Eklutna Hydroelectric Project

Terrestrial Wildlife

Study Report

FINAL

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June 2023

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Terms, Acronyms, and Abbreviations

ADFG	Alaska Department of Fish and Game
ATV	all-terrain vehicle
AWWU	Anchorage Water and Wastewater Utility
BGEPA	Bald and Golden Eagle Protection Act
cfs	cubic feet per second
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
MBTA	Migratory Bird Treaty Act
mi	mile
mph	miles per hour
NVE	Native Village of Eklutna
Project	Eklutna Hydroelectric Project
RM	river mile
SE	standard error
TEK	traditional ecological knowledge
TWG	Technical Working Group
USFWS	U.S. Fish and Wildlife Service

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1 INTRODUCTION

The 1991 Fish and Wildlife Agreement (1991 Agreement) was executed amongst the Municipality of Anchorage, Chugach Electric Association, Inc., Matanuska Electric Association, Inc. (collectively "Project Owners"), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the State of Alaska as part of the sale of the Eklutna Hydroelectric Project (Project) from the Federal government to the now Project Owners. The 1991 Agreement requires that the Project Owners conduct studies that examine and quantify, if possible, the impacts to fish and wildlife from the Project. The studies must also examine and develop protection, mitigation, and enhancement (PME) measures for fish and wildlife affected by such hydroelectric development. This examination shall consider the impact of fish and wildlife measures on other resources, including terrestrial wildlife, as well as available means to mitigate these impacts. The Project Owners initiated consultation in 2019 and have implemented studies to inform the development of the future Fish and Wildlife Program for the Project. As part of these studies, the Project Owners contracted ABR, Inc. to describe and evaluate terrestrial wildlife in the Project area.

To meet the requirements of the 1991 Fish and Wildlife Agreement for the Project, a set of wildlife studies was developed to address concerns over possible historical impacts to bird and mammal populations in the Project area. The studies were focused on establishing current baseline information on the use of the area by bird and mammal species and species groups of concern that were identified by members of the terrestrial technical working group (TWG) for the Project, which included representatives of federal and state resource management agencies and the Native Village of Eklutna (NVE). The species and species groups for which concern was expressed in the Year 2 study planning process (MJA 2022) were raptors (especially bald eagles), migratory waterfowl and shorebirds, beavers (for their ecosystem effects), moose, and black and brown bears. In response, five wildlife studies were developed and implemented, focusing on collecting baseline data on these taxa, and a sixth study, the Wildlife Habitat Evaluation, was conducted to address habitat impact concerns for these species and species groups as well as other species that are known or expected to occur in the Project area.

1.1. Nesting Raptors

Raptors are keystone species that play important roles as apex predators in the ecosystem and are protected under the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703-712), and in the case of bald and golden eagles, the Bald and Golden Eagle Protection Act (BGEPA; 16 U.S.C. 668-668d). To avoid possible disturbance "take" of breeding bald eagles under the BGEPA, it is important to take into account the locations of any active nests and avoid unnecessary disturbances near nest sites. In the past, at least two bald eagle nests were recorded in the lower reaches of the Eklutna River (USACE 2011).

1.2. Waterfowl and Shorebirds

Cook Inlet is an important staging area for migratory Arctic and boreal forest breeding waterfowl and shorebirds (Gill and Tibbetts 1999; ABR 2007; Bankert and Obritschkewitsch 2021). Upper Cook Inlet is also used by wintering rock sandpipers, but the extensive shorefast ice in Knik Arm restricts the use of that area by this species (Ruthrauff et al. 2013; Daniel Ruthrauff, USGS, pers. comm.). The lower reaches of the Eklutna River and the estuary are known to be used by migratory waterfowl, including at least common species such as mallards, green-winged teal, and American wigeon (USACE 2011). The estuary of the Eklutna River and the adjacent intertidal mudflats may also be used by migratory shorebirds during spring and fall. Hence, field surveys for migratory waterfowl and shorebirds were conducted for the Project in 2022.

