FINAL REPORT

BASELINE AVIAN SURVEYS WITHIN THE NATIONAL PETROLEUM RESERVE–ALASKA, 2000

STEPHEN M. MURPHY
AND
ALICE A. STICKNEY

PREPARED FOR

PHILLIPS ALASKA, INC.
P.O. BOX 100360
ANCHORAGE, ALASKA 99510

PREPARED BY

ABR, INC.
P.O. BOX 80410
FAIRBANKS, ALASKA 99708

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PHILLIPS Alaska, Inc.
P.O. Box 100360
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Stephen M. Murphy
and
Alice A. Stickney

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

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

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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 (scientific names of all bird and mammal species are given in Table 2), Tundra Swans, 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., purchased leases in the National Petroleum Reserve–Alaska (NPRA). In preparation for exploration activities in NPRA in winter 1999–2000, ARCO initiated baseline waterfowl surveys to evaluate the distribution and abundance of important breeding species in the vicinity of the lease blocks (Anderson and Johnson 1999). Eiders and Tundra Swans 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). In 2000, ARCO and subsequently PHIILIPS, Alaska, Inc. (hereafter PHILLIPS) requested that additional sites in NPRA be surveyed in preparation for winter exploration activities in winter 2000–2001.

The goals of these surveys in 2000 were to determine the distribution, abundance, and productivity of selected avian species in the lease blocks in the northeastern planning area of the NPRA. We had three specific objectives for the baseline surveys:

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

BACKGROUND

Although our surveys focused primarily on Spectacled Eiders, Steller's Eiders, and Tundra Swans, the status of other tundra-nesting species, such as King Eider and Brant, also were evaluated during our 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.

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). This special status mandates habitat protection on their breeding grounds in areas of development and in areas of oil exploration, such as within the NPRA. 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 NPRA, 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 NPRA EIS 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 often unassociated with any waterbody (Anderson et al. 1999).

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. 1998). 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). Thus, acquiring a pre-development baseline of swan nests and broods is useful for site planning and for documenting pre-development conditions.

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, 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).

BRANT

Brant 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.

STUDY AREA

Three survey areas (arbitrarily named North, South, and West), encompassing nine prospective exploratory drill sites (Hunter 1; Oxbow 1; Outlook 1; Rendezvous 1, 2, and 3; and Spark 2, 3, and 4 [Rendezvous 3 was subsequently dropped from the list for proposed drilling and another site, Spark 5, was proposed after our study was completed]) were located in the northeastern section of the NPRA (Figure 1). These curvey areas were approximately 15–50 km west of the village of Nuiqsut, Alaska (70º 15'N, 151º 15'–152º W) and approximately 125 km west of Prudhoe Bay on the Arctic Coastal Plain of northern Alaska (Figure 1). Aerial surveys for Spectacled Eiders and Tundra Swans included 100% coverage of the three survey areas, whereas ground surveys were conducted only in the immediate vicinity (~40 acres plots) of 9 prospective exploratory drill sites (no ground survey was conducted at Spark 5 because this site was added too late to fit into our scheduled field work).

Landforms, vegetation, and wildlife habitats in the northeastern NPRA were described in the recent Environmental Impact Statement for the lease area (BLM 1998) and are similar to 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 NPRA are influenced by the predominately northeastern winds during summer that control the development of oriented thaw lakes on the coastal plain and also affect aeolian deposition from the nearby Colville River (BLM 1998). Vegetative cover within the northeastern NPRA 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 climate of the northeastern NPRA 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 5º C (43º 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 0–10º C (32–50º F) during the growing season.

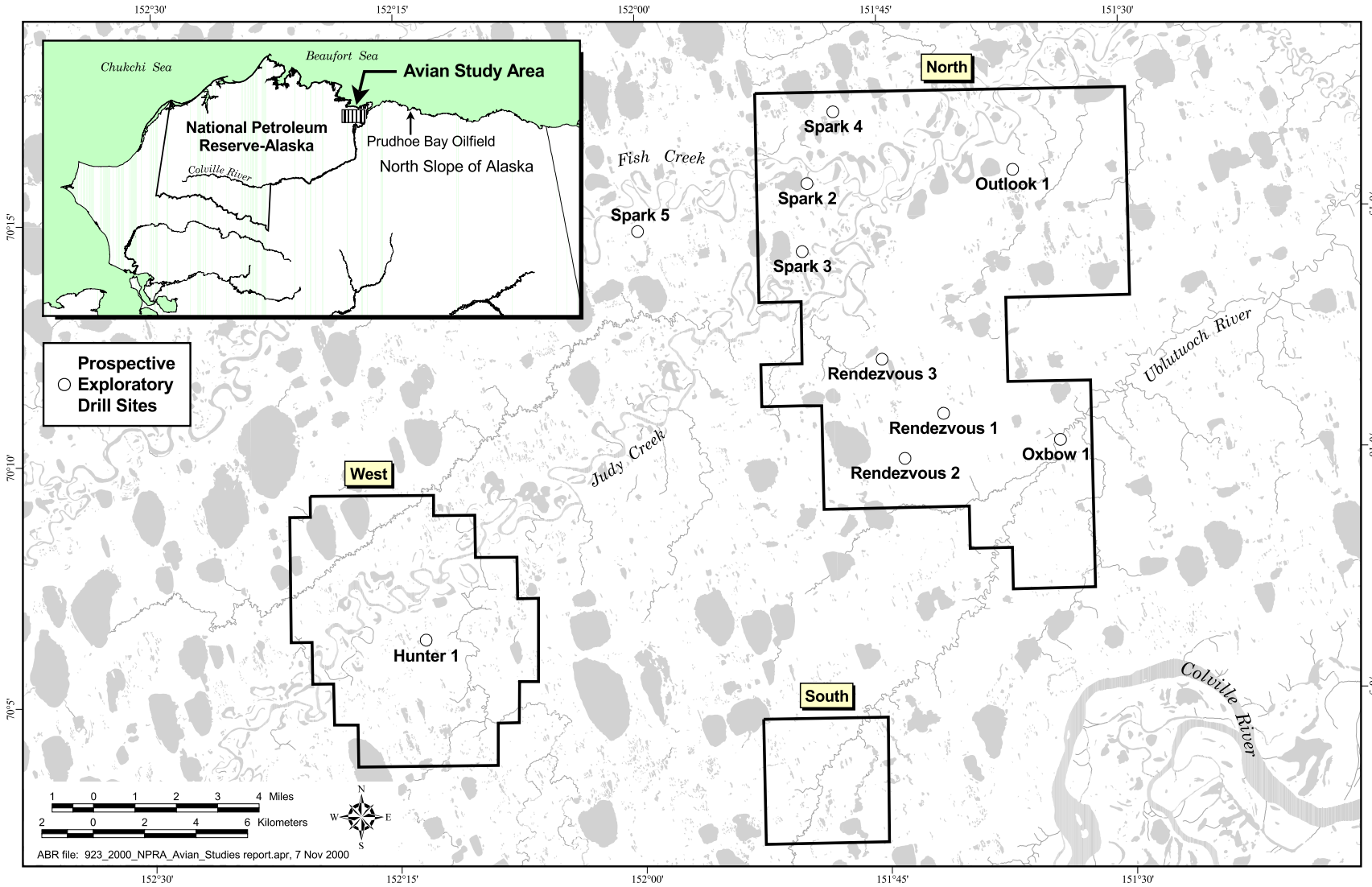

Figure 1. Locations of survey areas for avian studies in the northeastern National Petroleum Reserve–Alaska, June–August 2000. The 40-acre boundaries for prospective drill sites are denoted by the open circles The Rendezvous 3 site was dropped from, and the Spark 5 site was added to the list of proposed drill sites after our surveys were completed.

