodies with *Arctophila fulva* (pendant grass) received considerable use (greater than their availability) during the pre-nesting, nesting, and brood-rearing periods (Quakenbush et al. 1995). Other habitats that were used included flooded tundra and aquatic sedge ponds. 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 in the NPR–A EIS that some of the highest densities of King Eiders on the coastal plain occur in the NPR–A 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 Eider tend to nest in drier tundra habitats often unassociated with any waterbody (Anderson et al. 1999).

AERIAL BREEDING-PAIR SURVEY

Spectacled Eider

During the aerial survey on 13–14 June 1999, we saw only four Spectacled Eiders at three locations in the study area: 1 male in the Clover lease block, and 1 pair and 1 male between the Clover and Lookout lease blocks (Table 1, Figure 3). All of the Spectacled Eiders were seen on the ground. King Eiders were more numerous in the study area and occurred in both the Clover and Moose's Tooth lease blocks (Table 1, Figure 3). We observed more King Eiders that were flying than were on the ground. For both species, we observed most eiders between the Clover and Lookout lease blocks (the New Area was not surveyed for breeding pairs).

Density of Spectacled Eiders in the study area was 0.04 birds/km^2 (based on total indicated birds) in 1999 (Table 1). This density was lower than that recorded in the adjacent Kuparuk Oilfield in 1998 (0.08 birds/km^2, Anderson et al. 1999), in the Alpine Transportation Corridor in 1997 (0.08 birds/km^2, Johnson et al. 1998), and on the Colville River Delta (0.13 birds/km^2, Johnson et al. 1999). Our survey results in the study area fall within the bird density (≤0.05 birds/km^2) reported for Spectacled Eiders within the northeastern NPR–A by BLM (1998). These comparisons indicate that this small section of the northeastern NPR–A supports fewer breeding pairs

Table 1. Numbers and densities (per km^2) of Spectacled and King eiders recorded during a pre-nesting aerial survey of lease blocks in the National Petroleum Reserve–Alaska study area (no eiders were seen in the Lookout lease block), 13–14 June 1999.

	Numbers Observed						Densities (birds/km^2)[a]		
Species / Lease Block	Males	Females	Total Birds	Observed Pairs	Sightings	FWS Indicated Total Birds[b]	Breeding Pairs[c]	Total Birds[d]	FWS Indicated Total Birds
Spectacled Eider									
Clover									
All Birds[e]	1	0	1	0	1	2	0.04	0.04	0.09
Total									
All Birds[e]	3	1	4	1	3	6	0.02	0.03	0.04
King Eider									
Clover									
Non-flying	3	3	6	3	2	6	0.13	0.26	0.26
Flying	2	1	3	1	1	4	0.09	0.13	
All Birds	5	4	9	4	3	10	0.22	0.40	
Moose's Tooth									
Non-flying	1	1	2	1	1	2	0.02	0.05	0.05
Flying	0	0	0	0	0	0			
All Birds	1	1	2	1	1	2	0.02	0.05	
Total									
Non-flying	8	8	16	8	5	16	0.06	0.11	0.11
Flying	2	1	3	1	1	4	0.01	0.02	
All Birds	22	19	41	19	15	44	0.15	0.28	

[a] Densities based on area surveyed for each block (Clover = 22.8 km^2; Moose's Tooth = 43.6 km^2) and the total study area (143.4 km^2).
[b] FWS Indicated Total Birds is calculated according to the standard protocol (USFWS 1987a) see Appendix 1; flying birds are not counted.
[c] Number of breeding pairs = total males counted.
[d] Unadjusted density of total birds = total birds/km^2 surveyed.
[e] All Spectacled Eiders seen were on the ground (i.e., non-flying).

of Spectacled Eiders than the Colville Delta and developed oilfields to the east, probably due to differences in availability of suitable habitats among the areas and, perhaps, distance from the Beaufort Sea coast.

Steller's Eider

We did not see any Steller's Eiders during the breeding-pair aerial survey on 13–14 June 1999. Steller's Eiders have been recorded in the general vicinity in the past: one observation to the south of the least blocks in 1993, and one to the northeast of the lease blocks in 1995 (BLM 1998).