1.3. Beaver

Beavers are important "ecosystem engineers" that build dams, create ponds, and divert stream channels. Beaver ponds and diversions alter vegetative succession, create important wetland habitat for species such as juvenile salmon, waterfowl, moose, and other furbearers, and perform important ecological services such as water filtration and floodwater moderation (Naiman et al. 1986, 1988; Collen and Gibson 2000; Wright et al. 2002; Baker and Hill 2003; Pollock et al. 2003). In 2021, Project personnel were aware of at least three regions with active beaver colonies: the lower river downstream of the Alaska Railroad bridge, the middle river, and the upper river near the Anchorage Water and Wastewater Utility (AWWU) portal.

1.4. Moose Browse

For moose, twinning rates have long been used as an index of overall nutritional status of populations (Boer 1992; Gasaway et al. 1992; Keech et al. 2000; Boertje et al. 2007). However, twinning are logistically challenging and expensive to conduct. A simpler alternative metric of moose nutritional status can be derived by examining the amount of browse available to moose in an area and the proportion of available browse that has been removed by moose. Proportional browse removal has been shown to be inversely related to moose twinning rates (Seaton et al. 2011) and is used by the Alaska Department of Fish and Game (ADFG) as an index of moose population densities. Because dry biomass of moose browse has a statistically significant exponential relationship with twig diameter (Oldemeyer 1982), proportional biomass removal can be estimated from in-field measurements of twig diameter and the diameter of twigs at the browsing point (Seaton et al. 2011). In the Moose Browse study, we estimated browse removal rates and compared those with estimates of proportional browse removal from other moose populations with known nutritional status in different areas across Alaska.

1.5. Camera Traps and Miscellaneous Mammals

Many of the terrestrial mammal species that are likely to occur in the Project area are difficult to study due to low densities and/or cryptic behavior. These species include, but are not limited to, black bear, brown bear, coyotes, river otters, lynx, wolves, and wolverine. We used camera-traps and opportunistic observations to provide a cost-effective means to collect information on the occurrence, habitat use, and relative abundance of these species in the Project area.

1.6. Wildlife Habitat Evaluation

In the Wildlife Habitat Evaluation, the classifications of habitat value for those species known or expected to occur in the Project area (for each habitat type mapped in the Wetlands and Wildlife Habitat Study) make it possible to identify habitats that are important to a large number of wildlife species. The habitat evaluation provides information on the expected use of the study area, not only by common species, but also by species that occur in low numbers and are rarely observed, and it can also provide information on species that were not surveyed for in the field. The habitat evaluation data can also be used to assess the relative impacts of changes in habitat types from historical habitat availability, and from possible future changes in habitat availability that may result from approved Project mitigation measures.

2 STUDY OBJECTIVES

The goal of the terrestrial wildlife studies is to assess the seasonal presence, abundance (when sufficient data are available), and habitat use for key terrestrial wildlife species in the Project area. In collaboration with the terrestrial TWG, the key species and species groups that have been identified include raptors, migratory waterfowl and shorebirds, beaver, moose, and black and brown bear. These key species were selected because they were deemed most likely to be impacted by any potential future mitigation measures that may be implemented within the Eklutna River watershed as part of the final Fish and Wildlife Program for the Project. By incorporating current and historical wildlife habitat maps into the wildlife studies (see the Wetland and Wildlife Habitat Study), we were able to assess Project-specific habitat values for wildlife species and evaluate how wildlife populations likely would have been affected in the past by development of the hydroelectric Project, which is one of the primary goals of the 1991 Fish and Wildlife Agreement. Specific objectives of the wildlife study tasks are outlined below.

