Biotic Assessment of the Beaver Creek Watershed In the Southern Yukon Flats

40 acre lake (#14) in the proposed exchange area

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SUMMARY

The Yukon Flats National Wildlife Refuge (Refuge) is currently in negotiations with Doyon, Limited (Doyon) to consider exchanging approximately 44,515 hectares (110,000 acres) (proposed land exchange area or PLE) of Refuge lands in the southern Yukon Flats for an equal dollar value of Doyon lands in the region. Since there was limited biological information about this exchange parcel, the Refuge staff collected additional data to better describe the parcel's resources. Between June 16-24 and July 21-25, 2003, and July 12-20, 2004, baseline information on vegetation, water, fish, and bird resources was collected from the PLE and adjacent lands. We sampled 23 sites for plant resources and collected 594 specimens representing 45 families and 121 genera. One plant species, *Scheuchzeria palustris,* ranked as rare by the Alaska Natural Heritage Program, has been identified in the PLE. Other rare species, *Douglasia gormanii, Phlox hoodii,* and *Minuartia yukonensis* were identified in areas adjacent to the PLE. Plant identification is ongoing. Baseline water chemistry data collected from eight lakes within the PLE characterized most lakes as having summer surface waters not limited by oxygen saturation, dissolved oxygen levels in the bottom waters capable of supporting fish, conductivities which did not reflect chemically stratified waters, and water hardness levels indicative of soft water systems. Bathymetric data indicated that most lakes had steep gradients with maximum depths ranging from 3.2 to 24m and lake volumes ranging from .3 to 27 million cubic meters. The majority of lakes sampled were classified as dimictic and cold monomictic systems. Northern pike (*Esox lucius*) were present in all sampled lakes and Beaver Creek. A sample of 17 pike was collected from five locations and all tested positive for presence of methylmercury. Mean level of mercury was 1.92 parts per million (ppm) dry weight with four of the 17 pike in excess of 2 ppm (range 2.44–6.69). The fish with the highest mercury level was sampled from Beaver Creek. Birds were surveyed using point counts at nine locations including six lakes, two alpine sites, and Beaver Creek. A total of 1,231 birds representing 61 species was detected during the survey period. The five bird species that were most common included white-crowned sparrow (*Zonotrichia leucophrys*), Swainson's thrush (*Catharus ustulatus*), dark-eyed junco (*Junco hyemalis*), American robin (*Turdus migratorius*), and fox sparrow (*Passerella iliaca*). Although we sampled many of the larger lakes in the PLE we did not have uniform geographic coverage and we recommend further baseline inventories. Specific locations to target include proposed pipeline access corridors outside the PLE and the Beaver Creek drainage which includes a high diversity of resource values.

ACKNOWLEDGMENTS

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INTRODUCTION

Doyon, Limited (Doyon) has proposed to exchange certain lands Doyon owns within the Yukon Flats National Wildlife Refuge (Refuge) for approximately 44,515 hectares (110,000 acres) of Refuge lands (proposed land exchange area or PLE). The purposes of this proposed land exchange area are: 1) to facilitate oil and gas exploration and development by Doyon, and 2) protect high-quality wildlife habitats within the Refuge that are currently owned by Doyon. A separate environmental evaluation will be conducted to address this proposed exchange. Specific information concerning location of possible oil and gas support facilities has not yet been identified; however, two potential pipeline and access corridors have been identified by Doyon (Figure 1). Although biological data does exist over portions of the Yukon Flats region, there is little information available to land managers to assess resource values specific to the PLE.

OBJECTIVES

The following inventories were conducted to better describe resource features of the PLE:

1) Conduct a survey of the vascular flora focusing on the alpine, upland lakes and Beaver Creek wetland habitats.
    a) Document sensitive or rare vascular species
    b) Collect, process, and submit a permanent voucher collection of vascular flora to the University of Alaska Museum Herbarium, Fairbanks
    c) Create a database of plant voucher collection information for archival at the Refuge and make available to the Alaska Natural Heritage Program (ANHP)

2) Collect baseline water chemistry data and determine lake volumes and depths on a sample of lakes.

3) Document presence of fish on a sample of lakes and measure mercury levels on a sample of northern pike.

4) Characterize avian presence in habitats representative of the PLE.

STUDY AREA AND BACKGROUND

The PLE is situated in the southern Yukon Flats, about 24 km southwest of Birch Creek Village, and lies in the foothills of the White Mountains (Figure 1). The area encompasses the Beaver Creek watershed, includes approximately 40 km of Beaver Creek, and borders an additional 26 km of the Beaver Creek National Wild River corridor (USDI 1983). The area includes upland habitats ranging in elevations from 244 to 305 m and 196 lakes and ponds ranging from 0.4 to 304 hectares. The southern one-quarter of the PLE was proposed for wilderness designation in 1987 (USDI 1987).

The landscape is underlain by discontinuous permafrost and is heavily influenced by wildland fire. In addition the Beaver Creek floodplain is subjected to seasonal flooding. Due to the area's low annual rainfall, high summer temperatures, and high incidence of lightning, fire activity is often intense and widespread. The area includes portions of three old burns that, in total, burned over 50,000 acres between 1987 and 1999 (Fires A633, B510, B200, Alaska Fire Service records). It is estimated that Fire A633 burned over 40% of the area in 1996.

The area is characterized by mixed forests dominated by white spruce (*Picea glauca*), black spruce (*P. mariana*), paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*). Shrub communities of alder (*Alnus* spp.) and willow (*Salix* spp.) are most common in riparian sites and edges surrounding lakes and meadows. Dwarf shrubs such as shrub birch (*Betula nana*), Labrador tea (*Ledum palustre* spp.), crowberry (*Empetrum nigrum*), and blueberry (*Vaccinium uliginosum*) are common in the uplands.

The climate is continental sub-arctic which includes large seasonal extremes of temperature and daylight. Summer temperatures can exceed 38°C and are warmer than any other comparable latitude in North America. The mean minimum January temperature is -33°C with winter temperatures reaching -59°C or lower. Although the area has a short growing season of about 81 days, the long hours of sunlight during the spring and summer months produce abundant vegetation. The mean annual precipitation is 16.7 cm, ranging from 9.1 to 27.2 cm. Snow accumulations rarely exceed 76 cm.

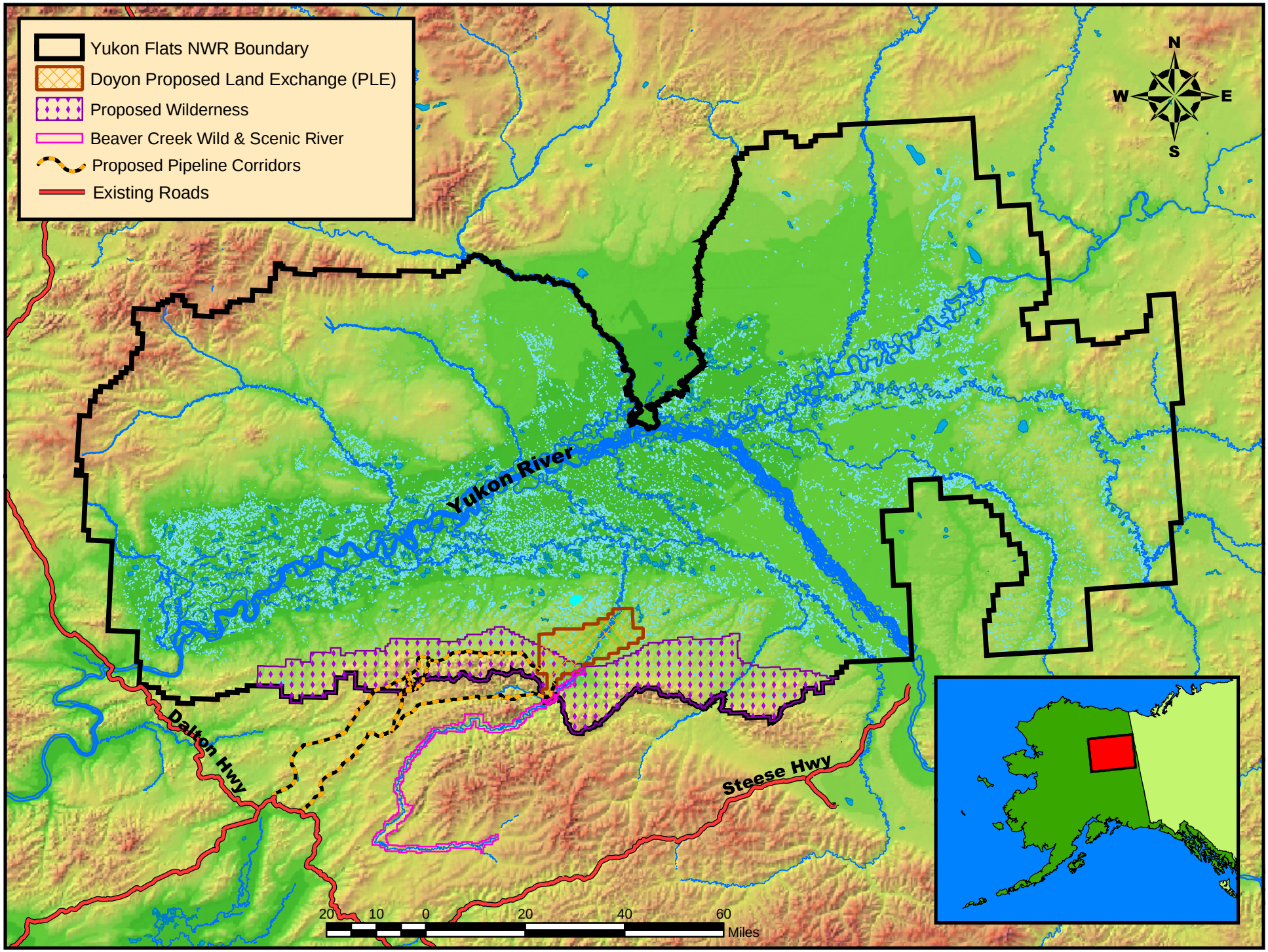

Figure 1. Location of the proposed land exchange area and surrounding features,Yukon Flats National Wildlife Refuge, Alaska.

The following is a summary of known previous resource data collected in the PLE.

Birds - The Division of Migratory Birds, U.S. Fish and Wildlife Service (Service), conducted aerial waterfowl breeding pair surveys over much of the PLE during June 11-14, 2000 (Hodges et al. 2001). Six north/south transects spaced at 5.6 km intervals were flown in the PLE. Timing of the survey was ideal for diving ducks but about two weeks late for dabbling ducks. Estimated birds per square kilometer were: American wigeon 0.50-1.48 (highest densities on Beaver Creek), mallard 0.62 – 1.25, white-winged scoter 3.0-7.0, and scaup species 0.62 – 1.25. The uplands were observed to have widely dispersed deep water lakes, and flying transect lines was found to be an inefficient method for obtaining detailed information in this region compared to lowland habitats.

On June 21, 2000 Refuge biologists conducted aerial surveys of 51 of 196 lakes in the PLE and documented bird use (Bertram and Vivion 2000). An Aviat Husky was used to circle the perimeter of lakes at an altitude of about 61-123 m above ground level. Waterbirds were observed on approximately 50% of lakes surveyed and included red-necked grebe (*Podiceps grisegena*), white-winged scoter (*Melanitta fusca*), lesser scaup (*Aythya affinis*), and pacific loon(*Gavia pacifica*). The most notable observation of this survey was the relatively uniform distribution of pacific loons occurring on 37% of lakes surveyed.

Mammals –Movement data sets are available for moose (*Alces alces*) and black bear (*Ursus americanus*) in the PLE (Nowlin and McLean 1985, Bertram and Vivion 2002). A moose telemetry study conducted between 1983 and 1986 included two bull moose that were captured on Glacier Creek, a tributary to Victoria Creek. The home ranges of these two bull moose were in the PLE and included heavy use of the Beaver Creek drainage. Twenty-nine black bears were radio-collared approximately 24 km north of the PLE. The PLE was used as denning and feeding habitat and a travel corridor for four of the marked bears.

Fish and water resources - Fisheries data have been collected on Beaver Creek at a weir site near the mouth of Victoria Creek and upstream on Bureau of Land Management (BLM) lands in the White Mountains Recreation Area (Kretsinger 1986, Carufel 1990, Fleming and McSweeny 2001, Collin et al. 2002). Salmon passage was monitored between 1998 and 2000 at a site approximately two miles upstream of the confluence of Victoria Creek and three miles upstream of the PLE. Both summer chum (*Onchorhynchus keta*) and chinook salmon (*Onchorhynchus tshawytscha*) passed through the weir in 1999 (75 summer chum, 128 chinook) and 2000 (11 summer chum and 114 chinook salmon).

Stock assessment of Arctic grayling (*Thymallus arcticus*) was conducted in 2000 in upper Beaver Creek, upstream from the Big Bend, about 32 km south of the PLE. The population was estimated at 1,325 fish per river mile, which is significantly higher than in any other reported studies on summer feeding populations of Arctic grayling in Alaskan rivers. Annual sport-fish harvest data have been collected by the Division of Subsistence, Alaska Department of Fish and Game since 1986 (Burr, pers. comm).