King Eider

Density of King Eiders in the study area in 1999 was 0.11 birds/km^2 (based on total indicated birds with flying birds excluded). The Clover lease block supported a higher density of King Eiders than the Moose's Tooth lease block (Table 1). The density of King Eiders in the study area in 1999 was at the lower end of the density range (0.07–0.47 birds/km^2) reported for this area by BLM (1998), and lower than that in the Kuparuk Oilfield in 1998 (0.28 birds/km^2; Anderson et al. 1999) and the Alpine Transportation Corridor in 1997 (0.47 birds/km^2;

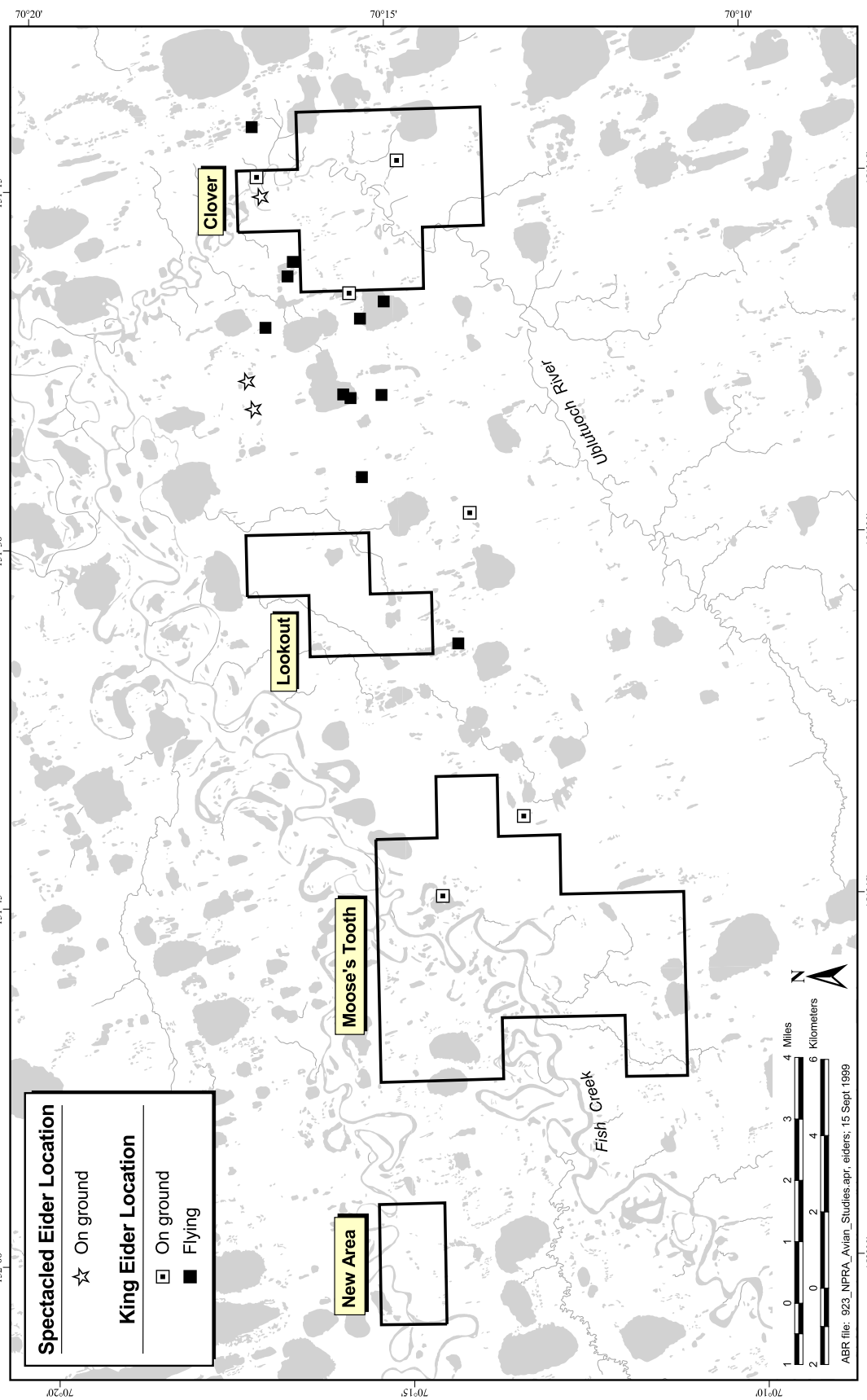

Figure 3. Eider observations recorded during the breeding-pair aerial survey of the lease blocks in the northeastern National Petroleum Reserve–Alaska, 13–14 June 1999. The westernmost lease block (New Area) was added after the aerial survey had been flow and was not covered by this survey.