- Raptor Nesting Survey—Locate nests of bald eagles and other large raptors to determine use of the study area by breeding raptors.
- Migratory Waterfowl and Shorebird Surveys—Determine the set of waterfowl and shorebird species that occur in the study area, their numbers and seasonal occurrence, and the use of the habitats available, focusing on the estuary and adjacent mudflats.
- Beaver Pond Mapping and Beaver Survey—Because beaver ponds are well known to provide high-quality salmon rearing habitat, conduct a beaver colony survey and generate an estimate of the current beaver population size in the study area.
- Moose Browse Study—Provide an assessment of the current level of moose browsing pressure in the study area to help assess where current moose numbers are relative to habitat carrying capacity.
- Camera Traps and Opportunistic Observations—Provide information on the different wildlife species present, especially large mammals, and some limited information on their relative density and distribution, including the use of natural wildlife movement corridors.
- Wildlife Habitat Evaluation—Provide information on the expected current use of mapped wildlife habitats in the study area by terrestrial mammals and birds of concern as well as other species that occur in low numbers and are rarely observed. Based on changes in habitats over time, evaluate how development of the hydroelectric Project could have impacted wildlife populations in the past.

3 STUDY AREA

Four of the wildlife studies use the same study area as defined for the Wetland and Wildlife Habitat Study, which includes a portion of Eklutna Lake near the current dam site, the riverine-influenced portions of the Eklutna River drainage, the complex of ponds remaining from mining activity in the lower river, the estuary, and the adjacent mudflats (Figure 3.1). For the Raptor Nesting Survey and the Migratory Waterfowl and Shorebird Surveys, broader study areas were developed to encompass the additional areas expected to be used by those species groups, as described below.

3.1. Task 1: Study Area: Raptor Nesting Survey

The Raptor Nesting Survey study area was expanded from the study area used for the other wildlife studies to include two additional features: (1) the hillsides and bluffs that face the Eklutna River upstream of the canyon were surveyed for cliff-nesting raptor species and goshawk nests; and (2) the coastal forests on NVE land north of the Eklutna River mouth were surveyed because they are known to support breeding bald eagles (Figure 3.1-1). The hillsides and bluffs overlooking the middle and upper river extended the survey area ~0.25 mi beyond the riverine-influenced corridor used as the boundary of the study area for the other wildlife studies. The U.S. Fish and Wildlife (USFWS) recommends a no-disturbance buffer zone of 660 ft to avoid take of eagles for most activities, such as road building and tree-clearing (USFWS 2007). Therefore, we used a conservative buffer zone of approximately double this distance from the edge of the study area for the Wetland and Wildlife Habitat Study to define the boundary for the Raptor Nesting Survey.

3.2. Task 2: Study Area: Migratory Waterfowl and Shorebird Surveys

The study area for the Migratory Waterfowl and Shorebird Surveys was expanded from the study area used for the Wetlands and Wildlife Habitat Study only at the Cook Inlet coastline. In this area, the study area was expanded along the Cook Inlet shoreline to encompass approximately 1.6 mi of intertidal salt marsh habitat on either side of the mouth of the Eklutna River. The study area also extended approximately 0.4 mi offshore of the edge of the salt marsh to include a substantial portion of intertidal mudflats, which can be used by foraging migratory shorebirds in upper Cook Inlet (Figure 3.2-1).