The Service has filed water rights applications for two lakes (Lake No. 17, i.e., PLE Lake 2 and Lake M) in the PLE (Bayha and Wolfe 1999). In 1995, the Service conducted a survey to measure both the true water surface elevation and true elevation of the outer perimeter of the wet meadow zone on both of these lakes.

The BLM operated an automated water level recorder stream gaging station near the confluence of Victoria and Beaver creeks from 1988 to 2000. Mean monthly discharges (June to August) in Beaver Creek ranged from 22 to 98 cubic meters per second between 1998 and 2000 (Collin et al. 2002). Currently, gaging stations are limited to the headwaters of Beaver Creek (Jon Kostohrys pers. comm.). Stream discharge information was collected on Beaver Creek at a water gauge site in the northeastern portion (N 66°03.28', W 146° 08.61') of the PLE about 20 miles downstream from the Victoria Creek confluence between 1994 and 1998 (Trawicki 2000). A stream gaging station was installed which measured water stage at 15 minutes intervals and downloaded data to a field recorder. Stream discharge was measured periodically to correlate discharge to stage (water depth). Seasonal discharge estimates were calculated. Peak discharge occurred in late May with high flow events occurring in June and July due to short duration thunderstorms.

Subsistence and recreation use - Subsistence use of the Beaver Creek drainage in the PLE has historically been by Birch Creek and Beaver village residents. Sumida et al. (1985, 1986), Caulfield (1983), and Caulfield et al. (1983) conducted household interviews that indicate moose and bear hunting and trapping were the dominant activities. Currently there is one active trapper in the PLE that maintains a series of trails and cabins. There are five cabins registered in the PLE.

Although the area is roadless, there is light public use on Beaver Creek from June through September. Sheep hunters access the area by boat and plane primarily in August. Recreation use of the Beaver Creek drainage by floaters is between June and September. About 300 parties boat the stretch of upper Beaver Creek and pull out at Victoria Creek. An additional 50 parties float the 180-mile stretch of Beaver Creek through the refuge that drains into the Yukon (Cogley, pers. comm.).

In summary, historical data that have been collected are not sufficient to adequately describe the PLE. Funding to examine resource values associated with the PLE was made available to the Refuge through a congressional add-on appropriation in March 2003. A variety of resources were inventoried in the PLE during June 16-26 and July 21-25, 2003 by a team of 9 biologists from the Fish and Wildlife Field Office, National Park Service, North Pacific Biological Research, and the Refuge. An additional inventory was conducted on Burman Lake July 12-19, 2004. This report summarizes these findings.

METHODS

Sample Site Selection

Topographic and surficial geology maps and color infrared photography were used to examine potential plant, fish/water, and bird inventory sites within the PLE. Decimal latitude and longitude locations for all inventory sample sites (and alternates) and potential camps were generated in ArcView 3.2 (Datum WGS 84). A reconnaissance helicopter flight was conducted on June 16, 2003 to identify potential landing sites, assess water depths, and identify alternate sample sites. Sampling dates were selected to take advantage of peak landbird detection by song and flowering phenology.

Plant inventory sampling regions were delineated in ArcView 3.2 by elevation and landform type: alpine (750-1,000 m), upland lakes (200-300 m), and active/inactive (150-180 m) and abandoned floodplains (180-220 m) along the Beaver Creek drainage. Due to the variety of Beaver Creek floodplain types, we had the opportunity to sample plant communities from different successional stages.

Lake surface areas within each watershed were located, measured and ranked using ArcGis to evaluate sample sites for water, fish and bird inventories (Appendix A). Sample sites were selected from lakes representative of different water basins and large enough for helicopter access. Additional bird sample sites were also selected from helicopter accessible areas in alpine habitats.

Access

A Bell 206 Jet Ranger helicopter was used to ferry three inventory teams (plant, bird, and fish/water) to various areas in the PLE. The fish/water crew and helicopter were based in Fort Yukon and traveled daily to sample sites. The bird and plant crews camped on-site at sample plots and were ferried daily to new sample sites. The bird and plant crews alternated daily use of the helicopter to visit multiple sample sites. In this fashion an inventory could be completed over a broad geographic area.

Zodiak and sampling gear being transported by sling between sampling sites.

Plant Inventory

An aerial reconnaissance of each sample area was conducted prior to landing to identify different plant community types to aid in locating unique plant species. Alpine landscapes exhibiting different lithologies, disturbance (wildlife use such as dall sheep forage areas and grizzly bear diggings; rock slides), mesic sites, and differential aspects and slope were selected. Upon landing, a location was recorded with a Garmin Global Positioning System (GPS, decimal degree format, NAD 27 datum). An “informed meander” technique (Larsen 2002) was used to maximize the number of unique species encountered along a given travel route. This technique required that crew members sample independently, working in different directions away from the helicopter, one sampling north-facing mesic areas below a saddle and the other person sampling a south-facing talus slope. Each person tried to encounter as many different community types as possible before returning to the helicopter. Sampling times ranged from one to three hours at each site. Specific locations were recorded with a GPS along the travel route.

All observed plants species were recorded and representatives of many species were collected for voucher specimens. Scientific name, species associations, aspect and habitat type were recorded in field notebooks. Plant specimens were placed in rigid plastic containers to protect from crushing. Voucher specimens were pressed at the end of each sampling day. Multiple specimens of the same species were combined on the same sheet if collected in the same habitat type and site. Each sheet was assigned a unique number (e.g. DVP1) to catalog species collected at each site.

Plant specimens were identified using Hulten (1968) and Cody (2000) regional plant identification keys, and Harris and Harris (2003) illustrated plant terminology glossary. Questionable voucher specimens were submitted to the University of Alaska (UA) Museum Herbarium for final verification. The final plant inventory species list will be compared to the Alaska Natural Heritage Program (ANHP) vascular plant tracking list (refer to website: http://enri.uaa.Alaska.edu/aknhp/biodiversity/botanical/vascular_species_concern_species_table/images/AKNHP_Plt_Trking_List_2003%20.pdf) to document the occurrence of rare species in the PLE and adjacent areas. Rare species were described using the following state ranking criteria: S1 = critically imperiled in state, S2 = imperiled in state, or S3 = rare or uncommon in state.

Data were entered into a Filemaker Pro 5 database and include date, location, collector, taxonomic identification, and habitat type. The distribution of plant inventory sites is located in ArcView 3.2 , file: 2003_plant collections.apr).

Water Inventory

Water temperature, conductivity, and dissolved oxygen were measured at each sample site using a Hydrolab Minisonde 4 Probe and Surveyor 4 Meter. Dissolved oxygen and conductivity meters were calibrated prior to going into the field. Conductivity standards were used to check meter performance prior to the measurement series in the field.

Triplicate one liter surface grab and bottom grab water quality samples were collected in plastic bottles. Bottom water samples were collected using a Wildco alpha bottle. Water quality sample containers were triple-rinsed in the water to be sampled prior to sampling. Sample bottles were filled to the top to minimize gaseous exchange. Each sample bottle was labeled prior to collection and placed in a cooler for transport to a field laboratory for analysis. Samples were analyzed for pH, total alkalinity, total hardness, and turbidity. Hardness and alkalinity were determined using Hach digital titrators and Hach (2002) methods. Measurements of pH were made using an Orion model 290A pH meter equipped with an Orion Triode combination electrode with automatic temperature compensation. Prior to each measurement series, two or three buffer calibrations were performed using pH buffers accurate to $\forall$ 0.02 pH units which bracketed the pH of the samples. Turbidity was measured using a Hach Model 2100P Portable Turbidity Meter which was calibrated prior to going into the field and checked daily prior to sample analysis with Hach Stablcal standards. Nitrate and phosphate concentrations were measured in selected samples at the Fish and Wildlife Field Office laboratory in Fairbanks using a Hach 2100 Single-Beam Spectrophotometer. Nitrate and phosphate were analyzed using Hach methods 8171 and 8048, respectively.

A GPS Map 168 Sounder was used to measure water depths on a series of transects extending perpendicular to the long axis of each lake. Mean water depths were multiplied by the surface area of each lake to estimate a general volume.

Fish Inventory

Fish were sampled in lakes and streams by hook and line and variable mesh gill nets. Juveline fish were captured with minnow traps. A ten foot zodiac with an 8 hp outboard was used to facilitate sampling. Fork lengths, total lengths, weights, a tissue sample, and an otolith were taken from each fish. Otoliths were used to estimate age and a muscle sample was used to test for presence of mercury (Chilton and Beamish 1982). Muscle samples were analyzed by the College of Veterinary Medicine at Texas A & M University, College Station, Texas.

A ten foot zodiac was used for water and fish sampling, lake measurements, and bird surveys.

Bird Inventory

Observers identified birds by sight, song, and call using standard Alaska Off-Road Breeding Bird Survey methods at each site along a 12 point transect between 0345 and 0730 (Handel 2002). Point counts were conducted by walking or by using a zodiac and outboard on the perimeter of waterbodies depending on the ruggedness of terrain. Bird species, behavior, sky condition, wind, temperature, latitude and longitude, and length of survey were recorded. Distribution and abundance of bird species were also monitored daily using the Alaska National Wildlife Refuge Checklist Project guidelines (USFWS 1999). These additional sightings were recorded as incidental detections observed at each sample site outside the scope of the point count surveys. We included all bird detections in the final summary.

Birds were monitored with standard point count methods.

RESULTS AND DISCUSSION

Plant Inventory

We visited 23 sites (Figure 2, Table 1) within or adjacent to the PLE between June 16-24 and July 21-25, 2003. We sampled three days each in the riparian, Beaver Creek wetlands, and upland lake habitats and four days in the alpine landforms. Upland lake WS19 and the alpine sites were located west and southwest (respectively) of the PLE area (Figure 2).

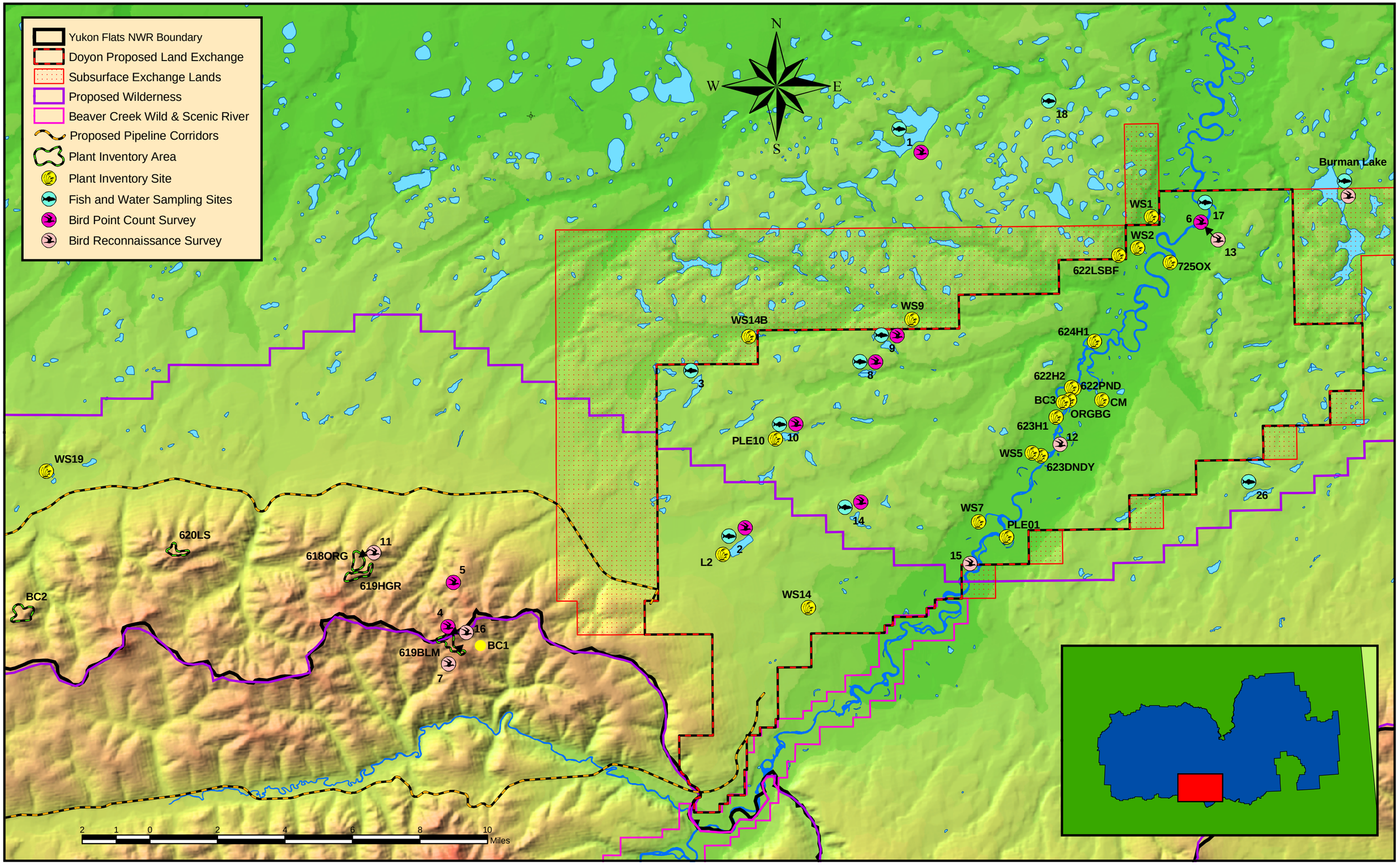

Figure 2. Location of sample sites in and adjacent to the proposed land exchange area, Yukon Flats National Wildlife Refuge, Alaska.