Johnson et al. 1998), but higher than that on the Colville Delta in 1998 (0.03 birds/km^2; Johnson et al. 1999). Density maps in BLM (1998) indicate that the highest densities (1.0–4.32 birds/km^2) of King Eiders in the northeastern NPR–A are east of Teshekpuk Lake.

GROUND-BASED NEST SEARCHES

Because the breeding-pair aerial survey alone is not sufficient for identifying the nesting locations of Spectacled Eiders in tundra areas on the Arctic Coastal Plain, we also searched suitable nesting habitats in each of the lease blocks and in areas where we saw Spectacled Eiders during the aerial survey. During late June, we searched 9 areas for nesting eiders and other large waterbirds and located 100 nests of 16 species (Table 2). We did not find any nests of Spectacled Eiders, but we did locate six King Eider nests, two Yellow-billed Loon (*Gavia adamsii*) nests, one Tundra Swan nest, and one Brant nest (Figure 4, Table 2).

Each of the lease blocks had some suitable nesting habitat for waterbirds, but Area 9 (comprised of three small search areas) in the Lookout lease block had both the largest number of nests and the greatest diversity of species. Yellow-billed Loons were found nesting in two large lakes adjacent to Fish Creek in the Moose's Tooth lease block (Figure 4). A pair of Tundra Swans also was nesting on the western lake that had one of the Yellow-billed Loon nests. We found two Brant nests in the search areas: one in the southeastern end of the Lookout lease block, and one just south in the New Area (Figure 4). We did not locate any larger nesting colonies of Brant during the aerial surveys or during the ground searches. The most common nesting waterbird in the search areas was the Pacific Loon (*G. pacifica*; 25 nests). We found at least 10 nests of only two other species, Glaucous Gull (*Larus hyperboreus*; 13 nests) and Greater White-fronted Goose (*Anser albifrons*; 10 nests).

Table 2. Waterbird nests found during ground-based nest searches in the National Petroleum Reserve–Alaska study areas, 29–30 June 1999. Nest-search areas, and nest locations for selected species (bolded), are displayed in Figure 4.

	Search Area (number of nests)									
Species	1	2	3	4	5	6	7	8	9	Total
Pacific Loon	6	2	4	5	2	2	1	0	3	25
Yellow-billed Loon	1	1	0	0	0	0	0	0	0	2
Tundra Swan	1	0	0	0	0	0	0	0	0	1
Greater White-fronted Goose	0	0	5	5	0	0	0	0	0	10
Brant	0	0	0	0	0	0	1	0	1	2
Canada Goose	1	0	0	1	1	0	0	0	5	8
Northern Pintail	0	0	0	0	0	1	0	0	4	5
Greater Scaup	1	1	0	0	0	1	0	0	0	3
King Eider	0	0	1	1	1	0	0	1	2	6
Oldsquaw	1	1	0	1	0	0	0	0	2	5
Red-breasted Merganser	1	0	1	0	0	0	0	0	0	2
Willow Ptarmigan	0	0	2	1	0	0	0	0	1	4
Long-tailed Jaeger	1	0	0	0	0	0	0	0	0	1
Glaucous Gull	0	1	1	2	2	0	1	0	6	13
Sabine's Gull	0	0	0	0	0	0	0	0	6	6
Arctic Tern	1	3	0	1	0	0	0	0	2	7
Total Nests	15	9	14	17	6	4	3	1	32	100