METHODS

EIDERS

AERIAL SURVEY FOR BREEDING PAIRS

We conducted one aerial survey for breeding pairs of eiders on 15 June 2000 following the same methods used in NPRA in 1999 (Anderson and Johnson 1999) and on the Colville delta since 1992 (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). 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 survey area. We calculated the total indicated birds following the procedures of the USFWS survey protocol (Appendix A). 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 nine locations for ground-based nest searches based on prospective drill-site locations provided by PHILLIPS. We delineated ~40 acre areas surrounding each of these sites and then searched potential waterbird nesting habitats (i.e., areas with mixtures of waterbodies, basin wetland complexes, and other small ponds and wetlands), with an emphasis on searching habitats favored by nesting Spectacled Eiders. For example, we searched most intensively within 25 m of the edge of waterbodies, because Spectacled Eiders tend to locate their nests near water (Anderson et al. 1998, Johnson et al. 1998). Nest searches were performed from 27 to 30 June, 2000, typically with 2-4 observers present at a site for 3–4 hours. Areas with more extensive wetland habitats were searched most intensively (i.e., more time and/or observers).

We also recorded the locations and status of all bird nests in the search area. For each nest found, we recorded the species and nest location on a color infra-red aerial photograph (1:63,000) of the area and noted the status (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 departing. All nest locations were summarized and the nests of selected species were digitized and added to a GIS database.

TUNDRA SWANS

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 last year in NPRA (Anderson and Johnson 1999) and for the Kuparuk Avian Studies and Colville River delta monitoring programs (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 somewhat larger than those used for the aerial survey for eider breeding pairs because of the wider transects flown (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 was 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 2000, we flew the nesting survey on 24 June and the brood-rearing survey on 19 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

AERIAL BREEDING-PAIR SURVEY

Spectacled Eider

During the aerial survey on 15 June 2000, we saw only six Spectacled Eiders at four locations in the three study areas: 2 pairs and 1 male on the ground, and one male flying (Table 1, Figure 3). All of these sightings were in the North survey area, and an additional pair was seen just outside this area.

Density of Spectacled Eiders in the three survey areas was 0.03 birds/km^2 (based on total indicated birds) in 2000 (Table 1), which falls within the range previously reported for this species in northeastern NPRA (≤0.05 birds/km^2; BLM 1998). 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). These comparisons indicate that this section of the northeastern NPRA supports fewer breeding pairs of Spectacled Eiders than the Colville River Delta and the developed oilfields to the east, probably due to differences among the areas in availability of suitable habitats 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 15 June 2000. Steller's Eiders have been recorded in the general vicinity in the past: one observation to the south of the proposed least blocks in 1993, and one to the northeast of the lease blocks in 1995 (BLM 1998).

King Eider

King Eiders were more numerous than Spectacled Eiders and occurred in all three survey areas (Table 1, Figure 3). We observed slightly more King Eiders on the ground than were flying. Density of King Eiders in the study area in 2000 was 0.16 birds/km^2 (based on total indicated birds with flying birds excluded). Both the North and South survey areas supported a higher density of King Eiders than did the West survey area (Table 1). The density of King Eiders in the three survey areas in 2000 was at the lower end of the density range (0.07–0.47 birds/km^2) previously reported for this area (BLM 1998). This density also is lower than densities 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; Johnson et al. 1998), but higher than that on the Colville River 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 NPRA are east of Teshekpuk Lake.

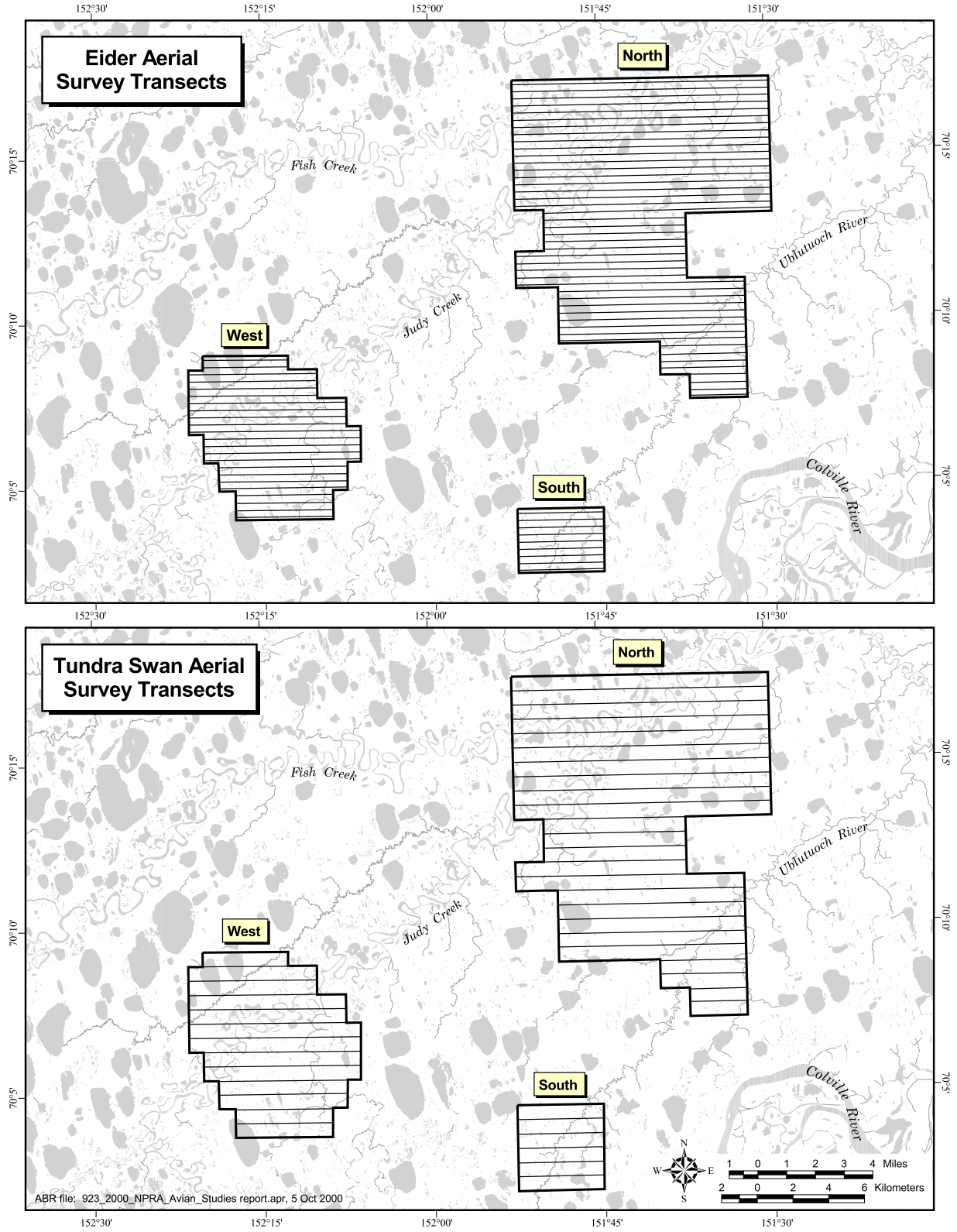

Figure 2. Transect lines for the aerial survey for breeding pairs of eiders and for Tundra Swans (both nesting and brood-rearing) in the northeastern National Petroleum Reserve–Alaska, 2000. Transects were 400 m wide for eiders and 1600 m wide for Tundra Swans.

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 several proposed exploratory drilling locations. During late June, we searched nine areas for nesting eiders and other large waterbirds and located 62 nests of 22 species (Table 2). Eight of the areas searched remained on the list of drilling locations proposed for the winter of 2000/2001; the Rendezvous 3 area was dropped from the list. An additional location, Spark 5, was proposed after we had already completed our ground searches. During our ground searches, we did not find any nests of Spectacled Eiders, but we did locate four King Eider nests, eight Greater White-fronted Geese nests, two Tundra Swan nests, and four Pacific Loon nests (Table 2, Figure 4).

Each of the ground search areas had some suitable nesting habitat for waterbirds, but Spark 4 had both the largest number of nests and the greatest diversity of species (Table 2, Figure 4). The presence of three Deep Open Lakes with adjacent wetland complexes, probably accounts for the productivity of this ground search area. Two other areas, Spark 3 and Hunter 1, also had a mixture of wetlands within the ground search area and moderate numbers of nests.