Table 1. Sites sampled by landform type in the PLE and adjacent areas June – July, 2003, Yukon Flats NWR, Alaska. Sites are listed in sample order within each landform type.

Beaver Creek active floodplain	Beaver Creek inactive floodplain	Beaver Creek abandoned floodplain	Upland lakes	Alpine
622BC3	623H1	622LSBF	L2	BC1
622PND	623DNDY	WS7	WS14	618ORG
622Hop2	725OX	WS1	WS14B	619FWS
624H1		WS2	WS9	619HGR
		WS5	WS19	620LS
		ORGBG		BC2

We collected 594 specimens representing 45 families and 121 genera. A species list is presented in Appendix B. Appendix C includes descriptive statistics for each sample site and appendix D includes a sample of photos from collection sites.

Sampling effort was generally distributed evenly among landform types (Jorgenson et al. 1999). However, a review of the upland lake and Beaver Creek wetland landforms indicates sampling gaps in the central and eastern PLE (west and east of Beaver Creek). Narrow lake margins with dense shrubs or trees prevented safe landing at many of the desired upland lake sample sites. Upland lakes L2 and WS19 and Beaver Creek wetland sites WS7 and WS5 where located in the 1996 burn. Upland lake WS14 was situated in the 1999 burn.

Plants collected from the alpine and Beaver Creek gravel bar plant communities were in peak flower. An examination of plant phenology in other landforms is in progress.

Alpine plant communities situated in the White Mountains were represented by 29 families and 61 genera (Appendix C) and were the most floristically diverse. Wetland sites in the Beaver Creek floodplain (active, inactive and abandoned) and wetlands in the upland region were represented by 22 and 25 families (respectively); the most common families at these sites were Cyperaceae, Poaceae and Salicaceae.

Although our examination of plant specimens is not complete, according to the vascular plant tracking list for Alaska (ANHP 2003), three of the species collected are considered rare (S3) and include *Douglasia gormanii*, *Minuartia yukonensis*, and *Scheuchzeria palustris*. *Phlox hoodii* is ranked as imperiled (S1, S2) in Alaska. The wetland associated *Scheuchzeria palustris* was collected in late July and the remaining alpine species were collected June 18-19. *Douglasia gormanii* was collected outside of the PLE in the White Mountains, on BLM lands west of Base Camp 1 (BC1, Figure 2). *Minuartia yukonensis*t was collected in the vicinity of Base Camp 1 (BC1, Figure 2), outside of the PLE in the White Mountains. It was found growing at the base of a shale rock outcropping (southwest aspect), with *Dryas*, *Anemone*, and *Cetraria*. *Phlox hoodii* was also collected outside of the PLE in the same area as *Douglasia*. *Scheuchzeria palustris* was collected within the PLE in a wetland adjacent to Beaver Creek at Orange Bog site (ORGBG), (see Figure 2 and photo above) in late July. It was found growing along the northwest edge with *Sphagnum*, *Equisetum* and *Carex*.

Following initial species determinations, questionable voucher specimens will be submitted to the UA Museum Herbarium for final verification. The occurrence of additional plant range extensions or rare or imperiled species will be included in a future amendment to this report.

Water Inventory

Surface water temperatures were within a small range (16.2-20.8^{o}C) for all lakes measured (Table 2, Figure 2). Temperatures varied among depths due to thermal stratification (see Appendix E for figures of temperature by depth). The deepest lakes sampled (Lakes 1, 9, and Burman Lake) were characertized with an established stable thermocline and greater than 10^{o} C difference in temperature between the epilimnion and the hypolimnion. The shallowest lakes (Lakes 8, 10, and 26) had not established the magnitude of thermocline as in the deeper lakes, although a temperature difference was detected between top and bottom waters. The greater thermal separation between top and bottom waters of shallow lakes likely occurred as the summer progressed. Bottom temperatures in shallow lakes were between 15^{o} C and 16^{o} C compared to between 4^{o} C and 5^{o} C for all other lakes (Table 2). This indicates a longer period of whole-lake mixing for shallower lakes (Wetzel 1975).

Lake 8 contained the lowest surface levels of dissolved oxygen.

Lake 14 was representative of steep walled lakes with maximum depths to 15 m.

Wetzel (1975) stresses that individuality in lake thermal regime is common. Lake thermal structure of lakes is governed by climatic variations, volume of inflow and outflow in relation to the volume of the basin, basin configuration, surface area, position of the basin in relation to wind action, and other factors. Based on latitude and elevation, Wetzel (1975) characterizes lakes from the PLE as transitional between dimictic and cold monomictic lake types. Dissolved oxygen concentrations of surface waters ranged from 6.5 mg/L at Lake 8 to 8.5 mg/L at Lake 26 and diminish with depth (Appendix E). Percent saturation of oxygen in surface waters ranged from 71 to 96% indicating that no major oxygen-consuming event, such as a decomposing algae bloom or certain types of contamination, was occurring in the epilimnion of these lakes. Bottom waters of the shallowest lakes (8, 10, and 26) had between 4.5 mg/L and 6.4 mg/L of dissolved oxygen. For all other lakes, dissolved oxygen concentrations in bottom waters were 5.4 mg/L or less. As a general guideline, 3 mg/L of dissolved oxygen is necessary to support salmonid fish except Arctic grayling (*Thymallus arcticus*) which can survive much lower dissolved oxygen concentrations.

Table 2. Surface water quality measurements at lakes in Yukon Flats NWR, Alaska, June, 2003.

Lake	Location	Depth (m)	Collection Date	pH[1]	Conduct.[2] (μS/cm)	Temp[2] (°C)	DO[2] (mg/L)	Hardness[1] (mg/L)	Alkalinity[1] (mg/L)	Turbidity[1] (NTU)	NO_3 (mg/L)	PO_4 (mg/L)
1[3]	WQ1	Surface	6/25/2003	8.4	301	18.3	9	159	168	1	0.1	0.02
1[3]	WQ1	26	6/25/2003		300	5	5.4					
2	WQ1	Surface	6/17/2003	7.3	60	17.1	8.1	37.1	27.6	0.9		
3	WQ1	Surface	6/20/2003	7.2	109	17.6	8.1	63.3	44.5	0.6		
3	WQ1	7	6/20/2003		101	7.1	3.2	63		4.5		
3	WQ2	Surface	6/20/2003		103	17.1	7.8					
3	WQ2	12	6/20/2003		103	4.2	0.8					
8	WQ1	Surface	6/21/2003	7.5	108	18.9	6.6	70.3	47.3	2		
8	WQ1	3	6/21/2003		107	15.9	6.4					
8	WQ2	Surface	6/21/2003		106	18.4	6.5					
8	WQ2	2	6/21/2003		106	17	6.7					
9	WQ1	Surface	6/22/2003	7.5	141	18.8	8.5	66.5	49.5	1.8	0.8	0.05
9	WQ1	16	6/22/2003		135	4.3	1.9					
9	WQ2	Surface	6/22/2003		141	19	8.2					
10	WQ1	Surface	6/19/2003	7.2	125	16.2	7	74.3	52.3	2.1		
10	WQ1	4	6/19/2003		125	15.4	5.6					
10	Dam	Surface	6/19/2003		138	16.4	5.7					
10	WQ2	Surface	6/19/2003		124	16.6	7.4					
10	WQ3	Surface	6/19/2003		126	17.6	7.7					
14	WQ1	Surface	6/18/2003		120	17.4	7.8					
14	WQ1	11	6/18/2003		139	4.3	0.1					
14	WQ2	Surface	6/18/2003		126	17	8					
14	WQ2	10	6/18/2003		122	5	1.9					
14	WQ3	Surface	6/18/2003		129	17.6	7.8					
14	WQ3	6	6/18/2003		123	5.9	1.5					
14	WQ4	Surface	6/18/2003	7.8				72.3	54	1		
14	WQ4	11	6/18/2003	6.2				77.7	58.7	10.8		
26	WQ1	Surface	6/24/2003	7.7	103	20.8	8.5	58.7	38	10.6	0.6	0.06
26	WQ1	5	6/24/2003		99	15.1	4.5					
26	WQ2	Surface	6/24/2003	8.2				59	37.7	2.3		
18[3]		Surface	6/21/2003	9.3					682		2.2	0.18
Burman[4]		Surface	7/13/2004	8	187	18.5	8	92	98		0.2	0.001
Burman[4]		24	7/13/2004	9.7	181	4.4	4.7					

[1] Mean of three samples collected at the same time.
[2] Measured on-site.
[3] Located adjacent to the PLE
[4] Surface measurements are mean of 3 samples collected at 3 basins

Conductivities of surface waters ranged from 60 μS/cm at Lake 2 to 301 μS/cm at Lake 1. Most conductivities were between 105 μS/cm and 130 μS/cm. Conductivity at Lake 18 was likely far greater than at other lakes based on the alkalinity measurement; however, conductivity was not measured at this lake. Based on the consistent conductivities at depth, none of these lakes are meromictic lakes, i.e., chemically stratified lakes, such as Pingo Lake (Likens and Johnson 1966) near Circle, Alaska, in the Birch Creek drainage.

Values of mean hardness and alkalinity varied between 37.0-159 mg/L and 27.6-168 mg/L, respectively, for surface water samples (Table 2). These values characterized all lakes except Lake 1 and Lake 18 as soft water systems (Hem 1992). Values of these measures were two to three times greater at Lake 1 than at other lakes. Lake 18 is in a class by itself among lakes sampled with alkalinity of 682 mg/L.

Nitrate and phosphate concentrations were conducted on samples of surface water from five lakes. Lakes 9 and 26 had similar values for nitrate and phosphate while Burman Lake and Lake 1 had lesser values for these constituents. Lake 18 had nitrate concentrations twice that and phosphate concentrations three times that of Lakes 9 and 26. The causative factors of high hardness, alkalinity, and nutrients at Lake 18 are unknown, however, these high levels explain why a rich algal bloom was present on the lake at the time of sampling.

Lake 18 had high nitrate and phosphate levels.

Most lakes in the PLE were characterized by steep gradients; the exceptions were Lakes 2 and 3, and 26. Maximum depths ranged from 3.2 to 24 m. Lake volumes ranged from .3 to 27 million cubic m. Area, mean and maximum depth, and volume for each sampled lake is given in Table 3.

Table 3. Surface area, average depth, and volume of sampled lakes in the proposed land exchange area, Yukon Flats NWR, Alaska, June, 2003.

Sample plot (Lake)	Surface area (m^2)	Average depth (m)/ Maximum Depth	Volume (m^3)
1[1]	2,855,461	9.18 / 30.6	26,210,764
2	500,470	2.70 / 6.4	1,351,058
3	344,249	1.96 / 3.2	674,154
8	199,643	3.96 / 9.5	791,085
9	195,973	8.90 / 17.8	1,744,718
10	195,629	1.61 / 4.9	314,839
14	159,353	5.99 / 14.9	954,000
26	268,448	1.91 / 5.4	513,427
Burman Lake[2]	3,035,119	9.0[3] / 24	27,316,071[3]

1 not located in the PLE
2 located in lands adjacent to the PLE
3 average depth and volume are estimates

Fish Inventory

Northern pike were present in all sampled lakes and Beaver Creek. Fishing intensity varied by lake and ranged from 5 to 147 fish. We captured all fish by hook and line except in Lakes 2, 14, and Burman where we also captured fish by variable mesh gill nets and minnow traps. Two pacific loons were captured as by-catch in Lake 2 and later mounted for public display. Appendix F includes data collected from 147 northern pike at Burman Lake, July 12-20, 2004.

A sample of 22 pike was collected from seven locations and were tested for presence of mercury. Morphological measurements, ages, and mercury levels are presented in Figure 3, Table 4. One sample came from Lake 1 which is about two miles north of the PLE. Mean level of mercury was 1.92 parts per million (ppm) dry weight with four of the 22 pike in excess of 2 ppm (range 2.44 – 6.69). Five of the 22 pike were tested for methylmercury; all results displayed high levels. The fish with the highest mercury level was sampled from Beaver Creek. Five fish were sampled for mercury levels from Burman Lake; the results have not been received.