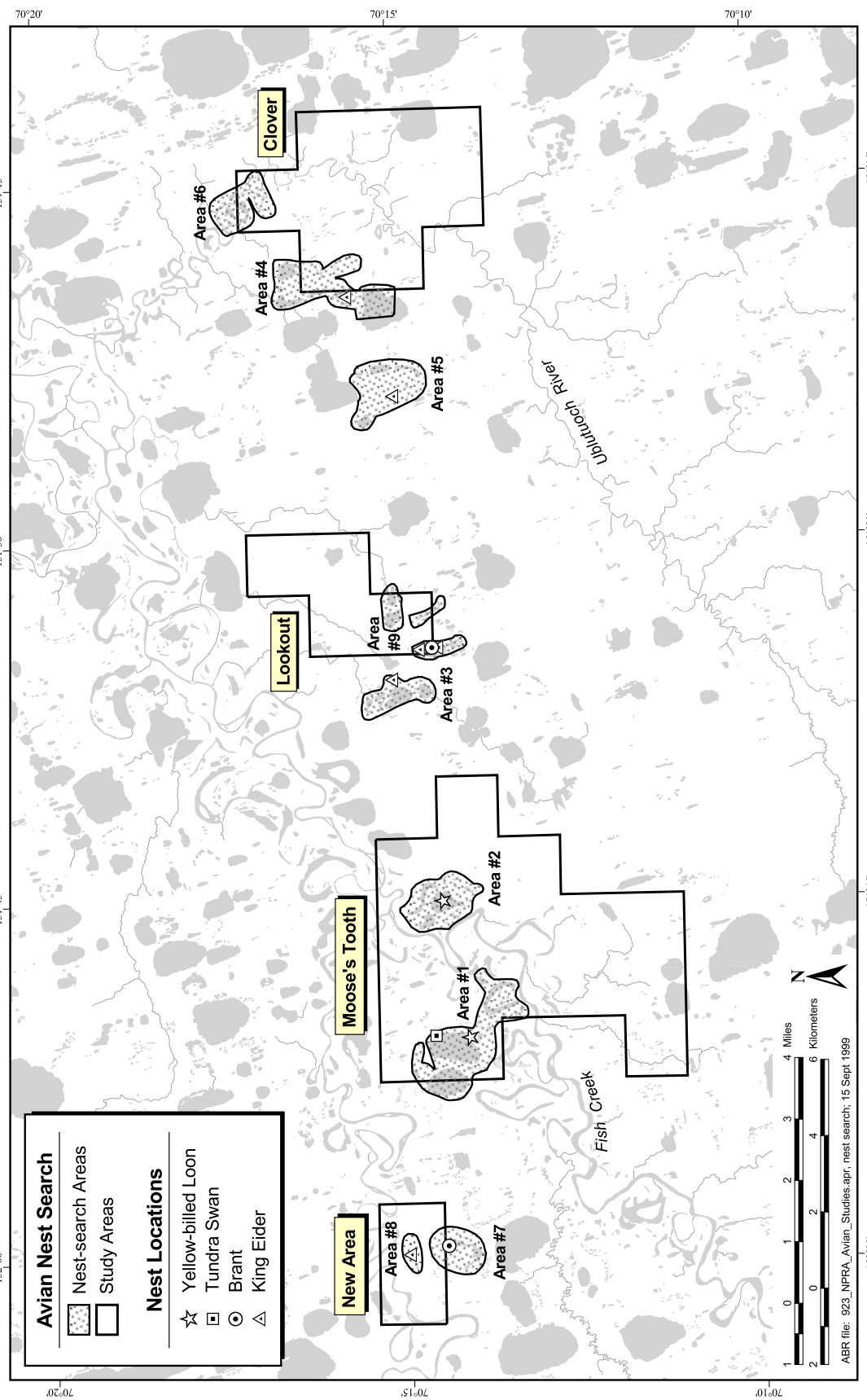

Figure 4. Avian nest search areas and nests found for selected species in the four lease block areas in the northeastern National Petroleum Reserve–Alaska, late June 1999. All nests found are listed in Table 2.

TUNDRA SWAN

BACKGROUND

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. 1998). Breeding pairs of Tundra Swans mate for life and defend a nesting territory to which they return annually. Thus, 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 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, which have been reported in the eastern channel of the Colville River and along the lower reaches of the Miluveach and Kachemach rivers during early–mid 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).