TUNDRA SWAN

AERIAL SURVEY FOR TUNDRA SWAN NESTS

During the aerial survey for nesting Tundra Swans on 24 June 2000, we located 16 adults associated with 12 nests, and 30 adults without nests, including 2 adults without nests which were seen just outside the survey block boundaries (Table 3, Figure 5). Most of the nests (10 of 12) occurred in the North survey block, and 1 each in the West and South blocks. Stickney et al. (1992) estimated that 27% of all nests probably are missed during systematic swan aerial surveys. Occupied nests 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.

Thus, comparisons among the study area and adjacent areas indicated that the density of swan nests in the study area generally was similar to elsewhere on the 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 NPRA.

We observed more nonbreeding swans than breeding swans in the survey area in 2000 (28 and 16 adults, respectively). Densities of breeding adults (0.05 birds/km^2), nonbreeders (0.09 birds/km^2), and total swans (0.14 birds/km^2) were 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 (24 breeders [12 nests × 2] vs 22 nonbreeders).

Nest density in the survey area was 0.04 nests/km^2, similar to 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 slightly less than the density recorded during the 1999 survey and 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).

Table 1. Numbers and densities (per km^2) of Spectacled and King eiders recorded during a breeding pair aerial survey in the National Petroleum Reserve–Alaska, 15 June 2000. See Figure 2 for extent of survey coverage.

	Numbers Observed						Densities (birds/km^2)[a]		
Species / Survey Area	Males	Females	Total Birds	Observed Pairs	Sightings	FWS Indicated Total Birds[b]	Breeding Pairs[c]	Total Birds[d]	USFWS Indicated Total Birds
SPECTACLED EIDER									
North									
Non-flying	3	2	5	2	3	6	0.02	0.03	0.03
Flying	1	0	1	0	1	2			
All Birds	4	2	6	2	4	8			
Total									
Non-flying	3	2	5	2	3	6	0.02	0.03	0.03
Flying	1	0	1	0	1	2			
All Birds	4	2	6	2	4	8			
KING EIDER									
North									
Non-flying	17	10	27	10	11	34	0.09	0.14	0.18
Flying	10	9	19	8	6	20			
All Birds	27	19	46	18	17	54			
West									
Non-flying	1	0	1	0	1	2	0.01	0.01	0.03
Flying	5	4	9	4	4	10			
All Birds	6	4	10	4	5	12			
South									
Non-flying	2	1	3	1	2	4	0.11	0.17	0.22
Flying	3	1	4	1	3	6			
All Birds	5	2	7	2	5	10			
Total[e]									
Non-flying	22	13	35	13	16	44	0.08	0.013	0.016
Flying	18	14	32	13	13	36			
All Birds	40	27	67	26	29	80			
UNIDENTIFIED EIDER									
West									
Flying	0	1	1	0	1	0	0	0.01	0
All Birds	0	1	1	0	1	0			
Total									
All Birds	0	1	1	0	1	0	0	0.01	0

[a] Densities based on area surveyed for each block (East = 192.9 km^2; South = 17.4 km^2; West = 68.0 km^2) and the total study area (278.3 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] Total number of birds includes birds seen just outside of the lease blocks.

Table 2. Bird and mammal species seen during surveys at selected sites in the National Petroleum Reserve–Alaska, 27–30 June 2000. Birds observed are denoted with ×; known breeders are denoted with a number indicating the number of nests found. The Rendezvous 3 site was dropped after our surveys from the list of prospective drill sites.

Common Name	Scientific Name	Hunter 1	Oxbow	Outlook 1	Rendezvous 1	Rendezvous 2	Rendezvous 3	Spark 2	Spark 3	Spark 4
BIRDS										
Pacific Loon	*Gavia pacifica*	×		×	**1**	×	**1**	×	**1**	**1**
Yellow-billed Loon	*Gavia adamsii*							×		
Greater White-fronted Goose	*Anser albifrons*	**1**	×	**2**	**1**	**1**	×	×	**1**	**2**
Canada Goose	*Branta canadensis*								**2**	
Tundra Swan	*Cygnus columbianus*							×		**1**
Northern Shoveler	*Anas clypeata*							×		
Northern Pintail	*Anas acuta*	×	**1**	×	×	×	×	×	×	
Green-winged Teal	*Anas crecca*		×							
Scaup sp.	*Aythya* sp.	×						**1**	×	**1**
King Eider	*Somateria spectabilis*			**1**	**1**			**1**		**1**
White-winged Scoter	*Melanitta fusca*	**1**								
Long-tailed Duck (oldsquaw)	*Clangula hyemalis*	×	×	×		×	×	×	×	**1**
Red-breasted Merganser	*Mergus serrator*							×		
Willow Ptarmigan	*Lagopus lagopus*	×	×	**2**	×	×	**2**	**1**	×	×
Rock Ptarmigan	*Lagopus mutus*							×	×	
Sandhill Crane	*Grus canadensis*									
Black-bellied Plover	*Pluvialis squatarola*	×	×		**1**	×	×	×	×	
American Golden-Plover	*Pluvialis dominica*	×	×		**2**	×		×	**1**	×
Bar-tailed Godwit	*Limosa lapponica*								×	
Semipalmated Sandpiper	*Calidris pusilla*	×	×	×	×	×	×	×	×	×
Pectoral Sandpiper	*Calidris melanotos*	×	×	×	×	×	×	**1**	×	×
Dunlin	*Calidris alpina*	×	×	×	×			×		×
Stilt Sandpiper	*Calidris himantopus*	×	×							×
Long-billed Dowitcher	*Limnodromus scolopaceus*	**1**	×	×	×	×	×	**1**	**1**	×

Table 2 (continued)

Common Name	Scientific Name	Hunter 1	Oxbow	Outlook 1	Rendezvous 1	Rendezvous 2	Rendezvous 3	Spark 2	Spark 3	Spark 4
Common Snipe	*Gallinago gallinago*						×			
Red-necked Phalarope	*Phalaropus lobatus*	**1**	×	**1**	**1**	×	×	×	×	×
Red Phalarope	*Phalaropus fulicaria*				×	**1**		×	×	
Parasitic Jaeger	*Stercorarius parasiticus*	**1**		×	**1**	×	×	**1**	×	**1**
Long-tailed Jaeger	*Stercorarius longicaudus*	**1**	**1**	×	×	×		×	**1**	**2**
Glaucous Gull	*Larus hyperboreus*	**1**	×	×	×	×	×	×	**2**	×
Sabine's Gull	*Xema sabini*					×	×	×		**1**
Arctic Tern	*Sterna paradisaea*		×			×	×	×	**3**	**4**
Yellow Wagtail	*Motacilla flava*	×	×	×		×		×	×	
Wilson's Warbler	*Wilsonia pusilla*							×		
American Tree Sparrow	*Spizella arborea*							×		
Savannah Sparrow	*Passerculus sandwichensis*		×	×		×		×	×	
Lapland Longspur	*Calcarius lapponicus*	**1**	×	×	×	×	×	×	×	×
Common Redpoll	*Carduelis flammea*	×	×	×				×	×	
Total Nests		**8**	**2**	**6**	**8**	**2**	**3**	**6**	**12**	**15**
MAMMALS										
Arctic Ground Squirrel	*Spermophilus parryii*		×							
Caribou	*Rangifer tarandus*		×		×					×