According to the U.S. Federal Drug Administration (FDA) nearly all fish contain some level of methylmercury, and it is especially common in predator fish such as northern pike who occupy a niche at the top of their food chain. Although the FDA does not recommend consumption of fish with levels of methylmercury in excess of 1ppm, they also purposely set this level 10 times lower than the lowest level associated with human health problems. These findings are similar to mercury levels in northern pike sampled in other regions of interior Alaska (Mueller et al. 1995, 1996)

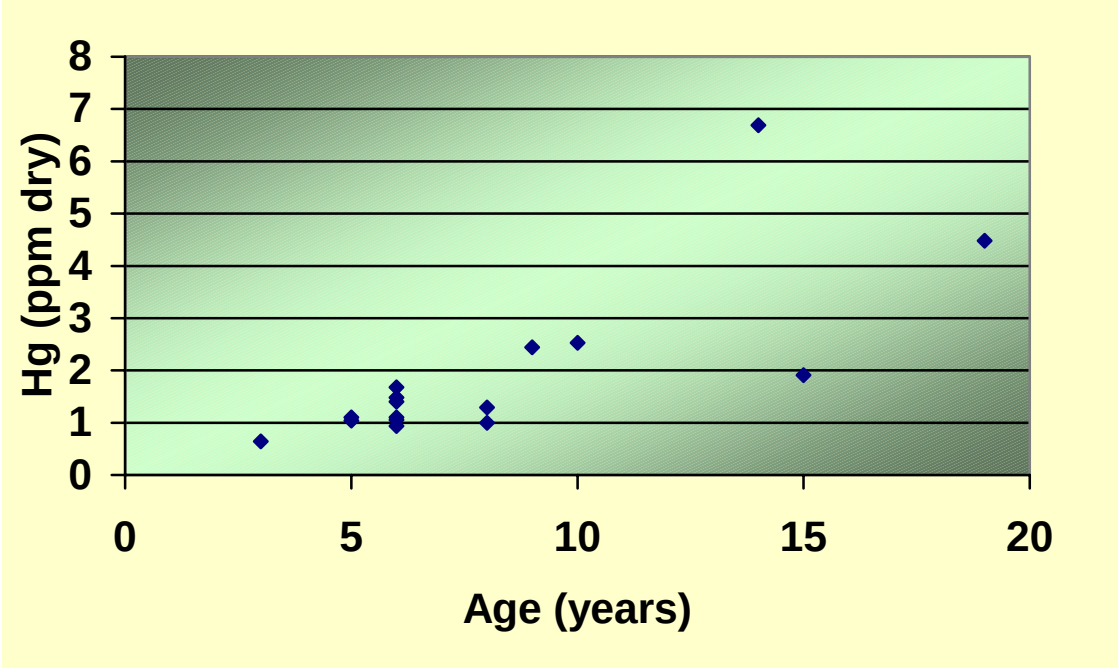

Figure 3. Levels of dry mercury in northern pike in the PLE, Yukon Flats NWR, 2003.

Table 4. Capture statistics and mercury levels for northern pike sampled at Lakes 1, 2, 8, 10, 14, and Beaver Creek (BC), Yukon Flats NWR, Alaska, June 2003.

Lake No.	Sample ID	Age	Weight (g)	Fork Length (mm)	Total Length (mm)	Hg (ppm) dry	MeHg	% MeHg
14	YF141EPM	3	785	461	481	0.643	-	-
10	YF101APM	5	1055	504	524	1.1	1.06	0.96
10	YF101CPM	5	1635	573	598	1.04	-	-
10	YF101BPM	6	1060	479	528	0.939	-	-
14	YF141CPM	6	1325	561	595	1.05	-	-
14	YF141FPM	6	1075	528	550	1.1	-	-
14	YF141GPM	6	1680	598	630	1.68	-	-
14	YF141IPM	6	1785	590	628	1.48	-	-
14	YF141KPM	6	1510	605	-	1.44	-	-
14	YF141APM	8	975	500	530	1	0.982	0.98
14	YF141DPM	8	945	492	519	1.29	-	-
8	YF081APM	9	1325	526	558	2.44	2.41	0.99
1[1]	YF0C1APM	10	1935	667	-	2.53	2.62	1.04
BC	YFBC1APC	14	1900	625	-	6.69	-	-
14	YF141HPM	15	1785	628	-	1.91	-	-
14	YF141BPM	19	3320	778	815	4.48	3.92	0.88
2	YF021APM	-	-	-	-	1.76	-	-
Burman[2]	1	-	1000	-	520	-	-	-
Burman[2]	2	-	1500	-	605	-	-	-
Burman[2]	3	-	1900	-	665	-	-	-
Burman[2]	4	-	1500	-	600	-	-	-
Burman[2]	5	-	2200	-	665	-	-	-

[1] Located adjacent to the PLE
[2] Located adjacent to the PLE, results from Burman fish are pending

Bird Inventory

Point counts were conducted at nine locations including six lakes, two alpine sites, and Beaver Creek between June 18-26, 2003 (Figure 2). The two alpine sites and one lake (Lake 1) were located adjacent to the PLE. Lake 1, situated about two miles northwest of the PLE, was selected for floatplane access to transport crews back to Fairbanks at the end of the survey period. Alpine sites and Lake 1 are thought to include avian habitats representative of habitats in the southern.

The 1996 burn burned over 40% of the PLE.

Three point count plots (2, 14, 10) were located within the 1996 burn, and plots 8, 9, and Beaver Creek were adjacent to the burn and included 50% of transects in the burn. All plots included water edge except alpine habitats.

A total of 1,231 birds representing 61 species was observed during the survey period, including 1,090 birds observed from fifty-five species during point counts (Appendix G). Fewer birds and species were observed in alpine plots compared to lake plots (Figure 4). Beaver Creek (photo below) included more bird species than any other plot (Figure 5).

Beaver Creek

The five bird species that were most common included white-crowned sparrow, Swainson's thrush, dark-eyed junco, American robin, and fox sparrow (Figure 6). All five of these species are attracted to recently burned, early succession habitats associated with lake edge. Of these species, white-crowned sparrows were the most widely distributed and in all plots except Beaver Creek and Lake 1. The five most common species detected by plot are given in Figure 6.

A reconnaissance flight of Victoria and Beaver creeks was conducted June 23, 2003 on those creek segments in or adjacent to the PLE. Two bald eagle were observed in flight; however, no nests sites were located.

Bird observations were recorded on daily checklists at Burman Lake between July 12-20, 2004 (Appendix H).

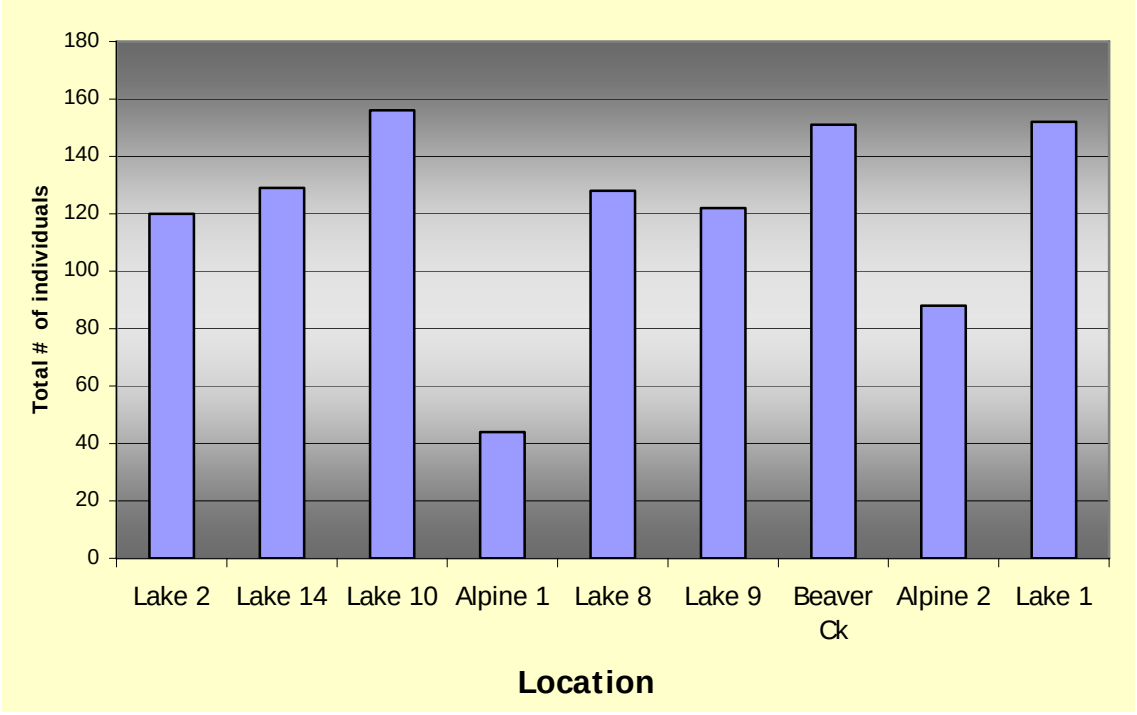

Figure 4. Number of individual birds detected during point count surveys in and adjacent to the proposed land exchange area, Yukon Flats National Wildlife Refuge, Alaska, June, 2003.

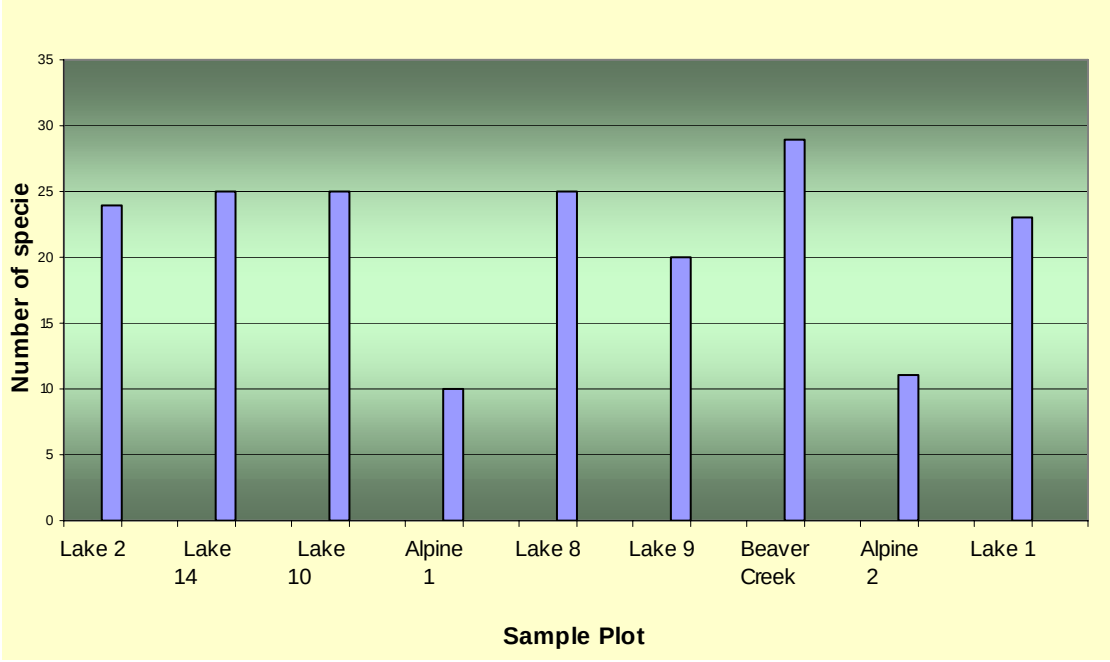

Figure 5. Number of bird species detected during point count surveys in and adjacent to the proposed land exchange area, Yukon Flats National Wildlife Refuge, Alaska, June, 2003.

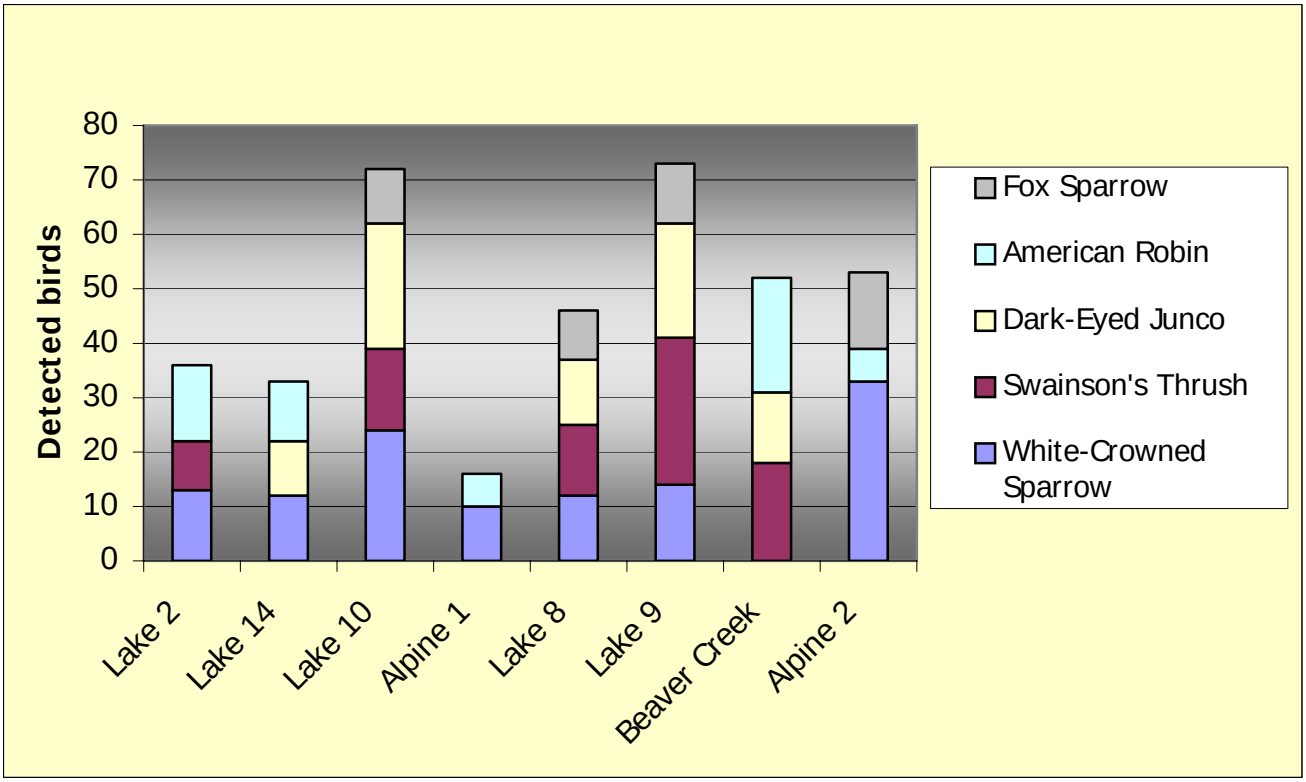

Figure 6. Five most common species detected in point counts in the PLE, Yukon Flats NWR, Alaska, June, 2003.