AERIAL SURVEY FOR TUNDRA SWAN NESTS

During the aerial survey for nesting Tundra Swans on 14 June 1999, we located 12 adults associated with 9 nests, and 22 adults without nests within the study area (Table 3, Figure 5). Most nests (6 of 9) occurred outside the lease blocks, with only two nests in the Moose's Tooth and one in the Clover lease blocks (Figure 5). We found four swan nests during the eider breeding-pair survey that we did not relocate during the swan survey; one of these nests was in the Moose's Tooth lease block. Stickney et al. (1992) estimated that 27% of all nests probably are missed during systematic swan aerial surveys. Occupied nests

Table 3. Numbers of Tundra Swans and nests observed during aerial surveys of the three lease blocks in the National Petroleum Reserve–Alaska study area, 13 June 1999.

	Lease Block					
Abundance (no.)	Clover	Lookout	Moose's Tooth	Outside Blocks	Total	Density[a] (no./km^2)
Nests	1	0	2	6	9	0.06
Swans with Nests						
Singles	1	0	1	4	6	0.04
Pairs	0	0	1	2	3	0.02
Total Adults	1	0	3	8	12	0.08
Swans without Nests						
Singles	1	1	0	6	8	0.01
Pairs	1	0	2	4	7	0.05
Total Adults	3	1	4	14	22	0.15
Total Swans	4	1	7	22	34	0.24

[a] Density based on a survey area of 143.4 km^2.