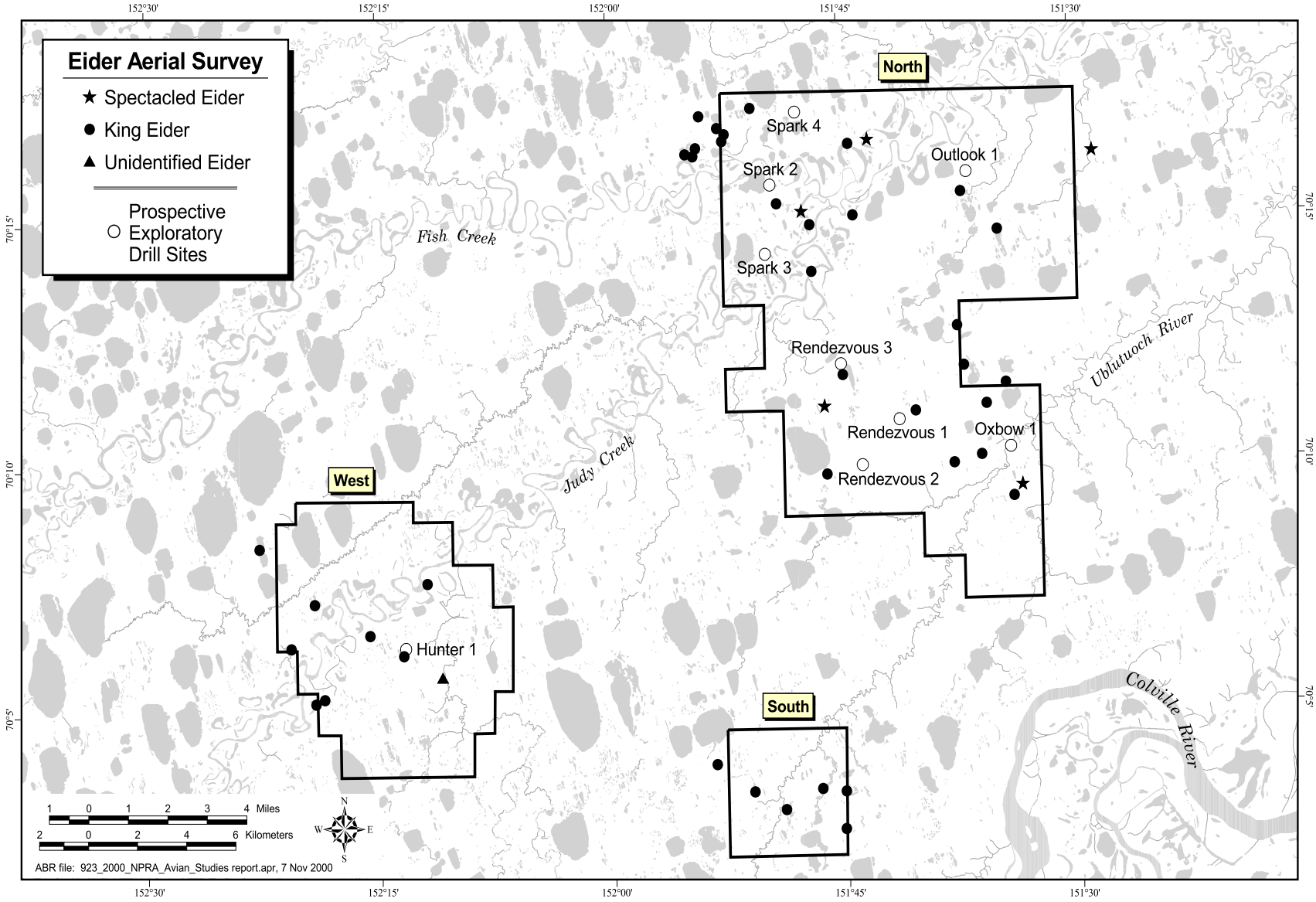

Figure 3. Eider observations recorded during the breeding-pair aerial survey in the northeastern National Petroleum Reserve–Alaska, 15 June 2000. The Rendezvous 3 site was dropped from the list of proposed drill sites after our study was completed.

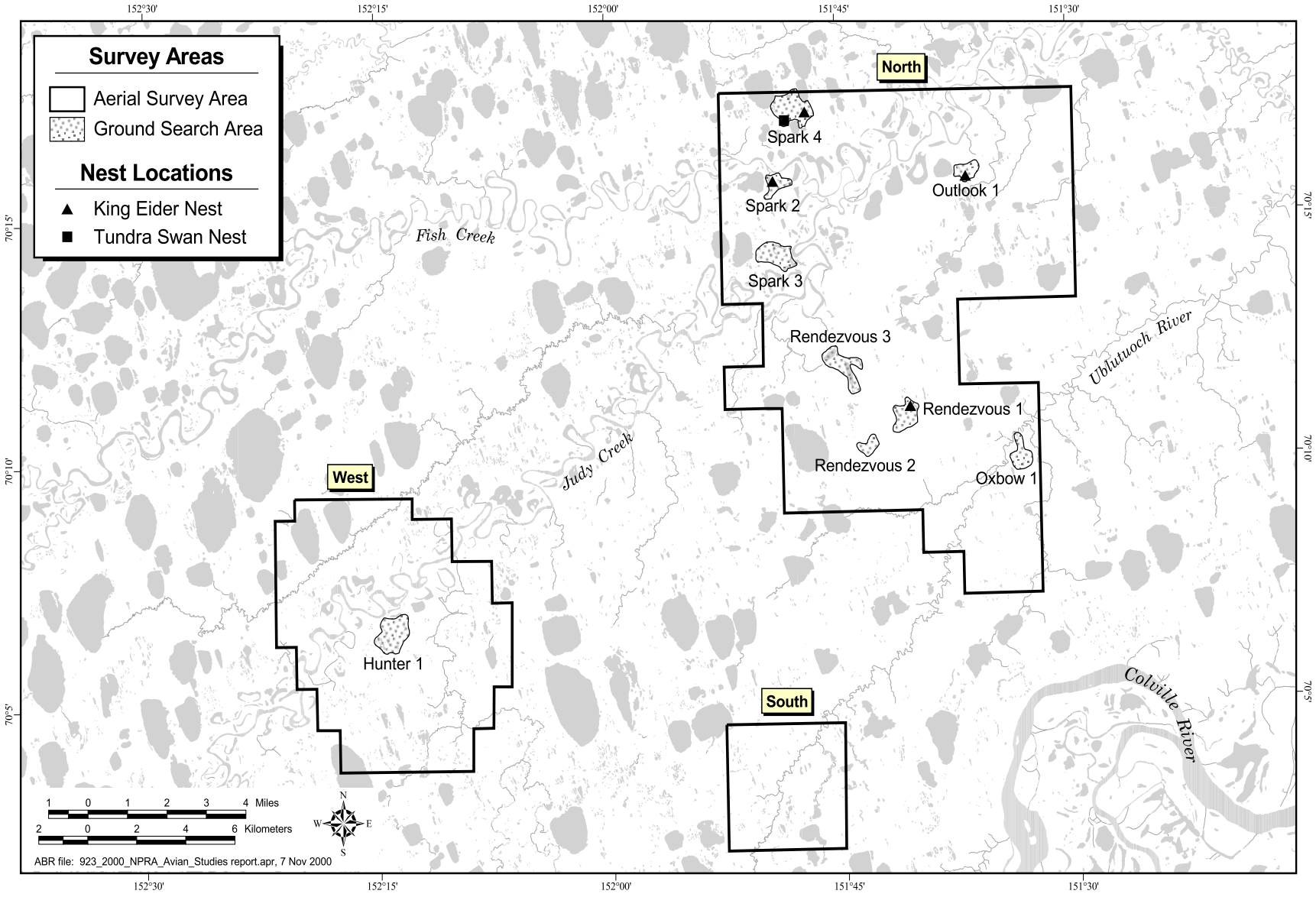

Figure 4. Avian nest search areas and nests found for selected species in the northeastern National Petroleum Reserve–Alaska, 27–30 June 2000. All nests found are listed in Table 2. The Rendezvous 3 site was dropped from the list of proposed drill sites after our study was completed.

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, 24 June 2000

	Survey Areas			Outside survey areas	Total	Density[a] (no./km^2)
	North	West	South			
Nests	10	1	1	0	12	0.04
Swans with Nests						
Singles	6	1	1	0	8	0.03
Pairs	4	0	0	0	4	0.01
Total Adults	14	1	1	0	16	0.05
Swans without Nests						
Singles	4	4	2	0	10	0.03
Pairs	5	2	0	1	8	0.02
In Flocks	4	0	0	0	4	0.01
Total Adults	18	8	2	2	30	0.09
Total Swans	32	9	3	2	46	0.14

[a] Density based on a survey area of 310.6 km^2 and excludes swans seen outside the survey areas.