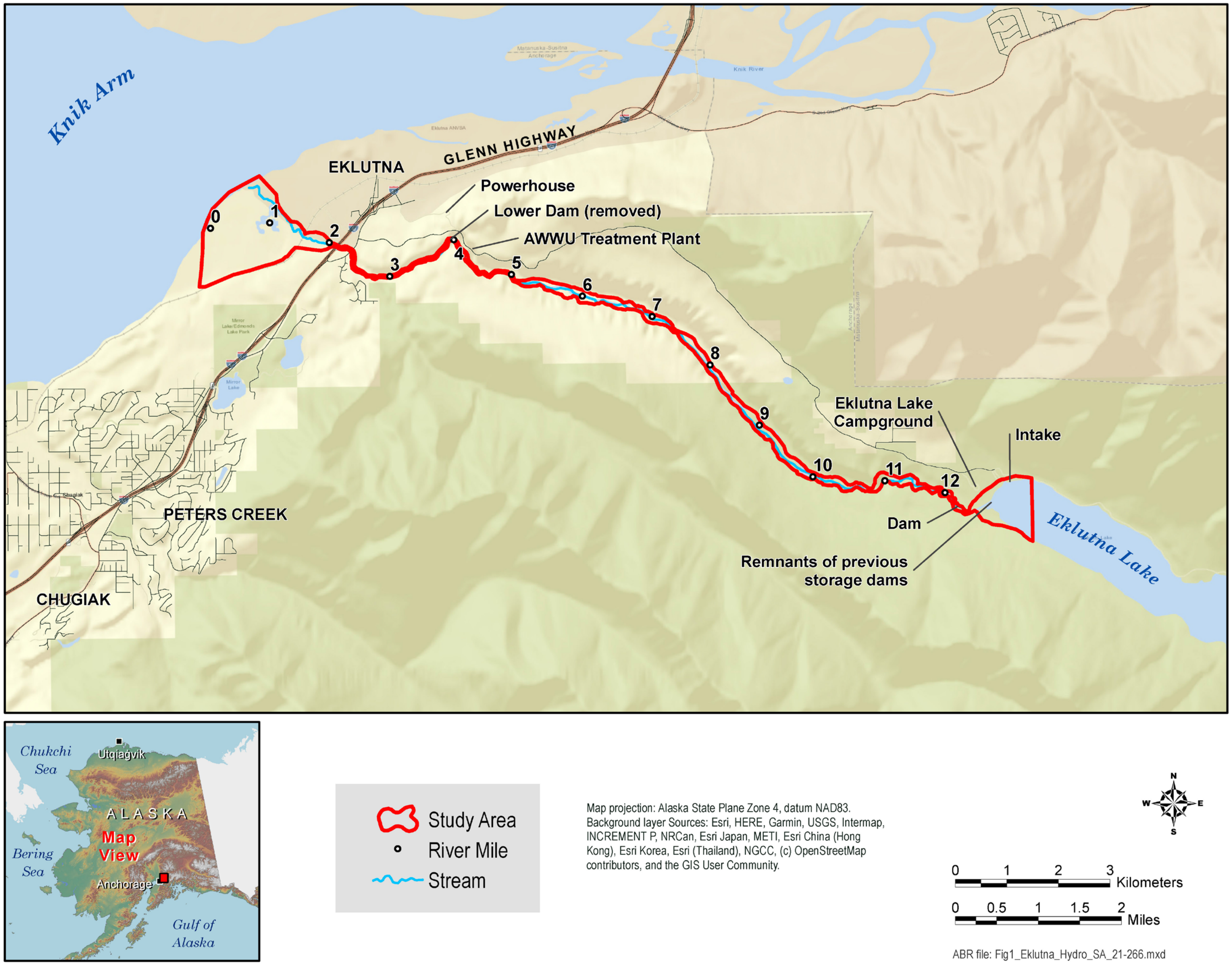

Figure 3.1. Terrestrial wildlife study area for the Eklutna Hydroelectric Project, 2022.