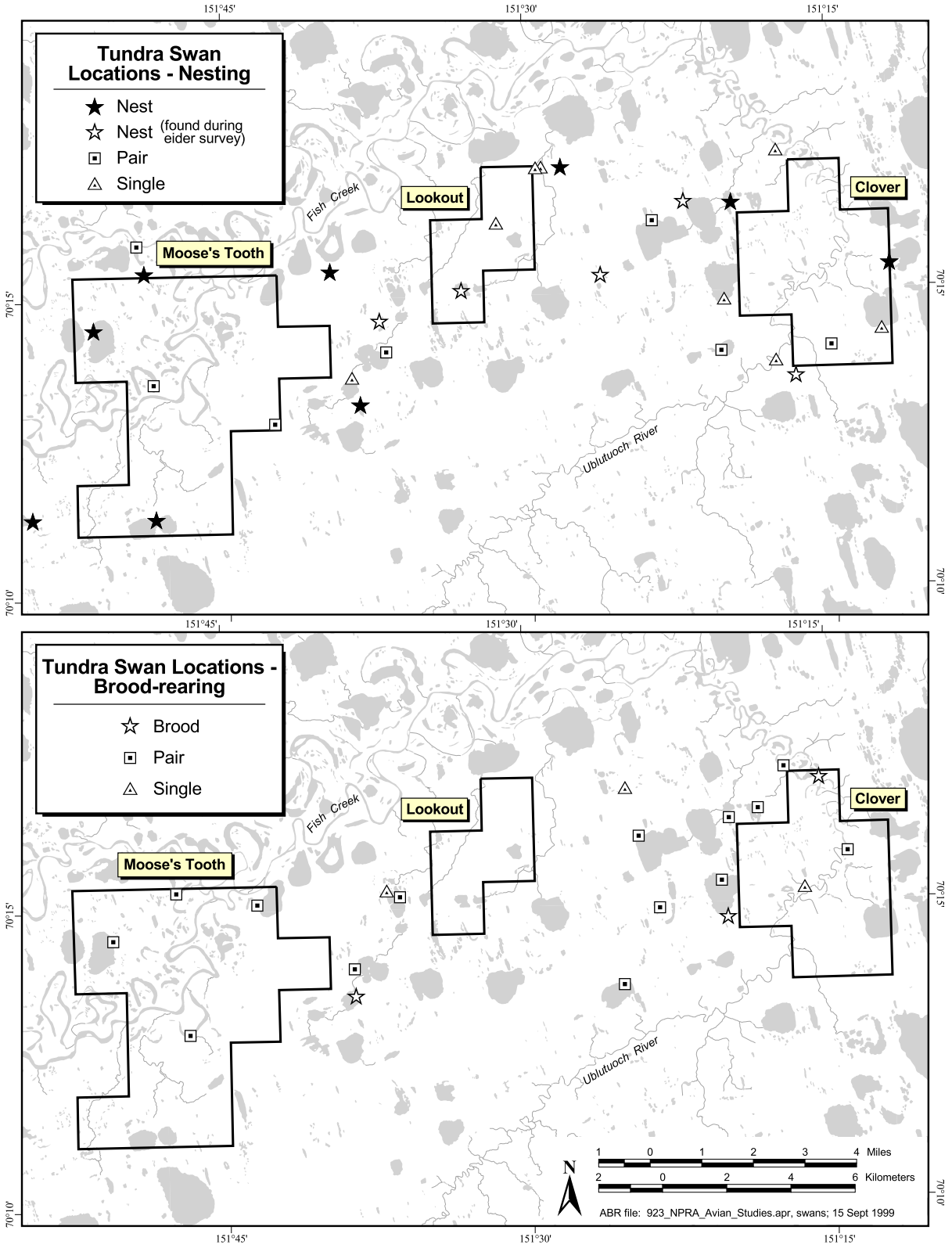

Figure 5. Locations of Tundra Swans observed during the nesting (upper) and brood-rearing (lower) aerial surveys of three lease blocks in the northeastern National Petroleum Reserve–Alaska, 1999. The nesting survey was flown on 14 June and the brood-rearing survey on 20 August. The westernmost lease block (New Area) was not covered by these surveys.

could be missed by observers if swans are not incubating at the time of the overflight of the survey aircraft or if they simply are not seen by the observer. For comparative purposes, we calculated all densities based only on the data collected during the swan survey.

Nest density in the study area was 0.06 nests/km^2, which was slightly higher than the 10-year mean nest density recorded in the Kuparuk Oilfield (mean = 0.04 nests/km^2; range = 0.01–0.05 nests/km^2; 1989–1998; Anderson et al. 1999) but identical to the 6-year mean nest density recorded on the Colville Delta (mean = 0.06 nests/km^2; range = 0.03–0.08 nests/km^2; 1992–1993 and 1995–1998; Johnson et al. 1999). Density of Tundra Swan nests in the study area also was comparable to nest densities recorded on the eastern Arctic Coastal Plain (0.04–0.06 nests/km^2; Platte and Brackney 1987).

We observed more nonbreeding swans than breeding swans in the study area in 1999 (22 and 12 adults, respectively). Densities of breeding adults (0.06 birds/km^2), nonbreeders (0.11 birds/km^2), and total swans (0.24 birds/km^2) were slightly lower than comparable densities in the Kuparuk Oilfield in 1998 (0.09, 0.16, and 0.25 birds/km^2, respectively) (Anderson et al. 1999). If we estimate the breeding population as the number of nests × 2 (i.e., each nest represents a pair of adults), and assume that some of the birds currently considered nonbreeders actually were the mates of the single birds associated with nests, then we have slightly fewer nonbreeders than breeders in the study area (18 breeders [9 nests × 2] vs 16 nonbreeders).

Thus, comparisons among the study area and adjacent areas indicated that the density of swan nests in the study area generally was slightly higher than densities recorded in the adjacent Kuparuk Oilfield, but similar to densities on the Colville River Delta and on the eastern coastal plain (Platte and Brackney 1987, Anderson et al. 1999, Johnson et al. 1999). Also, the density of adult swans we found in the study area during the nesting season was within the density range (>0–0.59 birds/km^2) identified by BLM (1998) for this region of the northeastern NPR–A.

AERIAL SURVEY FOR TUNDRA SWAN BROODS

We counted 46 Tundra Swans in the study area during the brood-rearing aerial survey on 20 August 1999 (Table 4, Figure 5). We observed three broods comprising nine young and six adults; brood sizes were identical at three young each. Only one of the three broods was inside a lease block (Clover; see Figure 5). Of the two remaining broods, one was located immediately west of the southwestern corner of the Clover lease block and the other was just east of the Moose's Tooth lease block.