AERIAL SURVEY FOR TUNDRA SWAN BROODS

We counted 52 Tundra Swans in the survey area during the brood-rearing aerial survey on 19 August 2000 (Table 4, Figure 6), as well as 7 swans just outside the area. We observed five broods comprising eight young and ten adults. The mean brood size in 2000 was 1.6 young/brood (range 1–2) which was smaller than last year's mean of 3 young/brood recorded in the survey area and less than the 11-year mean of 2.5 young/brood recorded in the Kuparuk Oilfield (Anderson et al. 2000).

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 42% (5 of 12 nests successful). A comparable brood-rearing survey was flown in the Kuparuk Oilfield, and preliminary calculations indicate an estimated nesting success rate of 63% in that area (ABR, Inc., unpublished data). These success rates for 2000 are lower than those recorded in previous years in the Kuparuk Oilfield (range = 64–100%; 1988–1999; Anderson et al. 2000) 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–early June 2000.

Given the relatively poor nesting success in the study area in 2000, 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 41 adult swans without broods, primarily in pairs scattered throughout the study area (Table 4, Figure 6); we saw 4 flocks (≥3 swans) of non-breeding swans. All swans with broods were observed in the North Block. Nonbreeding swans were observed in the North and West blocks; seven swans were just outside the survey area.

Table 4. Numbers of Tundra Swans and broods observed during an aerial survey of three survey areas in the National Petroleum Reserve–Alaska, 19 August 2000.

	Survey Areas			Outside survey areas	Total	Density[a] (no./km^2)
	North	West	South			
Broods	5	0	0	0	5	0.02
Swans with Broods						
Singles	0	0	0	0	0	0
Pairs	5	0	0	0	5	0.02
Young	8	0	0	0	8	0.03
Total Adults	10	0	0	0	10	0.03
Swans without Broods						
Singles	3	2	0	1	6	0.02
Pairs	8	2	0	0	10	0.03
In Flocks	9	0	0	6	15	0.03
Total Adults	28	6	0	7	41	0.11
Total Adults	38	6	0	7	51	0.14
Total Young	8	0	0	0	8	0.03
Total Swans	46	6	0	7	59	0.17

[a] Density based on a survey area of 310.6 km^2 and excludes swans seen outside the survey areas.

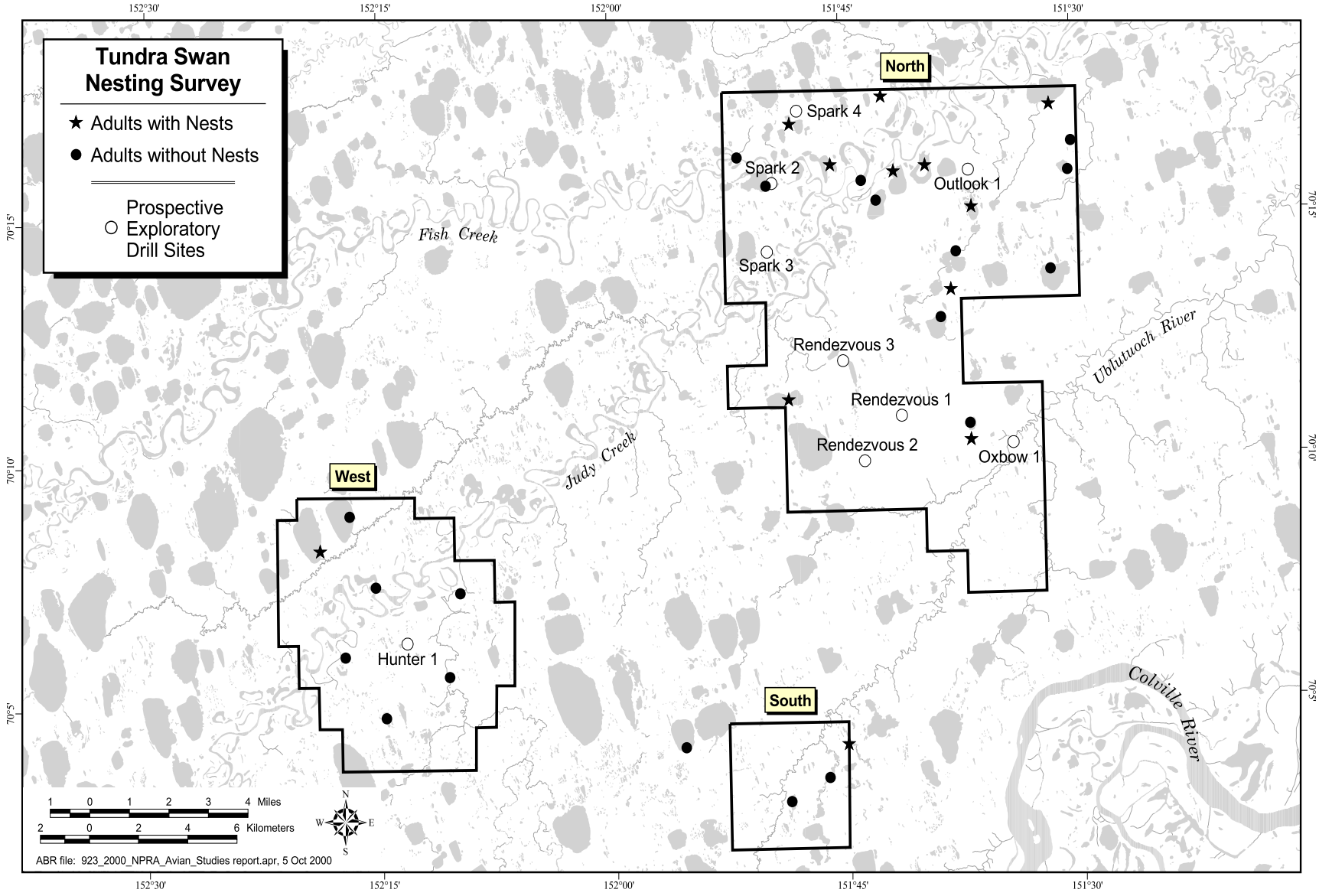

Figure 5. Locations of Tundra Swans observed during the nesting aerial survey in the northeastern National Petroleum Reserve-Alaska, 24 June 2000. The Rendezvous 3 site was dropped from the list of proposed drill sites after our study