RECOMMENDATIONS

If funds become available to conduct additional sampling we recommend the following:

1) Although we sampled many of the larger lakes we only sampled about 4% of available lakes in the PLE. We did not investigate lakes in the northwest region and avoided all lakes less than 40 acres due to access constraints of the charter aircraft. In future sampling efforts, a Bell Jet Long Ranger with floats could be used to access many of these areas. We recommend that similar surveys (plant, water, fish, bird) be conducted at these sites in an effort to effectively describe a broader and less biased geographic area.

2) Future botanical work in the eastern and central PLE and western adjacent areas should focus on wetland bogs of different seral stages, upland lakes (aquatics and terrestrial), and a revisit to the White Mountains (Refuge and BLM lands) with particular attention paid to areas that may be used as a pipeline access corridor to the PLE.

3) We directed little time on the Beaver Creek corridor during our sampling efforts. This region contains the highest diversity in fauna and should be investigated more thoroughly. Particular attention should be given to fish inventories and a systematic inventory should be conducted on the 25 mile stretch in the PLE. If funds are available additional methylmercury tests on fish tissues should be conducted.

4) Baseline data should also be collected from regions that have been identified as potential pipeline access corridors. Similar inventories are also recommended for lands that the Service would acquire in the proposed exchange.

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Appendix A. Area (acres), perimeter (miles), and locations (latitude/longitude) of lakes located in the proposed land exchange area.

Lake No	Acres	Perimeter (miles)	Latitude	Longitude	Lake No	Acres	Perimeter (miles)	Latitude	Longitude	Lake No	Acres	Perimeter (miles)	Latitude	Longitude
1	181.189	2.644	66.071	-146.262	51	13.367	0.743	65.975	-146.616	101	10.381	0.330	66.041	-146.367
2	123.669	2.110	65.926	-146.601	52	13.367	0.597	66.031	-146.095	102	4.548	0.357	65.911	-146.490
3	85.066	2.768	65.993	-146.650	53	13.075	0.577	65.942	-146.682	103	4.449	0.621	65.990	-146.249
4	58.589	1.608	65.991	-146.678	54	12.862	0.513	66.065	-146.333	104	4.357	0.327	65.980	-146.395
5	53.532	1.659	66.017	-146.585	55	12.847	0.617	65.975	-146.336	105	4.237	0.886	65.958	-146.310
6	59.239	1.280	65.960	-146.060	56	11.291	0.481	66.065	-146.225	106	4.187	0.370	65.977	-146.244
7	53.121	1.728	65.977	-146.678	57	11.153	0.502	65.991	-146.456	107	4.110	0.318	66.070	-146.320
8	49.333	2.185	66.000	-146.466	58	11.058	0.539	66.024	-146.096	108	4.071	0.337	65.973	-146.250
9	48.426	1.424	66.011	-146.443	59	10.898	0.497	66.056	-146.241	109	4.057	0.517	66.032	-146.199
10	48.341	1.539	65.973	-146.550	60	11.558	0.538	66.024	-146.684	110	3.735	0.321	65.991	-146.226
11	47.288	1.786	65.956	-146.573	61	10.598	0.478	66.060	-146.315	111	3.603	0.301	66.002	-146.430
12	45.158	1.537	65.980	-146.593	62	10.472	0.464	66.075	-146.322	112	3.500	0.330	65.947	-146.164
13	40.962	1.260	65.964	-146.526	63	9.726	0.776	66.059	-146.063	113	3.499	0.276	65.968	-146.660
14	39.377	1.545	65.937	-146.478	64	12.513	0.483	66.032	-146.637	114	3.482	0.325	65.980	-146.080
15	35.730	1.305	66.038	-146.092	65	9.700	0.962	65.978	-146.521	115	3.353	0.609	65.910	-146.372
16	34.471	1.484	65.980	-146.472	66	9.563	0.473	66.072	-146.250	116	3.273	0.322	65.971	-146.256
17	32.701	1.194	66.059	-146.260	67	11.084	0.482	66.049	-146.367	117	3.188	0.278	66.074	-146.139
18	31.825	0.873	66.055	-146.232	68	9.408	0.706	66.052	-146.176	118	2.817	0.450	65.958	-146.278
19	28.297	0.892	66.029	-146.537	69	9.282	0.646	65.948	-146.155	119	80.302	0.437	66.066	-146.368
20	27.922	0.827	66.029	-146.566	70	8.977	0.450	66.067	-146.194	120	9.897	0.358	66.076	-146.286
21	26.172	1.439	66.001	-146.674	71	8.974	0.560	66.016	-146.366	121	2.379	0.224	66.023	-146.204
22	26.147	0.823	66.070	-146.237	72	8.931	0.472	65.934	-146.413	122	2.325	0.222	65.910	-146.496
23	24.518	1.019	66.068	-146.302	73	8.867	0.465	66.010	-146.105	123	2.280	0.215	66.075	-146.201
24	24.148	1.056	65.945	-146.448	74	8.393	0.449	66.031	-146.355	124	2.158	0.311	66.001	-146.397
25	35.727	1.171	65.947	-146.676	75	8.230	0.472	66.028	-146.437	125	2.145	0.434	65.906	-146.409
26	66.335	1.064	65.947	-146.060	76	7.969	0.657	65.898	-146.428	126	2.104	0.315	65.995	-146.221
27	22.092	0.871	66.028	-146.475	77	7.940	1.109	65.927	-146.315	127	2.015	0.241	66.044	-146.182
28	21.369	1.267	66.018	-146.104	78	7.819	0.452	66.025	-146.598	128	4.260	0.282	65.824	-146.597
29	21.354	0.921	66.072	-146.317	79	19.912	unk	unk	unk	129	1.726	0.355	65.936	-146.349
30	21.275	1.265	66.065	-146.153	80	7.710	0.582	65.902	-146.530	130	1.667	0.188	65.876	-146.570
31	20.751	0.832	66.003	-146.277	81	7.386	0.468	66.062	-146.347	131	1.608	0.239	66.041	-146.195
32	32.885	1.222	66.010	-146.061	82	7.043	0.389	66.031	-146.553	132	69.123	0.214	66.054	-146.368
33	20.622	0.741	65.974	-146.324	83	6.995	0.429	66.006	-146.660	133	1.532	0.188	66.005	-146.201
34	19.712	0.883	66.068	-146.333	84	6.870	0.485	66.025	-146.212	134	1.528	0.244	65.945	-146.267
35	19.648	0.759	66.072	-146.347	85	6.605	0.398	66.012	-146.372	135	1.480	0.248	66.005	-146.212
36	19.502	0.725	66.027	-146.265	86	6.561	0.440	66.016	-146.625	136	1.392	0.231	66.049	-146.194
37	18.803	0.690	65.986	-146.498	87	6.483	0.366	66.005	-146.646	137	1.377	0.297	65.964	-146.267
38	18.566	0.670	66.067	-146.291	88	6.429	0.446	65.907	-146.492	138	1.327	0.304	65.969	-146.251
39	17.282	0.693	66.006	-146.561	89	6.272	0.534	66.073	-146.220	139	1.322	0.298	65.945	-146.296
40	17.215	1.209	65.987	-146.584	90	6.042	0.461	66.015	-146.460	140	1.318	0.172	65.999	-146.208
41	17.067	0.796	66.069	-146.213	91	6.009	0.887	65.964	-146.297	141	1.270	0.313	65.985	-146.266
42	16.803	0.632	65.991	-146.201	92	6.008	0.389	65.934	-146.467	142	1.261	0.317	65.952	-146.291
43	16.655	0.686	66.061	-146.327	93	5.383	0.671	65.863	-146.525	143	1.188	0.183	65.877	-146.565
44	16.090	0.630	66.052	-146.072	94	5.306	0.412	66.025	-146.200	144	1.121	0.272	65.926	-146.325
45	15.330	0.817	65.996	-146.059	95	5.130	0.395	65.954	-146.598	145	1.084	0.313	65.929	-146.362
46	14.948	0.574	66.015	-146.403	96	5.070	0.353	66.050	-146.235	146	1.017	0.184	65.912	-146.479
47	13.797	0.603	66.011	-146.540	97	5.003	0.356	65.992	-146.611	147	1.006	0.254	65.956	-146.307
48	23.732	0.558	66.075	-146.364	98	4.876	0.322	66.005	-146.191	148	4.106	0.213	66.076	-146.144
49	13.571	0.737	65.989	-146.448	99	4.751	0.341	66.018	-146.542	149	0.993	0.181	65.992	-146.246
50	17.713	0.642	66.031	-146.668	100	4.619	0.428	65.966	-146.294	150	0.992	0.158	65.969	-146.419

Appendix A. cont…

Lake No	Acres	Perimeter (miles)	Latitude	Longitude	Lake No	Acres	Perimeter (miles)	Latitude	Longitude	Lake No	Acres	Perimeter (miles)	Latitude	Longitude
151	0.972	0.196	65.982	-146.079	167	0.442	0.102	66.061	-146.162	183	0.240	0.094	65.978	-146.272
152	0.890	0.139	65.979	-146.391	168	0.407	0.096	66.069	-146.280	184	0.218	0.073	66.012	-146.483
153	0.804	0.181	65.945	-146.320	169	0.388	0.102	66.049	-146.189	185	0.197	0.068	65.971	-146.218
154	0.782	0.149	66.012	-146.227	170	0.364	0.097	66.072	-146.137	186	0.191	0.080	65.997	-146.251
155	0.780	0.188	65.980	-146.259	171	0.362	0.104	66.054	-146.121	187	0.184	0.066	65.876	-146.470
156	0.778	0.202	65.964	-146.301	172	0.345	0.089	66.046	-146.201	188	0.182	0.064	65.948	-146.395
157	0.758	0.233	66.025	-146.164	173	0.329	0.090	65.964	-146.600	189	0.125	0.053	65.967	-146.222
158	9.351	0.182	66.076	-146.356	174	0.326	0.086	65.985	-146.271	190	29.496	0.067	66.033	-146.380
159	0.574	0.113	66.056	-146.124	175	0.320	0.084	66.020	-146.203	191	0.108	0.048	65.984	-146.267
160	0.563	0.126	65.934	-146.312	176	0.300	0.086	65.921	-146.309	192	0.092	0.046	65.972	-146.219
161	0.557	0.144	65.957	-146.282	177	0.282	0.091	66.071	-146.140	193	1.075	0.074	66.004	-146.688
162	0.534	0.117	65.965	-146.599	178	0.279	0.087	65.939	-146.273	194	0.060	0.037	65.967	-146.222
163	0.533	0.115	65.966	-146.644	179	0.275	0.112	65.998	-146.252	195	7.863	0.630	66.002	-146.686
164	0.487	0.109	65.823	-146.601	180	10.198	0.140	66.048	-146.052	196	0.014	0.035	65.946	-146.167
165	0.478	0.113	65.946	-146.509	181	0.259	0.075	66.043	-146.161					
166	0.456	0.136	65.875	-146.490	182	0.254	0.084	65.965	-146.601					

Appendix B. Summary of vascular plant species collected within and adjacent of the proposed land exchange area, Yukon Flats National Wildlife Refuge and White Mountains Recreations Area, Alaska, June-July, 2003.