We cannot calculate a precise measure of nesting success for the study area (due to the possibility of broods movements), but the number of broods located in the study area suggests a minimum nesting success of 33% (3 of 9 nests successful). A comparable brood-rearing survey was flown in the Kuparuk Oilfield, and preliminary calculations indicate an estimated nesting success rate of 64% in that area (ABR, Inc., unpublished data). These success rates for 1999 are substantially lower than those recorded in previous years in the Kuparuk Oilfield (range = 68–100%; 1988–1998; Anderson et al. 1999) and on the Colville Delta (range = 66–100%; 1992–1993, 1995–1998; Johnson et al. 1999). The likely causes of the lower nesting success are colder temperatures and prolonged snow melt in May–June 1999.

Given the relatively poor nesting success in the study area in 1999, it was not surprising that the brood density (0.02 broods/km^2) was lower than the mean densities recorded in the region in recent years (0.04, 0.03, and 0.03 broods/km^2 in the Colville Delta [6 years], Alpine Transportation Corridor [8 years], and Kuparuk Oilfield [9 years], respectively).

In addition to brood-rearing groups, we observed 31 adult swans without broods, primarily in pairs scattered throughout the study area (Table 3, Figure 5); we saw no flocks (≥3 swans) of nonbreeding swans. We observed a pair and one single adult in the Clover lease block and three pairs in the Moose's Tooth lease block.

Table 4. Numbers of Tundra Swans and broods observed during an aerial survey of three lease blocks in the National Petroleum Reserve–Alaska study area, 20 August 1999.

Abundance (no.)	Lease Block			Outside Blocks	Total	Density[a] (no./km^2)
	Clover	Lookout	Moose's Tooth			
Broods	1	0	0	2	3	0.02
Swans with Broods						
Singles	0	0	0	0	0	0
Pairs	1	0	0	2	3	0.02
Young	3	0	0	6	9	0.06
Total Adults	2	0	0	4	6	0.04
Swans without Broods						
Singles	1	0	0	2	3	0.02
Pairs	1	0	3	10	14	0.10
Total Adults	3	0	6	22	31	0.22
Total Adults	5	0	6	26	37	0.26
Total Young	3	0	0	6	9	0.06
Total Swans	8	0	6	32	46	0.32

[a] Density based on a survey area of 143.4 km^2.

CONCLUSIONS

The baseline surveys for eiders and Tundra Swans in the four lease blocks located in the northwestern NPR–A revealed that these species are present in the area, generally in numbers similar to those found in adjacent areas to the east (Colville River Delta, Kuparuk Oilfield). Several breeding pairs of Spectacled Eiders occurred in the vicinity of the lease blocks, but we found no nests during ground searches of suitable habitat. No Steller's Eiders were seen in 1999, but Steller's Eider's have occurred in the general area (BLM 1998) and they, as well as Spectacled Eiders, should be considered during any subsequent monitoring program. As specific exploration sites are chosen within the lease blocks, more extensive ground-based searches for eiders during the breeding season might be necessary to confirm the presence of these threatened species. In addition to nesting Tundra Swans (see below), the ground-based nests searches also revealed the presence of two other regionally important species in the lease blocks: Yellow-billed Loons and Brant. Yellow-billed Loons are a relatively rare species on the Arctic Coastal Plain that can be found nesting in numbers only on the Colville River Delta and to the west near the Chipp and Meade rivers (Johnson and Herter 1989). They have received regulatory agency attention during the development of the adjacent Alpine oilfield on the Colville Delta and likely would receive similar attention in these lease blocks. Brant nest primarily in colonies but the scattered nesting pairs, such as the one we found in the study area, are not uncommon. Unless larger numbers of nesting Brant are discovered during ground searches in the lease blocks, it is unlikely that this species will be of regulatory concern in the study area.

The study area and associated lease blocks appear to support a healthy population of Tundra Swans. Densities of Tundra Swans nests and broods within the study area were comparable to those found in the Colville River Delta area and the adjacent Kuparuk Oilfield. Densities of adult swan are within the range reported for the area by BLM (1998). As in past developments within the oilfields, mitigative measures to conserve nest sites and reduce disturbance to nesting swans may be called for during exploration within several of the lease blocks where nests occurred. Given the late spring conditions in 1999, which apparently resulted in diminished swan nesting and productivity region-wide, the densities recorded during the swan surveys may not be

representative of the normal or maximal densities that could occur in the lease blocks, thus this area may warrant continued surveys in the coming years, if oil exploration proceeds.

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Appendix 1. 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.