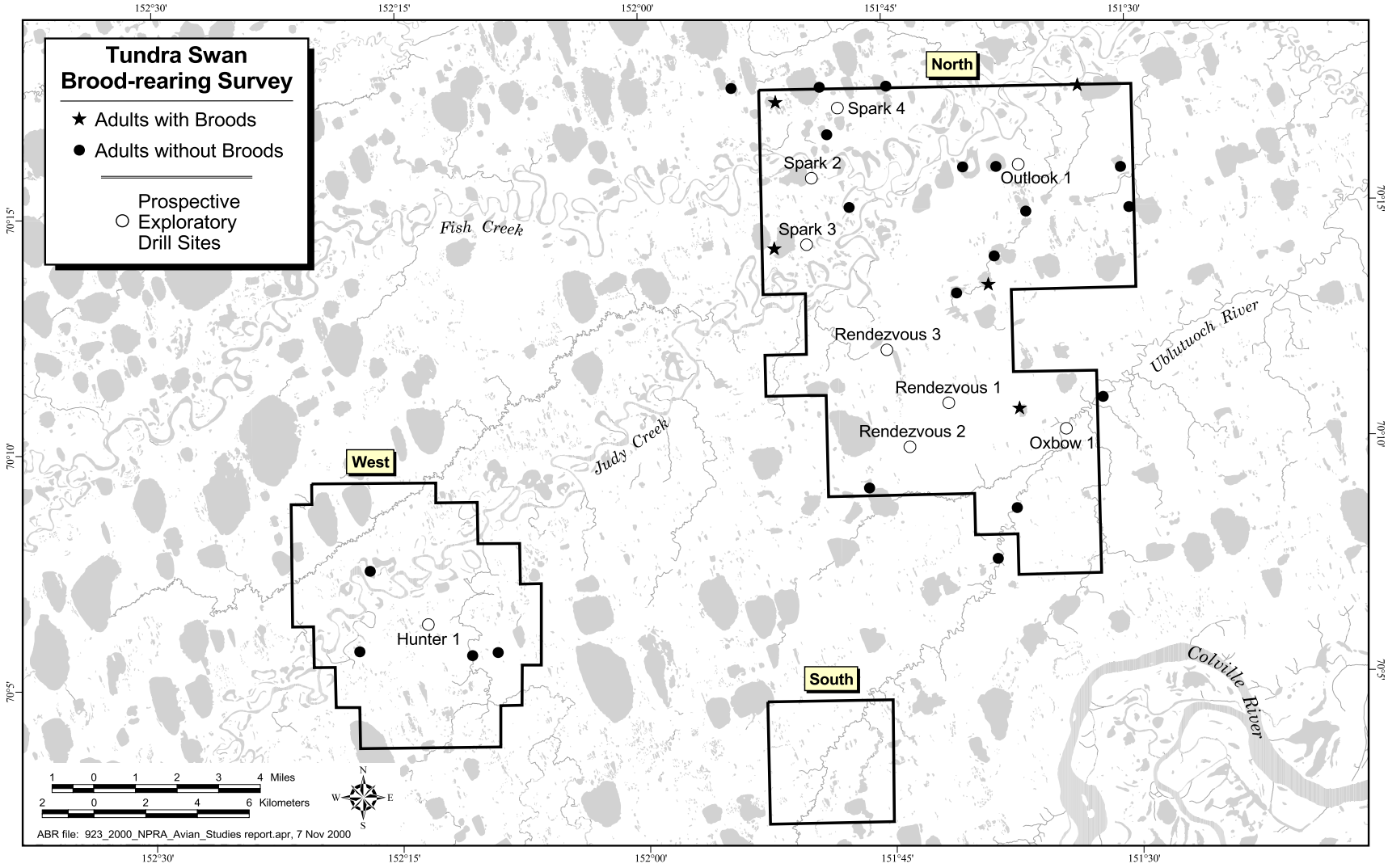

Figure 6. Locations of Tundra Swans observed during the brood-rearing aerial survey in the northeastern National Petroleum Reserve-Alaska, 19 August 2000. The Rendezvous 3 site was dropped from the list of proposed drill sites after our study

OTHER AVIAN SPECIES

In addition to surveys conducted specifically to collect information about avian use of proposed drill sites in the NPRA, regional surveys have been conducted to collect information about the presence of selected avian species on the Arctic Coastal Plain, including the NPRA. Species that have been the focus of regional surveys have included Peregrine Falcons and Brant. In 1999, Ritchie and Wildman (2000a) found a Peregrine Falcon pair with nest approximately 8 km west of Spark 2 on the bank of Fish Creek and within 2 km of the proposed Spark 5 drill site. Quite a few peregrine nests also were found in the transition area between the Coastal Plain and the Brooks Range Foothills. Nests in this transition area tended to be on top of mudbanks cut by meandering rivers and occasionally on high-relief mudbanks along lake shorelines (Ritchie and Wildman 2000a). The peregrine population in NPRA apparently is expanding and suitable substrates for nesting exist within the area we surveyed in 2000.

Brant nesting surveys have been flown along the Arctic Coastal Plain from the Colville River delta to at least as far west as Barrow since 1994 (Ritchie and Wildman 2000b). These surveys focus primarily on coastal habitats, but these surveys in some years have included the Fish Creek drainage. In 1996, the Brant nesting survey recorded a colony of at ~6 nests just outside the northeast corner of our 2000 North survey area. All other Brant colonies located on that survey were closer to the coast.

SITE-SPECIFIC SUMMARIES

During the ground visits to proposed exploratory drill sites, we took notes on general habitat characteristics of each of the search areas, as well as recording information on nests that we found. (Although Rendezvous 3 was subsequently dropped from the list of sites proposed for drilling in the winter of 2000/2001, it was on our list of areas to be searched during the summer, so the information is included here.) The aerial surveys for eiders and Tundra Swans also provided information pertinent to some of the prospective drill sites. No Spectacled Eiders were seen within the 40 acre areas encompassing each of the prospective drill sites, and only four were seen within 2 km of a prospective drill site (one pair southwest of Rendezvous 3, one male near both Spark 2 and Spark 3, and one male southeast of Oxbow 1; Appendices B1–3). One male King Eider was observed during the pre-nesting aerial survey near the border of the Hunter 1 site, and 23 King Eiders were recorded within 2 km of the nine prospective drill sites (Appendices B1–3). Four King Eider nests were found in the ground search areas, however (Table 2). Although no Tundra Swan nests were found during the aerial survey within the 40 acre areas surrounding the prospective drill sites, four nests and two broods were recorded within 2 km of the proposed drill sites during the aerial surveys. One of these nests, near Spark 4, also was recorded in the same location during the ground search (Appendices B1–3). A brief description of the habitat and avian resources for each prospective drill site follows.

HUNTER 1

The search area at Hunter 1 is dominated by an Old Basin Wetland Complex adjacent to Judy Creek, which consists of a horseshoe of small ponds surrounding a large expanse of low-center polygons. The area is elevated above the creek, however, and may not benefit from seasonal flooding. Hunter 1 was one of the more productive sites for breeding birds, with 8 nests of 8 species found during nest searching (Table 2). In addition, three King Eiders (one pair 2 km to the northwest and one male just outside the proposed drill site boundary) were recorded in this area during the aerial survey (Figure 3, Appendix B2).

OXBOW 1

This area is bisected by a deeply incised stretch of the Ublutuoch River, which has a fairly deep (1–2 m) channel. Wetlands in the survey area are limited in complexity and contain little in the way of the deeper waterbodies that are favored by loons, eiders, geese, and swans. The search area was of low value to nesting waterbirds, as we found only two nests (Table 2). Immediately south of the Oxbow 1 survey area, a large wetland complex offers habitat more suitable for nesting and brood-rearing waterbirds. A Spectacled Eider male was seen during the aerial survey in this wetland area. In addition, six King Eiders (2 pairs west and 2

males south) were recorded during the aerial survey within 2 km of the proposed drill site (Figure 3, Appendix B1). A Tundra Swan nest and brood were recorded within 2 km northwest of the prospective drill site during the aerial surveys (Figures 5 and 6, Appendix B1).

OUTLOOK 1

This area is dominated mostly by shallow, marshy ground rather than sizable ponds or lakes. There are, however, some perennial shallow open ponds. Larger ponds and deep open waterbodies are immediately adjacent to the site, and the wetlands within Outlook are connected to these more extensive and diverse wetlands. Drainage of the site apparently flowed north into a larger, more complex wetland. Outlook 1 was moderately productive for breeding waterbirds, with six nests of four species found during nest searching, including a King Eider nest (Table 2). During the aerial surveys, four King Eider pairs were recorded within 2 km south of the proposed site (Figure 3), and two Tundra Swan nests were recorded, one within 2 km west, and the other within 2 km south of the site (Figure 5, Appendix B1).

RENDEZVOUS 1

The southeastern portion of this search area is dominated by rolling uplands with tussocks, dwarf birch, and willow, which provide little if any nesting habitat for waterbirds. The search area encompassed the southern end of a large basin wetland complex. Most of the open aquatic habitat was small *Carex*-dominated ponds, which were hydrologically connected to one another. This site was moderately productive for breeding waterbirds, with eight nests of seven species found during nest searching (Table 2). During the eider breeding pair survey, a King Eider male was recorded within 1 km of the proposed drill site (Figure 3), and we found a King Eider nest at this location during our ground search (Figure 4, Appendix B1). There were no Tundra Swans recorded within 2 km of the proposed drill site.

RENDEZVOUS 2

This area is dominated by uplands and has only limited wetland habitats favored by nesting or brood-rearing waterbirds. No stream or other structured drainage system occurs within the area. The majority of the area is dominated by Moist Tussock Tundra. Standing, perennial water was limited to shallow ponds with aquatic sedges, with few emergents. Only two nests were found during nest searching (Table 2). During the eider aerial survey, a King Eider pair was observed within 2 km southwest of the proposed drill site (Figure 3, Appendix B1).