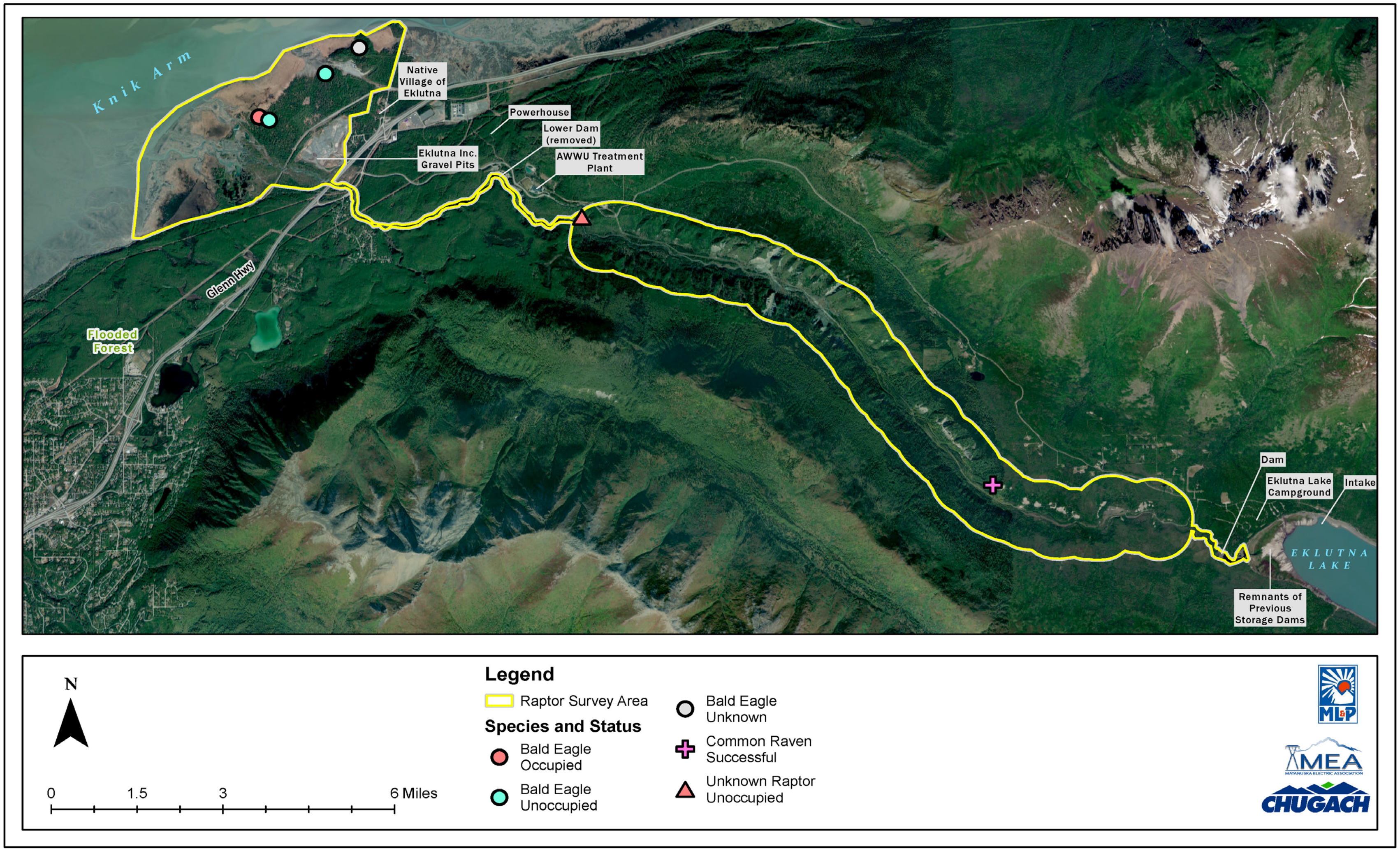

Figure 3.1-1. Aerial raptor nesting survey area for the Eklutna Hydroelectric Project, 9 May 2022.