Achillea
Adoxa moschatellina
Agrostis scabra
Alnus tenuifolia
Alnus viridis
Andromeda polifolia
Androsace chamaejasme
Androsace septentrionalis
Anemone drummondii
Anenome narcissiflora
Anenome parviflora
Antennaria friesiana
Arabis
Arctagrostis latifolia
Arctophila fulva
Arctostaphylos rubra
Arctostaphylos uva-ursi
Arnica griscomii
Arnica lessingii
Artemesia
Aster sibiricus
Astragalus umbellatus
Beckmannia erucaeformis
Betula nana
Bromus
Bupleurum arcticum
Calamagrostis
Caltha natans
Caltha palustris
Cardamine pratensis
Cardamine purpurea
Carex aquatilis
Carex bigelowii
Carex canascens
Carex capillaris
Carex chordorrhiza
Carex diandra
Carex eleusinoides
Carex magellanica
Carex media
Carex saxatilis
Carex scirpoidea
Carex utriculata
Cassiope tetragona
Castillega caudata
Castilleja hyperborea
Cerastrium beeringianum
Chamaedaphne calyculata
Chenopodium capitatum
Chrysosplenium trandrum
Cicuta mackenzieana
Comarum palustris
Corallorrhiza trifida
Corydalis pauciflora
Crepis elegans
Cystopteris fragilis
Diapensia lapponica
Dodecatheon pulchellum
Douglasia gormanii
Draba borealis
Drosera anglica
Drosera rotundifolia
Dryas alaskensis
Dryas integrifolia
Dryas octopetela
Dryopteris fragrans
Eleocharis acicularis
Eleocharis palustris
Elymus trachycaulus
Epilobium angustifolium
Epilobium latifolium
Epilobium palustre
Equisetum arvense
Equisetum fluviatile
Equisetum palustre
Equisetum pratense
Equisetum scirpoides
Erigeron
Eriophorum angustifolium
Eritrichium splendens
Eutrema edwardsii
Festuca brachyphylla
Galium boreale
Galium trifidum
Gentiana propinqua
Glyceria
Hedysarum alpinum
Hedysarum boreal
Hierochloe alpine
Hierochloe oderata
Hippuris vulgaris
Juncus arcticus
Juncus castaneus
Juncus filiformis
Lesquerella arctica
Lloydia serotina
Loiseleuria procumbens
Lupinus arcticus
Luzula rufescens
Lycopodium selago
Melandrium
Menyanthes trifoliata
Mertensia paniculata
Minuartia arctica
Minuartia elegans
Minuartia obtusiloba
Minuartia rubella
Minuartia yukonensis
Moehringia lateriflora
Myrica gale
Myriophyllum spicatum
Nuphar polysepalum
Nymphaea tetragona
Oxycoccus microcarpus
Oxytropis bryophila
Oxytropis campestris
Oxytropis maydelliana
Oxytropis scammaniana
Papaver
Parnassia kotzebuei
Parnassia palustris
Parrya nudicaulis
Pedicularis capitata
Pedicularis labradorica
Pedicularis lanata
Pedicularis langsdorffii
Pedicularis lapponica
Pentstemon gormani
Petasites hyperboreus
Phleum pratense
Phlox hoodii
Pinguicula vulgaris
Platanthera hyperborea
Platanthera obtusata
Poa alpina
Polemonium boreale
Polygonum aviculare
Polygonum vivaparum
Potamogeton subsibiricus
Potentilla hookeriana
Potentilla norvegica
Potentilla pennsylvanica
Potentilla uniflora
Puccinellia
Pyrola asarifolia
Pyrola grandiflora
Ranunculus aquatilis
Ranunculus gmelini
Ranunculus lapponicus
Ranunculus trichophyllus
Rhododendron lapponicum
Ribes hudsonianum
Ribes triste
Rorippa hispida
Rosa acicularis
Rubus arcticus
Rubus idaeus
Rumex
Salix alaxensis
Salix arbusculoides
Salix arctica
Salix commutata
Salix glauca
Salix interior
Salix pulchra
Salix rotundifolia
Saussurea
Saxifraga caespitosa
Saxifraga hieracifolia
Saxifraga oppositifolia
Saxifraga punctata
Saxifraga reflexa
Saxifraga spicata
Saxifraga tricuspidata
Scheuchzeria palustris
Selaginella sibirica
Senecio atropurpureus
Senecio congestus
Senecio triangularis
Senecio yukonensis
Shepherdia canadensis
Silene
Solidago canadensis
Sparganium minimum
Stellaria
Taraxacum officinale
Thalictrum alpinum
Thalictrum sparsiflorum
Tofieldia coccinea
Trientalis europaea
Trisetum
Valeriana capitata
Viburnum edule
Wilhelmsia physodes
Woodsia

Appendix C. Descriptive statistics of plant inventory sites located within and adjacent of the proposed land exchange area, Yukon Flats National Wildlife Refuge and White Mountains Recreation Area, Alaska, June-July, 2003.

Site name	Date	Site description	GPS locations (decimal degrees) Latitude	Longitude
L2 * (Lake 2)	6-17-03	Uplands; shoreline of northeast-southwest oriented lake; surrounding area burned in 1996; abundant willows	65.9228	-146.61903
BC1 (Base Camp 1)	6-18-03	Alpine; flattened ridge top; *Dryas* dwarf scrub	65.88435	-146.90483
618ORG * (Orange Gravel Slope)	6-18-03	Alpine; knob (north to south orientation) north of Hogback Ridge, separated by lower saddle; orange rocky shale (small substrate) leading up to rocky outcroppings; evidence of dall sheep use on west side of rock outcropping	65.91838	-147.00503
619BLM *	6-19-03	Alpine; hike from Base Camp 1, *Dryas* dwarf scrub, mesic	65.88440	-146.90743
619FWS (C6 Corydalis)	6-19-03	Alpine; below and west of peak 3655'	65.88711	-146.91301
619HGR * (Hogback Ridge)	6-19-03	Alpine; this ridge is to the south of Orange Gravel Slope site, with a northeast to southwest orientation; six miles east and north of Mt. Schwatka	65.91333	-147.01272
620LS * (Limestone Crags)	6-20-03	Alpine; three miles northeast of Mt. Schwatka; ridge oriented east-west; inventoried large north face of rocky slope	65.92384	-147.18081
BC2 * (Base Camp 2)	6-21-03	Alpine; 3041' north-south oriented knob with orange shale, rocky outcropping at top; hiked east and west side of knob	65.90026	-147.35827
622PND * (Beaver Ck Hop 1)	6-22-03	Active floodplain; small wetland adjacent to Beaver Creek; willow fringe and *Equisetum*	65.99237	-146.24956
622H2 (6-22 Hop 2)	6-22-03	Active floodplain, oxbow shoreline	65.99288	-146.24198
622LSBF*(Beaver Ck Loess Bluff and wetland; Hop 3)	6-22-03	Abandoned floodplain; 1 mile west of Beaver Creek; loess bluff above wet shrub/graminoid meadow	66.04921	-146.20074
623H1 (Beaver Ck Hop 1)	6-23-03	Inactive floodplain; Beaver Creek oxbow	65.96494	-146.2795
623DNDY * (Beaver Ck Hop 2)	6-23-03	Inactive floodplain; Beaver Creek older gravel bar	65.96383	-146.28492
624H1 * (BC BVR Pond)	6-24-03	Active floodplain; modified wetland due to beaver activity; moist mud canals	66.01249	-146.22736

Site name	Date	Site description	GPS locations (decimal degrees) Latitude	Longitude
WS14 * (Lily Pond)	7-21-03	Upland; lake surface covered with pond lilies and other emergent vegetation, low shrub/graminoid shoreline	65.89983	-146.52973
WS7 * (Gravel Bridge)	7-21-03	Abandoned Beaver Creek floodplain, small pond and ephemeral pools in old channel; surrounding area burned in 1996; graminoids dominant along wetland margins; willows revegetating among downed, burned logs above wetland	65.93594	-146.3511
WS1 *	7-22-03	Abandoned floodplain; long lake east west orientation with shrub/graminoid shoreline and 9 m tall loess bluff	66.06552	-146.16566
WS2 *	7-22-03	Abandoned floodplain; wetland with beaver lodge; shoreline has a red hue to it	66.0522	-146.18054
WS5 *	7-22-03	Inactive floodplain; pond connected to oxbow of Beaver Creek; surrounding area burned in 1996; shoreline littered with downed logs	66.04587	-146.14653
WS14B *	7-24-03	Upland; clumps of *Eleocharis acicularis* and *Rorippa* growing on mud/moss shoreline; spruce forest on raised ridge 2 m above shoreline at east end	66.01593	-146.59023
WS9 * (Tussock Basin)	7-24-03	Upland; in drainage surrounded by uplands; tussock meadow with shrub birch and willow	66.02278	-146.4187
ORGBG * (Orange Bog)	7-24-03	Abandoned floodplain; *Sphagnum* bog, a few standing spruce trees near edge, very saturated, some standing water; graminoid/*Equisetum* on Beaver Creek end of bog; adjacent to open spruce forest	65.9875	-146.25428
WS19 *	7-25-03	Upland lake north of the White Mountains; saturated moss shoreline with clumps of *Carex*; loess bluff at east end of lake	65.95852	-147.32755
725OX * (Beaver Ck Oxbow)	7-25-03	Inactive floodplain; east of Beaver Creek; gravel bar with *Salix*, mudshore with newly emerging vegetation	66.04587	-146.14653

(* sites displayed in Figure 1).

Appendix D. Figures of 15 of the 24 plant inventory sites. Figures 1-5, 14 and 15 are adjacent to the PLE. Figures 6-13 and 19 are within the proposed land exchange area, Yukon Flats National Wildlife Refuge and White Mountains Recreation Area, Alaska, June – July, 2003.

Figure 1. Hike from Base Camp 1 to site 619FWS. Photo taken from 3655' hill looking west along Spine Rock site; Mt. Schwatka in background, left side of photo.

Figure 2. Looking north up at Orange Gravel Slope; lupines were in peak flower.

Figure 3. View of Hogback Ridge (right center of photo); sampled both north and south slopes and walked along grassy ridge to north (see arrow).

Figure 4. View of the north side of Limestone Crags; inventoried area to right of snowfield (left side of photo) across to area on right side of photo, to base of slope.

Figure 5. Base Camp 2 hike; looking up at knob from western saddle.

Figure 6. Looking northwest at NW14 (Lily Pond). Sampled aquatic plants in south-eastern lobe (center of photo), peninsula and shoreline.

Appendix D. cont.

Figure 7. WS14 (Gravel Bridge); old channel of Beaver Creek; low lying area with grasses, sedges and aquatic plants; surrounding land w/ dense willow and downed logs from 1996 fire.

Figure 8. Looking northwest at WS1 site; bluff (in background) and west end of shoreline sampled.

Figure 10. Looking southwest at WS5 (in center) – sampled west shoreline of pond in from western side of outlet stream and along north shore of oxbow in the background. Surrounding area burned in 1996.

Figure 11. Looking east at site 14B; sampled shoreline visible in left center of photo and aquatic vegetation towards the eastern end of the lake.

Figure 12. WS9 (Tussock Basin) located 5 miles east of the WS14-east site, in same drainage; looking north (see arrow).

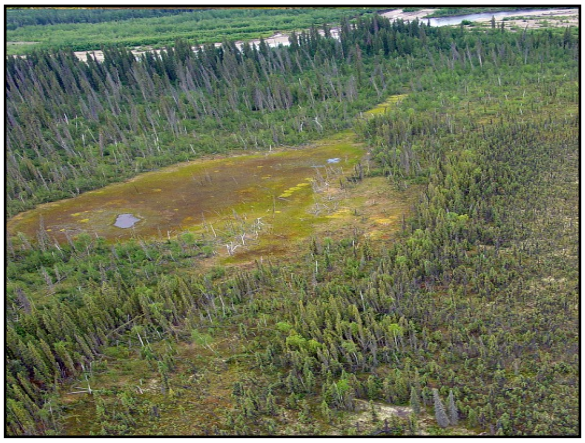


Figure 13. Orange Bog site with Beaver Creek in the background; sampled far end of bog and along top and left edge.

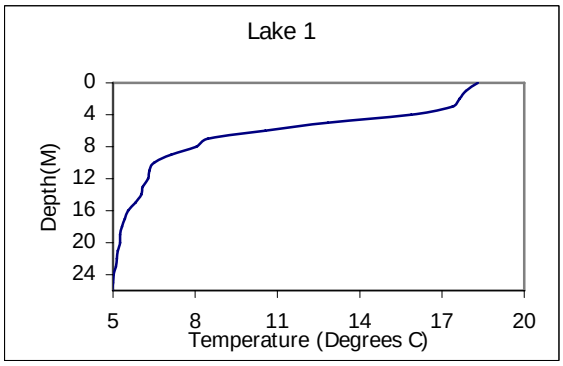
Appendix D. cont.

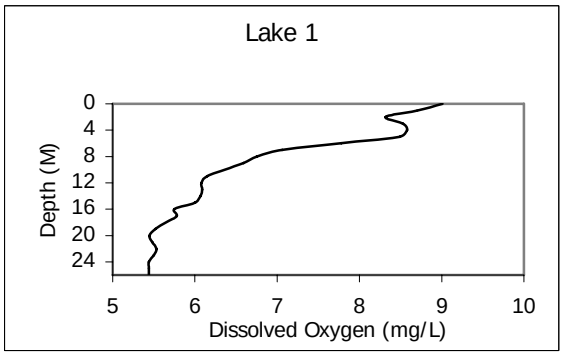
Figure 14. WS19 – looking south towards the White Mountains; photo taken from loess bluff. Sampled eastern and southern shoreline and bluff.

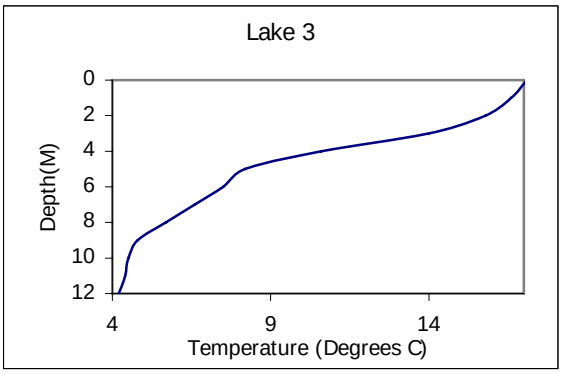
Figure 15. WS19 looking towards loess bluff on north end of lake.