RENDEZVOUS 3

This area has two deep open lakes and a couple of basin wetland complexes dominated by shallow *Carex* ponds. Most of the terrestrial habitat is low-center polygons, with tussocks on all elevated sites including polygon ridges. Some Upland Shrub patches also occurred in the area. This site was not productive waterbird nesting habitat, as we found only three nests of two species (Table 2). During the eider aerial survey, a Spectacled Eider pair were observed within 2 km of the proposed drill site, and a King Eider male was observed just south of the site boundary (Figure 3, Appendix B1). This area was dropped fron the list of sites proposed for drilling during the winter of 2000/20001.

SPARK 2

A little over half of the Spark 2 area lies within the well-defined old channel/flood-plain of Fish Creek and contains a fairly rich mix of habitat types, including a deep open lake with *Arctophila* fulva stands, and willow/shrub thickets. This lake drained into the river via a ~30 m channel that appears to be open spring through fall. Other wetlands included ponds and shallow open lakes. Six nests of six species, including a King Eider nest, were found during the ground search (Table 2). During the breeding pair aerial survey, one Spectacled Eider male and a King Eider pair were seen within 2 km of the proposed drill site (Figure 3, Appendix B1). No swans with nests or broods were seen within 2 km of the proposed drill site during the swan aerial surveys (Figures 5 and 6).

SPARK 3

This area is close to Judy Creek and has good hydrologic connectivity with the creek at a southern wetland complex and an oxbow lake. Uplands in the area are well-drained with deeply-incised

drainages, including a channel that drains a deep open lake northwest of the area. Wetlands connected to the creek in eastern portion of search area are more productive than isolated wetlands (perched ponds) in upland western portion. Dense stands of willow occur along creek attract passerines, ptarmigan, and foxes (two inactive dens). This area has a diversity of habitat types, and this was reflected in the number of nests found during the ground search (12 nests of 8 species; Table 2). There were at least 2 King Eider pairs recorded within 2 km of the proposed drill site during the aerial survey (Figure 3), and one Tundra Swan brood recorded during the brood-rearing aerial survey (Figure 6, Appendix B1).

SPARK 4

This area was the most diverse and productive of any we searched on the ground in 2000. We found more nests (15) of more species (10) than in any other area (Table 2). This area contains three deep open lakes with adjacent wetland complexes. The eastern wetland complex has numerous small ponds with emergents, ephemeral wetlands, wet sedge, and lots of hummocky microrelief. The big lake and connected wetlands in northwest corner of search area were very productive and contained several nests of waterbirds, as did the lake complex in southern portion of search area. The habitat in the center of search area was fairly high and dry, and dominated by tussocks. We found a King Eider and a Tundra Swan nest during the ground search (Table 2) During the breeding pair aerial survey, a King Eider pair was recorded within 2 km of the proposed drill site (Figure 3, Appendix B1). A Tundra Swan nest was observed during the nesting aerial survey at the same location where we located a nest during the ground search (Figures 4 and 5, Appendix B1).

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Appendix A. 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:

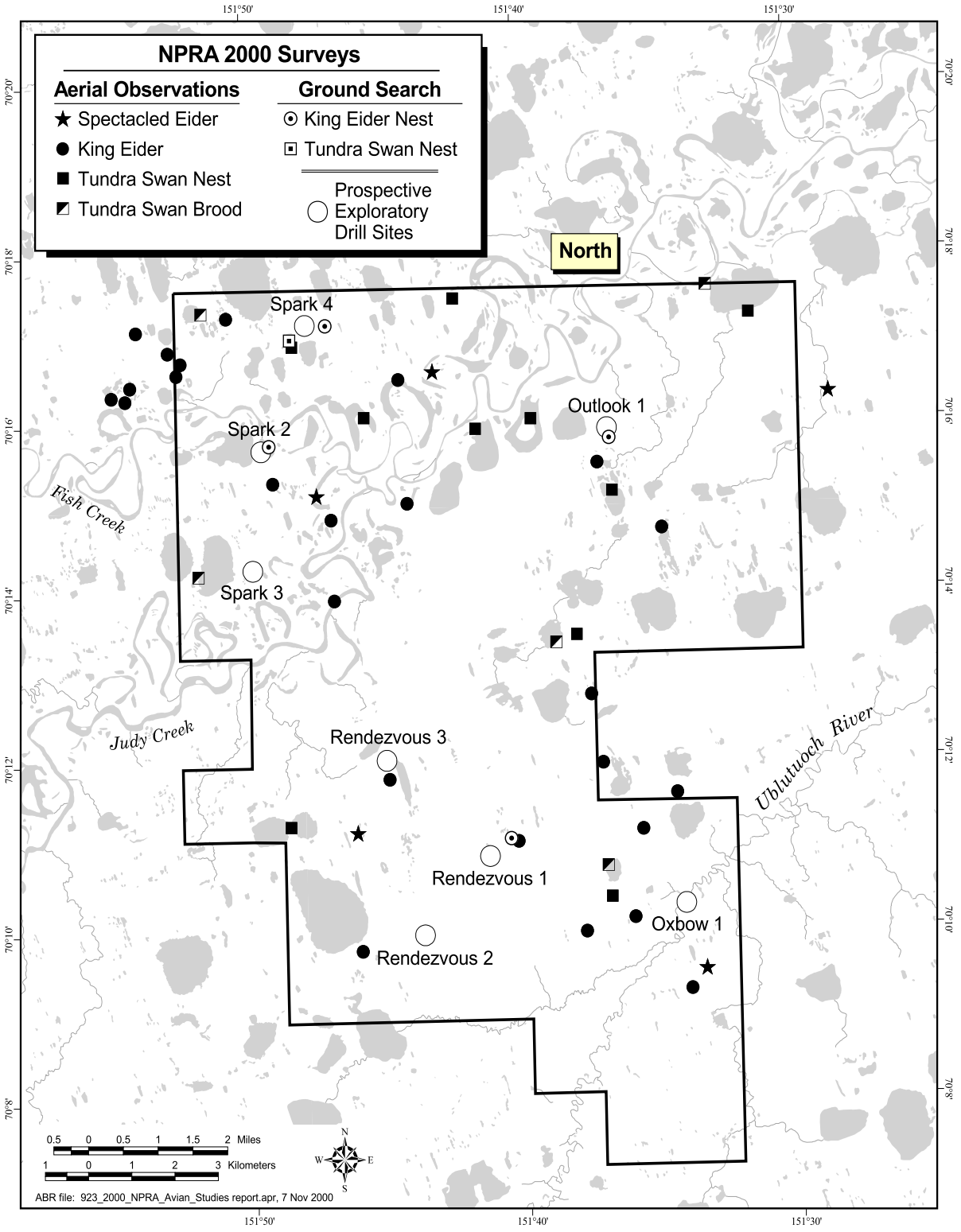
Total indicated birds = (lone males × 2) + (flocked males × 2) + (pairs × 2) + (group total × 1).