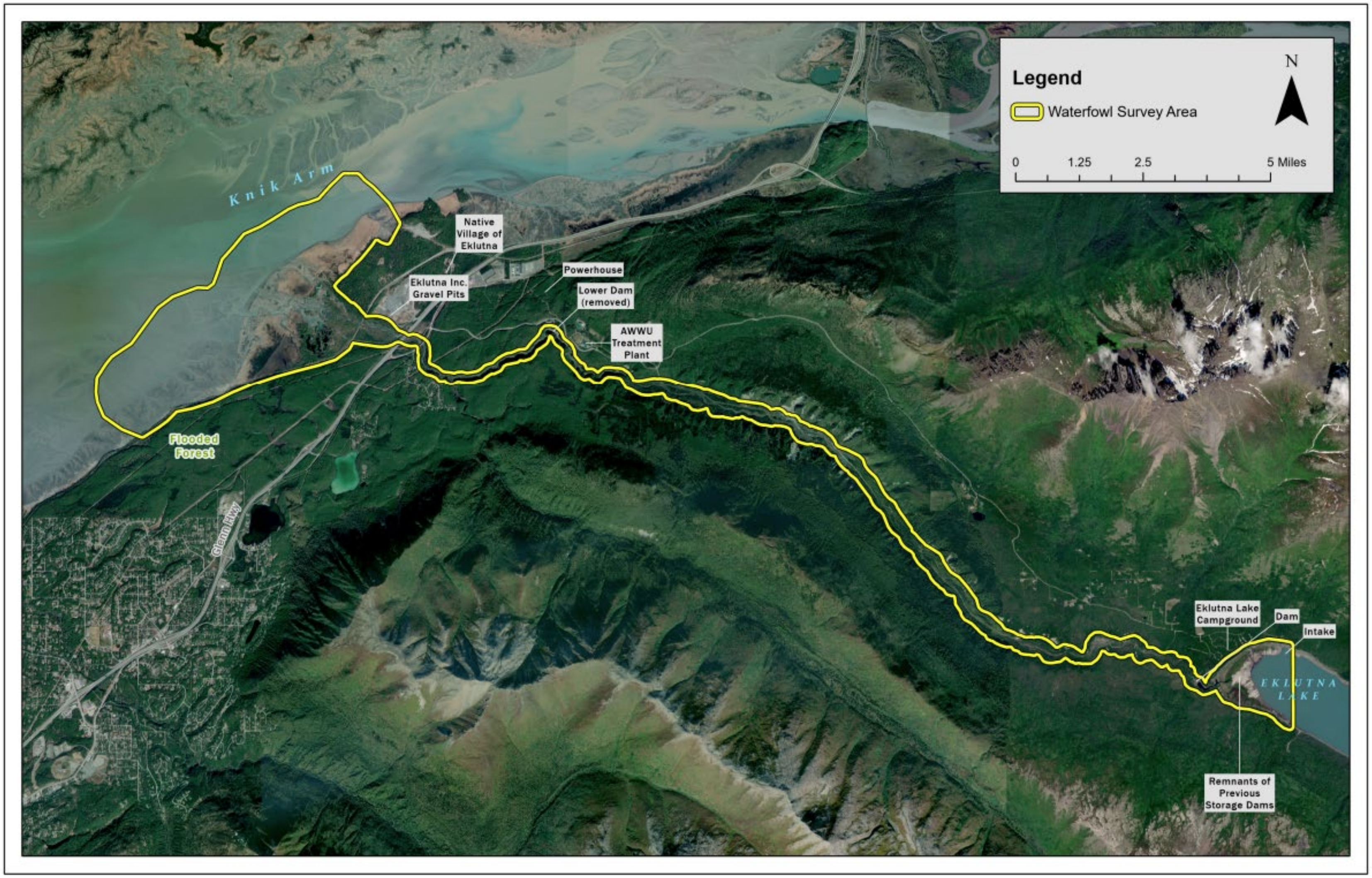

Figure 3.2-1. Migratory waterfowl and shorebird survey area for the Eklutna Hydroelectric Project, spring and fall 2022.

4 METHODS

4.1. Task 1: Raptor Nesting Survey

To determine the current status and distribution of nesting raptor species in the Project area, we conducted a helicopter survey for nesting raptors. Helicopter-based surveys have proven safe and efficient for determining the presence of large conspicuous nests of both tree-nesting raptors (e.g., bald eagles, northern goshawks, red-tailed hawks) and cliff-nesting species (e.g., golden eagles, peregrine falcons, American kestrels, merlin), and are deemed an appropriate method for surveying for raptors when conducted by trained professionals (Pagel et al. 2010). We conducted the raptor nest occupancy survey on 9 May 2022 following established protocols for the inventory and monitoring of eagle nests using aircraft (USFWS 2007, Pagel et al. 2010). We flew the survey in a small, piston-engine helicopter (Robinson R-44, Regional Helicopters) with 2 observers seated on the same side of the aircraft. We approached all suitable nesting habitats and flew slow passes (5–40 mph) within ~100–600 ft of trees and cliffs to search for nests. When a nest was found, we collected data on nest attributes (nest-building species, status, condition, and location) following the format of USFWS nest-record cards. We recorded nest site coordinates using a hand-held global positioning system (GPS) receiver while hovering directly above nest sites. We remained ~500 ft above the nest if a bird was present to minimize disturbance. The focus of the survey was bald eagles, but the nests of other raptors (e.g., northern goshawks) as well as common ravens were also recorded. Common ravens, while not raptors, build nests that are often reused by raptors, and thus, we also record their nests during raptor surveys.