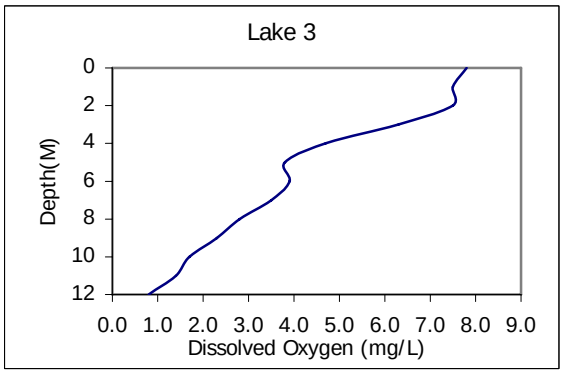
Figure 16. WS Beaver Creek Oxbow, looking south. Sampled far end of oxbow shore and shrub zone (center) and gravel area in between (left center).

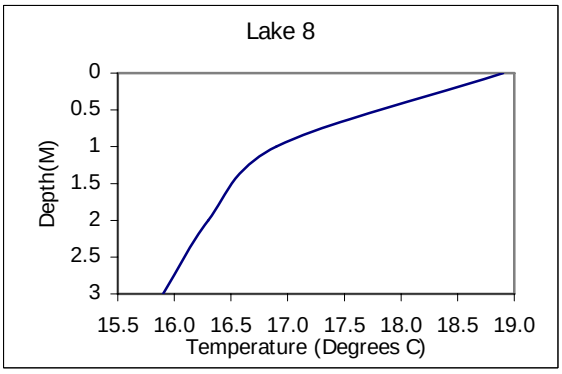
Appendix E. Temperature and dissolved oxygen depth profiles for Lakes 1, 3, and 8, Yukon Flats National Wildlife Refuge, Alaska, June 2003, July, 2004.

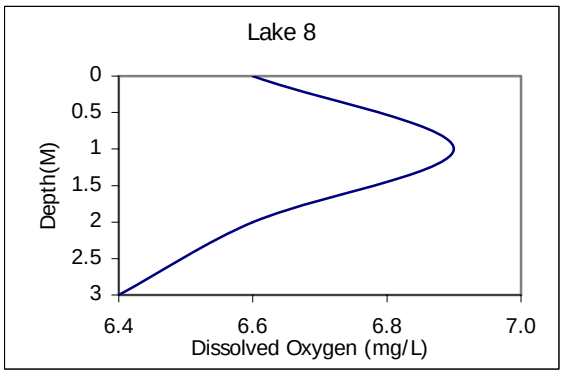




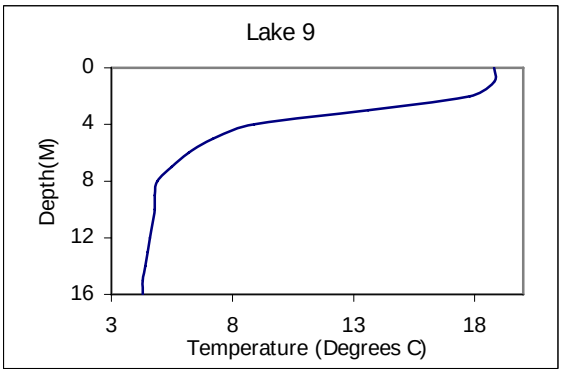


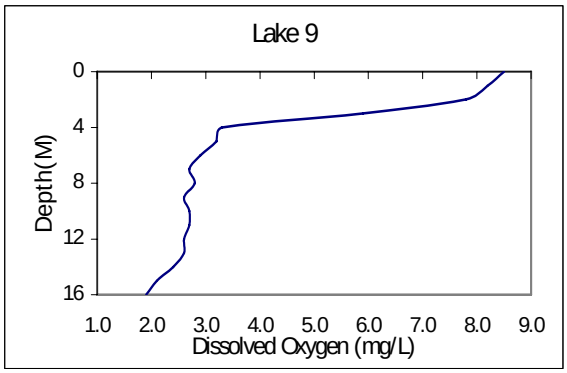


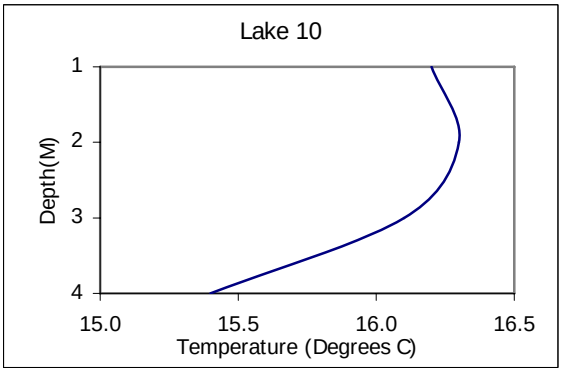


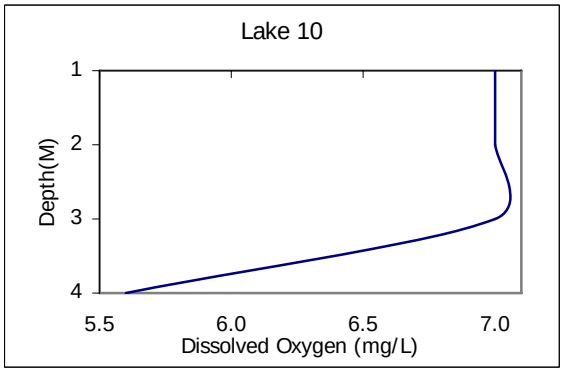


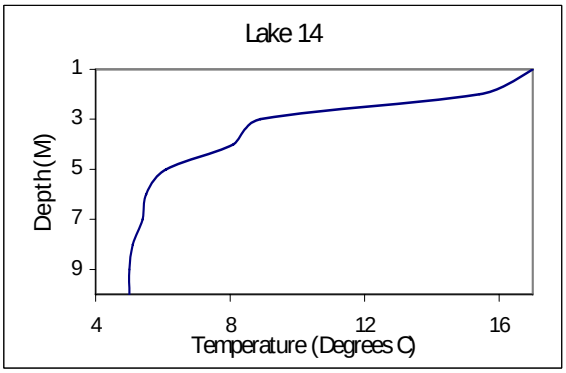
Appendix E. cont. Temperature and dissolved oxygen depth profiles for Lakes 9,10, and 14, Yukon Flats National Wildlife Refuge, Alaska, June 2003, July, 2004.

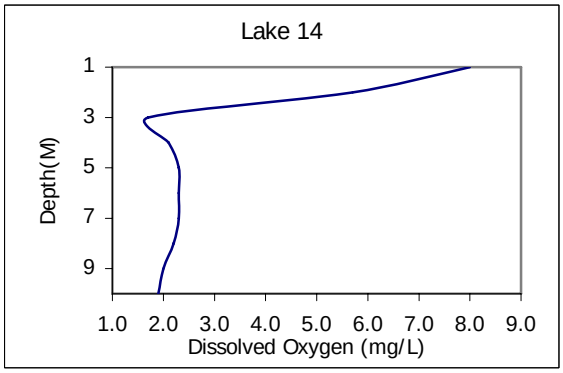




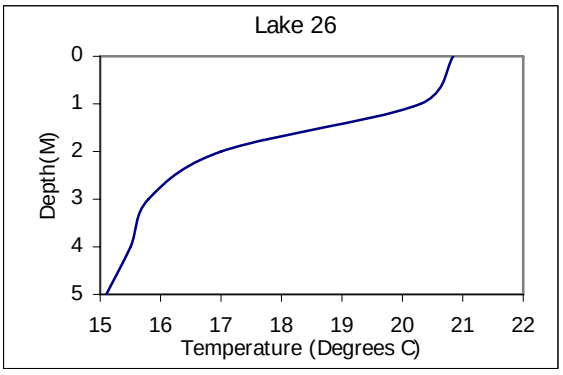


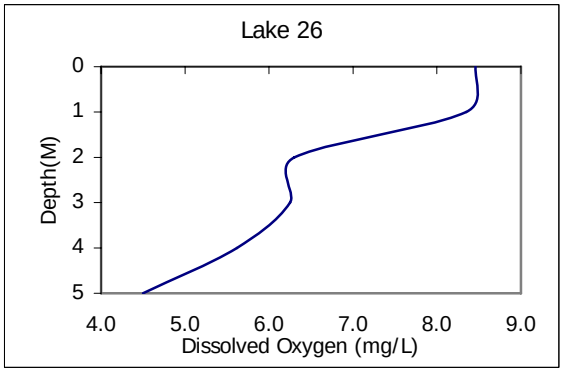


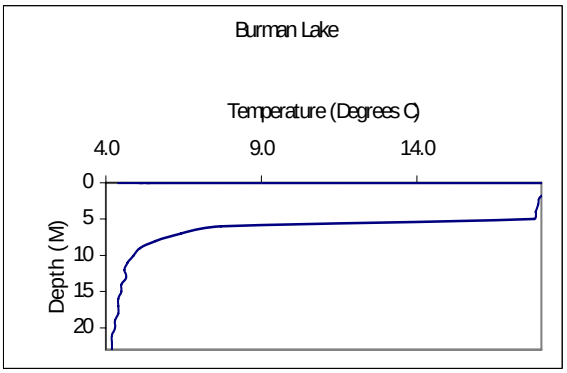


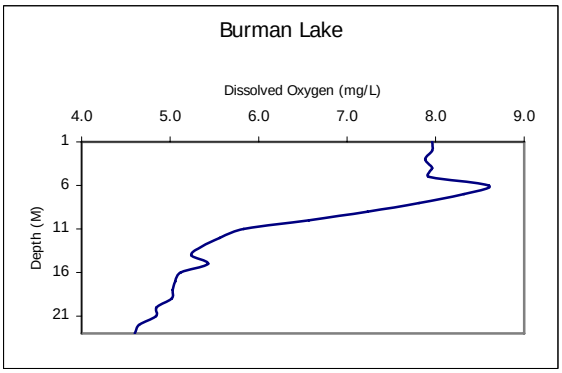


Appendix E. cont. Temperature and dissolved oxygen depth profiles for Lakes 26 and Burman, Yukon Flats National Wildlife Refuge, Alaska, June, 2003, July, 2004.









Appendix F. Length and weights of northern pike collected at Burman Lake, Yukon Flats National Wildlife Refuge, Alaska, July 12-20, 2004.

Date	Length (mm)	Weight (kg)	Date	Length (mm)	Weight (kg)	Date	Length (mm)	Weight (kg)
7/12/04	685	2.7	7/15/04	390	0.5	7/19/04	575	1.4
7/13/04	570	1.7	7/15/04	635	2.0	7/19/04	610	1.8
7/14/04	88	-	7/15/04	645	2.0	7/19/04	630	1.7
7/14/04	85	-	7/15/04	610	2.2	7/19/04	650	2.2
7/14/04	75	-	7/15/04	-		7/19/04	610	1.8
7/14/04	85	-	7/16/04	730	2.7	7/19/04	725	3.0
7/14/04	86	-	7/16/04	525	0.7	7/19/04	630	1.7
7/14/04	74	-	7/16/04	630	1.5	7/19/04	450	0.7
7/14/04	87	-	7/16/04	660	2.1	7/19/04	680	2.5
7/14/04	95	-	7/17/04	585	1.4	7/19/04	625	1.7
7/14/04	95	-	7/17/04	620	1.9	7/19/04	625	2.0
7/14/04	100	-	7/17/04	690	2.7	7/19/04	640	2.1
7/14/04	87	-	7/17/04	585	1.6	7/19/04	645	2.0
7/14/04	83	-	7/17/04	705	2.5	7/19/04	580	1.5
7/14/04	94	-	7/17/04	610	1.2	7/19/04	580	1.7
7/14/04	98	-	7/17/04	585	1.6	7/19/04	580	1.5
7/14/04	90	-	7/17/04	630	1.9	7/19/04	515	1.0
7/14/04	95	-	7/17/04	640	1.7	7/19/04	580	1.1
7/14/04	560	-	7/17/04	630	1.8	7/19/04	620	1.9
7/14/04	670	-	7/17/04	650	2.0	7/19/04	595	1.6
7/14/04	590	1	7/17/04	600	1.6	7/19/04	655	1.8
7/14/04	570	-	7/17/04	520	1.0	7/19/04	630	1.1
7/14/04	675	2.3	7/17/04	560	1.2	7/19/04	780	2.5
7/14/04	530	1.2	7/17/04	605	1.5	7/19/04	690	2.5
7/14/04	610	1.7	7/17/04	665	1.9	7/19/04	575	1.6
7/14/04	480	0.9	7/17/04	470	0.4	7/19/04	595	1.3
7/14/04	540	1.1	7/17/04	650	2.1	7/19/04	660	1.6
7/14/04	695	2.2	7/17/04	550	1.5	7/19/04	500	0.9
7/14/04	690	-	7/18/04	630	2.0	7/19/04	725	2.6
7/14/04	605	1.6	7/18/04	550	1.3	7/19/04	690	2.8
7/14/04	570	1.4	7/18/04	630	1.8	7/19/04	600	1.5
7/14/04	675	2.4	7/18/04	610	1.7	7/19/04	570	1.2
7/14/04	600	1.3	7/18/04	650	2.2	7/19/04	670	2.3
7/14/04	495	1.1	7/18/04	630	1.8	7/20/04	630	1.3
7/14/04	540	1.2	7/18/04	650	2.1	7/20/04	600	1.7
7/15/04	590	1.5	7/18/04	690	2.7	7/20/04	640	1.8
7/15/04	630	1.7	7/18/04	580	1.5	7/20/04	600	1.8
7/15/04	590	1.4	7/18/04	665	2.3	7/20/04	420	
7/15/04	670	2.2	7/18/04	710	2.75	7/20/04	570	1.5
7/15/04	570	2.4	7/18/04	680	2.2	7/20/04	665	2.2
7/15/04	630	1.5	7/18/04	550	1.3	7/20/04	610	1.7
7/15/04	610	1.2	7/18/04	520	1.0	7/20/04	710	2.2
7/15/04	670	-	7/18/04	280	-	7/20/04	580	1.2
7/15/04	610	1.7	7/18/04	550	1.1	7/20/04	560	1.5
7/15/04	610	1.4	7/18/04	470	0.7	7/20/04	585	1.3
7/15/04	495	1.0	7/18/04	600	1.5	7/20/04	630	1.7
7/15/04	430	0.4	7/18/04	665	2.2	7/20/04	670	2.2
7/15/04	600	1.8	7/19/04	670	2.2	7/20/04	590	1.8
7/15/04	380	0.5	7/19/04	540	1.5	7/20/04	590	1.8
						7/20/04	570	1.3

Appendix G. Numbers of birds and species observed in lakes 2, 8, 10, 14 and alpine 1 during point count surveys in the proposed land exchange area, Yukon Flats National Wildlife Refuge, Alaska, June, 2003.