Each of these categories is defined in the USFWS protocol:

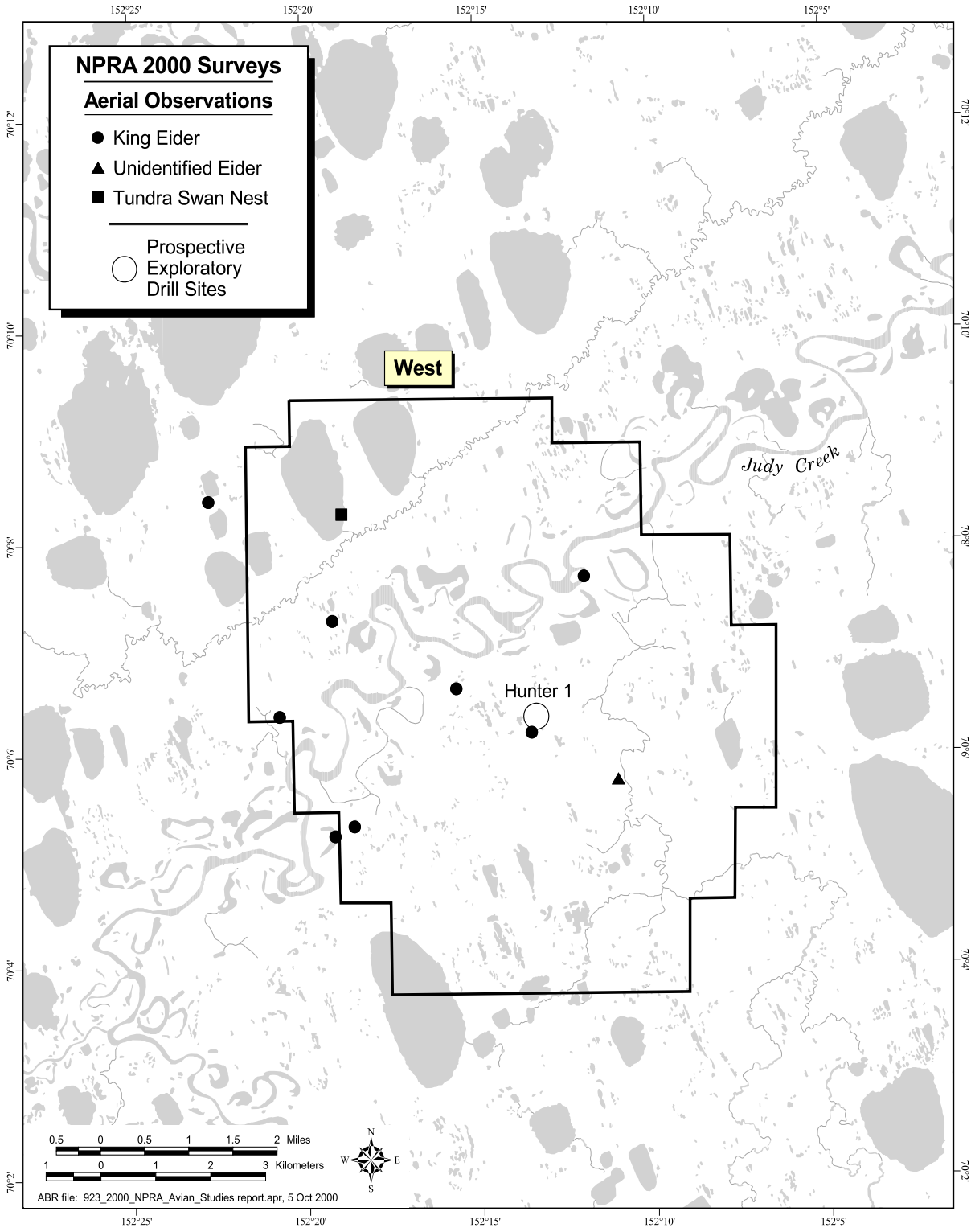
1) "lone males" are single, isolated males without a visible associated female;
2) "flocked males" are two or more males in close association (limited to 2–4 males per flock; no females in the flock);
3) a "pair" is a male and female in close association; and
4) a "group" is three or more of a mixed-sex 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.

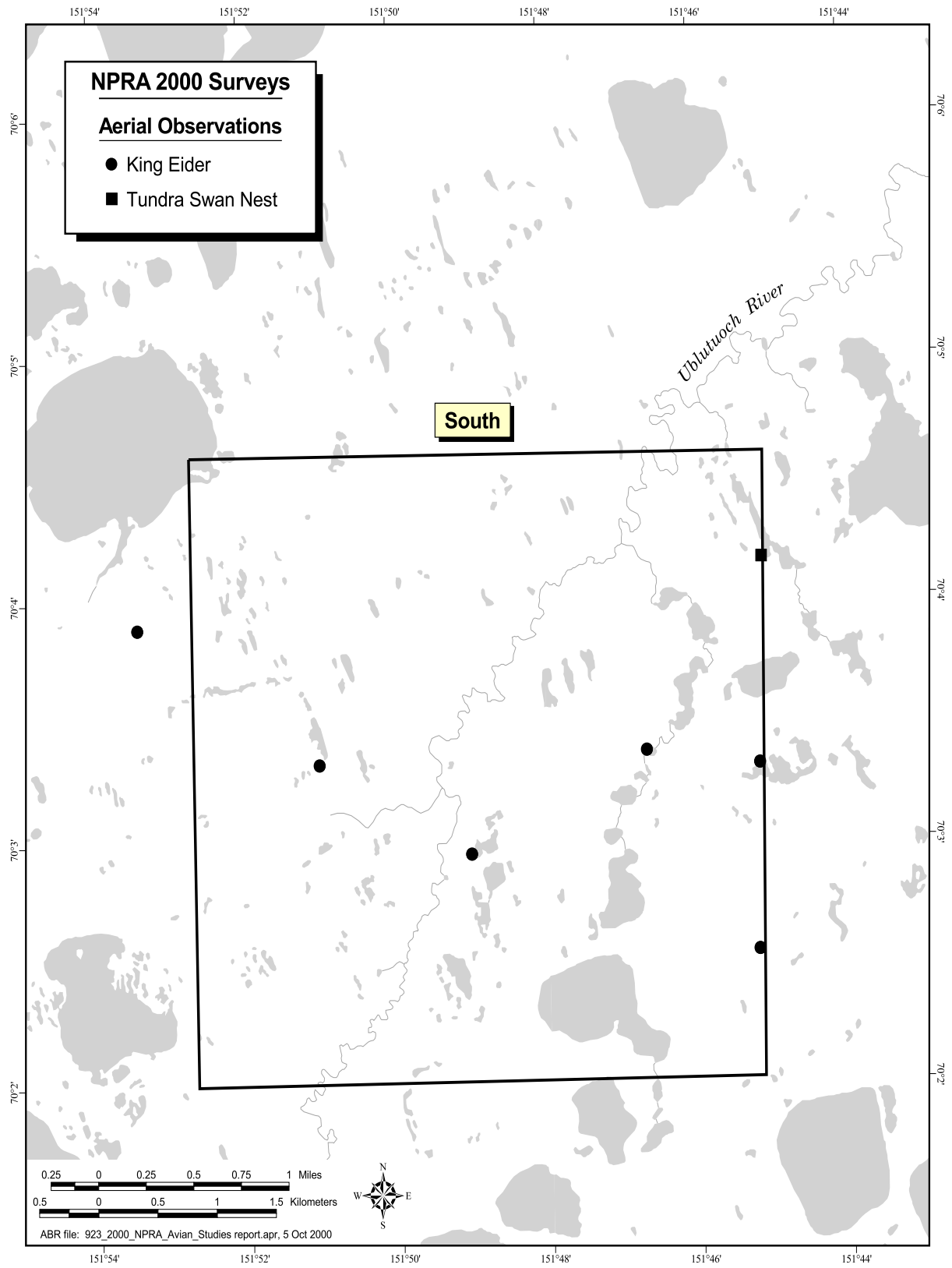
Appendix B. Maps of eiders and Tundra Swans found on aerial surveys, and nests (of King Eiders and Tundra Swans) and broods (of Tundra Swans) found during ground searches of prospective drill sites in the three survey areas in the northeastern National Petroleum Reserve–Alaska, June–August 2000.



Appendix B1. Locations of eiders and Tundra Swans found on aerial surveys, and nests (of King Eiders and Tundra Swans) and broods (of Tundra Swans) found during ground searches of prospective drill sites in the North survey area in the northeastern National Petroleum Reserve–Alaska, June–August 2000. The 40-acre boundaries for prospective drill sites are denoted by the open circles. The Rendezvous 3 site was dropped from the list of proposed drill sites after our study.



Appendix B2. Locations of eiders and Tundra Swans found on aerial surveys, and nests (of King Eiders and Tundra Swans) and broods (of Tundra Swans) found during ground searches of prospective drill sites in the West survey area in the northeastern National Petroleum Reserve–Alaska, June–August 2000. The 40-acre boundaries for prospective drill sites are denoted by the open circles



Appendix B3. Locations of eiders and Tundra Swans found on aerial surveys in the South survey area in the northeastern National Petroleum Reserve–Alaska, June–August 2000.