4.2. Task 2: Migratory Waterfowl and Shorebird Surveys

We conducted two combined waterfowl and shorebird surveys during the spring and two surveys during the fall of 2022 (Table 4.2-1). The focus of the surveys was on waterfowl and shorebirds, but all bird and mammal species observed were recorded. We planned the survey dates to align with the peak numbers of migratory waterfowl and shorebirds moving through the Cook Inlet area, based on survey data from other Cook Inlet studies (Gill and Tibbits 1999, ABR 2007, Bankert and Obritschkewitsch 2021). We conducted the spring surveys on 2 and 13 May, and the fall surveys on 27 August and 17–18 September. Each survey consisted of simultaneous ground-based and aerial efforts, except for the late fall survey when observer availability forced us to conduct the aerial survey on 17 September and the ground-based survey the following day. We surveyed the mudflats as they became exposed on the outgoing tide. We started each survey on the falling tide when the tide line dropped below the edge of saltmarsh vegetation and started to expose intertidal mudflats; this typically occurred 1.5 hours after the predicted Anchorage high tide. During the late fall surveys, high tides were lower and never fully covered the mudflats. On those dates, we started those surveys at the time of the predicted high tide.

Table 4.2-1. Dates, times, and tidal information for migratory waterfowl and shorebird surveys conducted during spring and fall 2022.

Survey	Date	Survey Time	High Tide Time	High Tide Magnitude (ft)
Early Spring	2 May	0930–1130	0839	30.77
Late Spring	13 May	0730–0915	0557	28.74
Early Fall	27 August	0920–1020	0756	30.14
Late Fall - Aerial	17 September	1300–1405	1300	24.27
Late Fall - Ground	18 September	1345–1430	1415	23.18

During the ground-based surveys, we stationed a biologist and bear guard at the Eklutna River mouth with a spotting scope and binoculars as the outgoing tide exposed the intertidal mudflats. The observer regularly scanned the exposed mudflats, open water, and coastal marshes with the spotting scope or binoculars and recorded the number and species of all birds seen using a voice recorder and approximated the location of each flock on a map using a tablet computer. Any birds not identified to species were recorded and assigned to a more general category (e.g., unidentified duck). The ground observations lasted 45 minutes to 2 hours, depending on the bird activity level.

During the aerial surveys, we flew a Robinson R-44 helicopter with the pilot on the right side and a single observer on the left side of the aircraft. The observer used image-stabilizing binoculars to identify birds. The aerial survey was focused on two primary areas within the study area, the coastal marshes/mudflats surrounding the mouth of the Eklutna River and the western (downstream) end of Eklutna Lake. After arriving in the study area, the observer would determine whether the tide had receded enough to survey the exposed mudflats. If the timing was appropriate, the observer surveyed the coastal area first followed by the survey of Eklutna Lake. If the tide was still too high, the observer surveyed Eklutna Lake first to allow the tide to recede further. The coastal area was surveyed by flying slow (10–25 mph) at an altitude of 98–164 ft above the ground on roughly straight transects parallel to the shore. Transects were spaced 820 ft apart and the observer was able to scan all areas between each transect, resulting in complete coverage of the study area. We did not survey any forested areas since they were unlikely to be used by shorebirds or waterbirds, but we did survey the ponds in the lower river area both north and south of the river and downstream of the railroad tracks. When the observer spotted birds they could not identify or anticipated a flock of shorebirds or waterfowl coming into view, the pilot would lower the altitude and circle areas if needed to confirm identifications. We often circled ponds twice to get accurate waterfowl counts, and we typically flew an additional transect over exposed mudflats to verify we did not miss any flocks of shorebirds. During the Eklutna Lake portion of the survey, we flew along the lake shore within the study area and recorded any shorebirds or waterfowl along the lake margin, in the littoral zone, or on open water. Observers also surveyed for waterfowl on the Eklutna River between the lower river area and Eklutna Lake, but due to the topography and dense vegetation, detectability of birds along the river was low. Similar to the ground surveys at the coast, the aerial observer recorded the species and number of birds on a voice recorder and marked each groups' location on a moving-map application running on a tablet computer.