	Lake 2 6/18/03		Lake 14 6/19/03		Lake 10 6/20/03		Alpine 1 6/21/03		Lake 8 6/22/03	
Species	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points
Alder Flycatcher	3	3	10	8	5	4	0	0	8	5
American Pipit	0	0	0	0	0	0	10	6	0	0
American Robin	14	11	11	10	6	5	6	6	7	6
American Tree Sparrow	1	1	5	4	2	2	0	0	0	0
American Wigeon	0	0	0	0	0	0	0	0	1	1
Arctic Tern	0	0	0	0	0	0	0	0	9	3
Bank Swallow	0	0	0	0	2	1	0	0	0	0
Bohemian Waxwing	2	1	1	1	2	1	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0	0	0
Chipping Sparrow	0	0	1	2	0	0	0	0	0	0
Common Goldeneye	0	0	0	0	0	0	0	0	0	0
Common Loon	0	0	0	0	0	0	0	0	0	0
Common Raven	0	0	0	0	0	0	0	0	2	2
Common Redpoll	2	2	2	2	4	4	4	4	11	8
Dark-eyed Junco	3	3	10	7	23	11	0	0	12	8
Fox Sparrow	5	4	7	5	10	8	2	2	9	7
Gray Jay	0	0	2	2	0	0	0	0	3	2
Gray-cheeked Thrush	0	0	0	0	0	0	0	0	0	0
Great-horned Owl	0	0	0	0	0	0	0	0	0	0
Hammond's Flycatcher	0	0	0	0	0	0	0	0	0	0
Horned Grebe	3	1	1	1	8	2	0	0	0	0
Lapland Longspur	0	0	0	0	0	0	2	1	0	0
Lesser Scaup	0	0	3	2	4	2	0	0	0	0
Lesser Yellowlegs	21	8	8	3	8	7	0	0	8	6
Lincoln's Sparrow	1	1	0	1	3	3	0	0	2	2
Mallard	2	1	0	0	5	1	0	0	0	0
Mew Gull	0	0	0	0	0	0	0	0	3	2
Myrtle Warbler	3	3	8	5	7	6	0	0	2	2
Northern Flicker	1	1	2	2	0	0	0	0	2	2
Northern Goshawk	0	0	0	0	0	0	0	0	0	0
Northern Waterthrush	12	7	7	5	1	1	0	0	0	0
Northern Wheatear	0	0	0	0	0	0	1	1	0	0
Olive-sided Flycatcher	0	0	2	2	2	2	0	0	0	0
Orange-crowned Warbler	2	2	0	0	1	1	0	0	1	1
Pacific Loon	4	3	2	2	6	1	0	0	1	1
Pine Grosbeak	0	0	0	0	0	0	0	0	0	0
Red-tailed Hawk	0	0	4	3	0	0	0	0	0	0
Ruby-crowned Kinglet	0	0	2	2	0	0	0	0	1	1
Rusty Blackbird	1	1	14	6	0	0	0	0	0	0
Savannah Sparrow	0	0	0	0	1	1	1	1	0	0

	Lake 2 6/18/03		Lake 14 6/19/03		Lake 10 6/20/03		Alpine 1 6/21/03		Lake 8 6/22/03	
Species	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points
Semi-palmated Plover	0	0	0	0	0	0	0	0	0	0
Spotted Sandpiper	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0
Swainson's Thrush	9	8	6	5	15	9	1	1	13	10
Townsend's Solitaire	0	0	0	0	0	0	7	7	0	0
Tree Swallow	0	0	1	1	0	0	0	0	1	1
Varied Thrush	2	2	0	0	0	0	0	0	3	3
Violet-green Swallow	0	0	0	0	0	0	0	0	0	0
Western Wood-pewee	2	2	3	3	7	7	0	0	7	6
White-crowned Sparrow	13	7	12	7	24	11	10	9	12	10
White-winged Crossbill	0	0	0	0	3	3	0	0	2	1
White-winged Scoter	4	1	0	0	0	0	0	0	0	0
Wilsons Snipe	3	2	0	0	2	2	0	0	5	5
Wilson's Warbler	0	0	0	0	0	0	0	0	0	0
Yellow Warbler	7	7	5	4	5	3	0	0	3	3
Totals[1]	120	82	129	95	156	98	44	38	128	98
	24 species		25 species		25 species		10 species		25 species	

[1]Numbers include flyovers within the point count boundary that were observed during each count.

Appendix G. cont. Numbers of birds and species observed in lakes 1, 9, Beaver Creek, and alpine 2 during point count surveys in the proposed land exchange area, Yukon Flats National Wildlife Refuge, Alaska, June, 2003.

	Lake 9 6/23/03		Beaver Creek 6/24/03		Alpine 2 6/25/03		Lake 1 6/26/03		Total	
Species	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points
Alder Flycatcher	1	1	15	10	0	0	5	3	47	34
American Pipit	0	0	0	0	13	7	0	0	23	13
American Robin	6	4	21	10	6	6	9	7	86	65
American Tree Sparrow	0	0	0	0	0	0	0	0	8	7
American Wigeon	0	0	0	0	0	0	0	0	1	1
Arctic Tern	0	0	2	1	0	0	0	0	11	4
Bank Swallow	0	0	17	3	0	0	0	0	17	3
Bohemian Waxwing	1	1	3	3	1	1	0	0	10	8
Bufflehead	0	0	5	1	0	0	0	0	5	1
Chipping Sparrow	0	0	0	0	0	0	0	0	1	2
Common Goldeneye	0	0	1	1	0	0	1	1	2	2
Common Loon	0	0	0	0	0	0	5	4	5	4
Common Raven	0	0	1	1	0	0	0	0	3	3
Common Redpoll	0	0	3	3	13	7	4	4	43	34
Dark-eyed Junco	21	9	13	8	4	3	19	9	105	58
Fox Sparrow	11	9	1	1	14	9	7	5	66	50
Gray Jay	4	4	3	3	0	0	7	3	19	14
Gray-cheeked Thrush	0	0	0	0	1	1	1	1	2	2
Great-horned Owl	0	0	1	1	0	0	0	0	1	1
Hammond's Flycatcher	0	0	1	1	0	0	0	0	1	1
Horned Grebe	0	0	0	0	0	0	0	0	12	4
Lapland Longspur	0	0	0	0	1	1	0	0	3	2
Lesser Scaup	0	0	0	0	0	0	0	0	7	4
Lesser Yellowlegs	0	0	1	1	0	0	0	0	46	25
Lincoln's Sparrow	1	1	0	0	0	0	1	1	8	9
Mallard	0	0	0	0	0	0	0	0	7	2
Mew Gull	3	2	1	1	0	0	0	0	7	5
Myrtle Warbler	11	8	5	4	0	0	13	8	49	36
Northern Flicker	3	3	4	4	0	0	1	1	13	13
Northern Goshawk	1	1	0	0	0	0	0	0	1	1
Northern Waterthrush	0	0	0	0	0	0	0	0	20	13
Northern Wheatear	0	0	0	0	0	0	0	0	1	1
Olive-sided Flycatcher	0	0	0	0	0	0	0	0	4	4
Orange-crowned Warbler	0	0	10	7	0	0	5	3	19	14
Pacific Loon	3	2	0	0	0	0	4	2	20	11
Pine Grosbeak	0	0	0	0	0	0	1	1	1	1
Red-tailed Hawk	0	0	1	1	0	0	0	0	5	4
Ruby-crowned Kinglet	4	3	0	0	0	0	4	3	11	9
Rusty Blackbird	0	0	0	0	0	0	0	0	15	7
Savannah Sparrow	0	0	0	0	0	0	0	0	2	2

	Lake 9 6/23/03		Beaver Creek 6/24/03		Alpine 2	6/25/03	Lake 1 6/26/03		Total	
Species	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points	# Birds	# Points
Semi-palmated Plover	0	0	2	1	0	0	0	0	2	1
Spotted Sandpiper	0	0	8	6	0	0	0	0	8	6
Surf Scoter	0	0	0	0	0	0	3	1	3	1
Swainson's Thrush	27	12	18	10	1	1	28	12	118	68
Townsend's Solitaire	0	0	0	0	0	0	0	0	7	7
Tree Swallow	0	0	0	0	0	0	0	0	1	1
Varied Thrush	3	3	2	2	1	1	4	3	15	14
Violet-green Swallow	1	1	0	0	0	0	0	0	1	1
Western Wood-pewee	5	5	1	1	0	0	0	0	25	24
White-crowned Sparrow	14	7	4	3	33	11	2	2	124	67
White-winged Crossbill	0	0	0	0	0	0	0	0	5	4
White-winged Scoter	0	0	0	0	0	0	17	3	21	4
Wilson’s Snipe	1	1	3	3	0	0	1	1	15	14
Wilson's Warbler	0	0	1	1	0	0	0	0	1	1
Yellow Warbler	1	1	3	3	0	0	10	5	34	26
Totals[1]	122	78	151	95	88	48	152	83	1090	715
	20 species		29 species		11 species		23 species		55 species	

[1]Additional sightings recorded as incidental detections include: 7 Alder Flycatcher, 8 American Pipit, 13 American Robin, 2 American Tree Sparrow, 1 Bank Swallow, 2 Bohemian Waxwing, 1 Common Goldeneye, 1 Common Merganser, 5 Common Redpoll, 1 Common Snipe, 1 Dark-eyed Junco, 1 Gray-crowned Rosy Finch, 7 Gray Jay, 1 Horned Grebe, 3 Horned Lark, 1 Lapland Longspur, 2 Lesser Scaup, 11 Lesser Yellowlegs, 2 Lincoln's Sparrow, 9(?) Mallards, 1 Mew Gull, 5 Myrtle Warbler, 2 Northern Flicker, 3 Northern Waterthrush, 2 Northern Wheatear, 5 Orange-crowned Warbler, 1 Olive-sided Flycatcher, 9 Pacific Loon, 2 Peregrine Falcon, 4 Red-tailed Hawk, 2 Rusty Blackbird, 1 Say's Phoebe, 4 Spotted Sandpiper, 1 Sharp-shinned Hawk, 2 Surf Scoter, 4 Swainson's Thrush, 3 Townsend's Solitaire, 9 White-crowned Sparrow, 1 Western Wood-pewee, 1 Yellow Warbler

Appendix H. Numbers of bird, and mammal species observed at Burman Lake, July 12-20, 2004.

Avian species	#Adults	# Males	#Females	Comments
Alder Flycatcher	4			
American Robin	3			
American Wigeon	3			brooding hen
Arctic Tern	9			
Bald Eagle	2			mature, immature
Bank Swallow	2			
Bufflehead	2		1	
Common Goldeneye	1			
Common Loon	20			
Common Raven	1			
Common Redpoll	1			
Common Snipe	1			
Gray Jay	2			
Lesser Scaup	3		1	
Lesser Yellowlegs	1			
Mallard	34			
Mew Gull	4			
Mew Gull	2 (plus 2 young)			1 adult w/ 2 young; 1 lone adult
Northern Flicker	3			
Northern Shoveler	15			
Northern Waterthrush	4			
Osprey	2			
Pacific Loon	10			
Peregrine Falcon	2			
Peregrine Falcon	1			
Phalarope	200-300			
Redhead	1			
Red-tailed Hawk	1			
Rusty Blackbird	3			
Surf Scoter		7	5	5 pairs
Trumpeter Swan	3			
White-crowned Sparrow	2			
White-winged Scoter	175	112	22	mixed flock
Mammals, other spp.				
Red Squirrel	1			
Moose	3	lone bull	cow w/ calf	
Muskrat	1			
Beaver	2			
Black Bear	1			
Wood Frog	3			