4.3. Task 3: Beaver Pond Mapping and Beaver Survey

We conducted the beaver colony survey on 10 October 2022 using a small piston-engine helicopter (Robinson R-44) with a single observer seated opposite the pilot. We flew the survey in late fall after deciduous trees and shrubs had dropped their leaves, creating optimal sightability of waterbodies and shorelines. We searched for all beaver lodges and dams within the study area (Figure 4.3-1), marked their locations with a handheld GPS receiver, took documentary photos, and noted whether they were active or not. Beaver colonies were identified as active when lodges had fresh food caches nearby or nearby fresh cuttings along the shoreline or in the water. Fresh food caches contained small-diameter trees and saplings, typically with leaves still attached, that had been cut and stored underwater for winter food (Hay 1958, Payne 1981; Figure 4.3-1). During the survey, we flew from 20–200 ft above the treetops and flew slowly (~5 mph) over the coastal pond complex in the lower river multiple times before flying up the river corridor to Eklutna Lake at ~20 mph.

At the request of the terrestrial TWG, we also conducted a single ground-based survey on 22 September 2022 in an attempt to estimate family sizes of beaver colonies in the area. A single observer accompanied by a bear guard spent up to 3 hrs observing beaver colonies. Observers sat quietly at a good observation point and recorded any animal observations or activity.

4.4. Task 4: Moose Browse Survey

We conducted the moose browse survey during late winter, 12–15 April 2022, so that the data would represent maximum seasonal browse removal. We followed the methods of Seaton et al. (2011) to estimate mean browse removal rates at the individual plant level by sampling 30 plots within the study area (Figure 4.4-1). Prior to the field survey, we randomly generated 30 primary plot-centers and 30 secondary plot-centers in a GIS for possible browse sampling. We excluded brackish and tidal habitats at the coast and the area above the existing Eklutna Lake dam as they were not expected to receive much moose browse. To be sampled, a plot had to contain at least one or more of the following preferred moose browse species: willow (*Salix* spp.), black cottonwood/balsam poplar (*Populus* spp.), Alaska birch (*Betula neoalaskana*), red-osier dogwood (*Cornus stolonifera*), or high-bush cranberry (*Viburnum edule*). Following the methods of Seaton et al. (2011), if a primary sampling plot did not contain any preferred moose browse species, we either sampled at the nearest secondary plot or moved the plot-center due-north or due-south until browse species were present. Both black cottonwood (*P. trichocarpa*) and balsam poplar (*P. balsamifera*) occur in southcentral Alaska and are nearly indistinguishable unless catkins are present, so we did not attempt to differentiate between the two species; we referred to them simply as “poplar.” We navigated to each plot by GPS on foot or skis. At each plot, we sampled browse within a 49.2-ft radius circle. We randomly selected up to 3 plants per species and up to 10 random twigs per plant from between 1.6 ft and 9.8 ft above ground; these heights correspond to the primary height range for moose browsing (Seaton et al. 2011). For each twig, we recorded the diameter at the base of the current annual growth and at the point of browsing, if applicable, as measured with a dial-caliper (Figure 4.4-2). We then counted the number of twigs within browsing height for each sampled plant and noted whether the plant was broomed (plant architecture resulting from multiple years of heavy browsing and compensatory shoots; Figure 4.4-3).

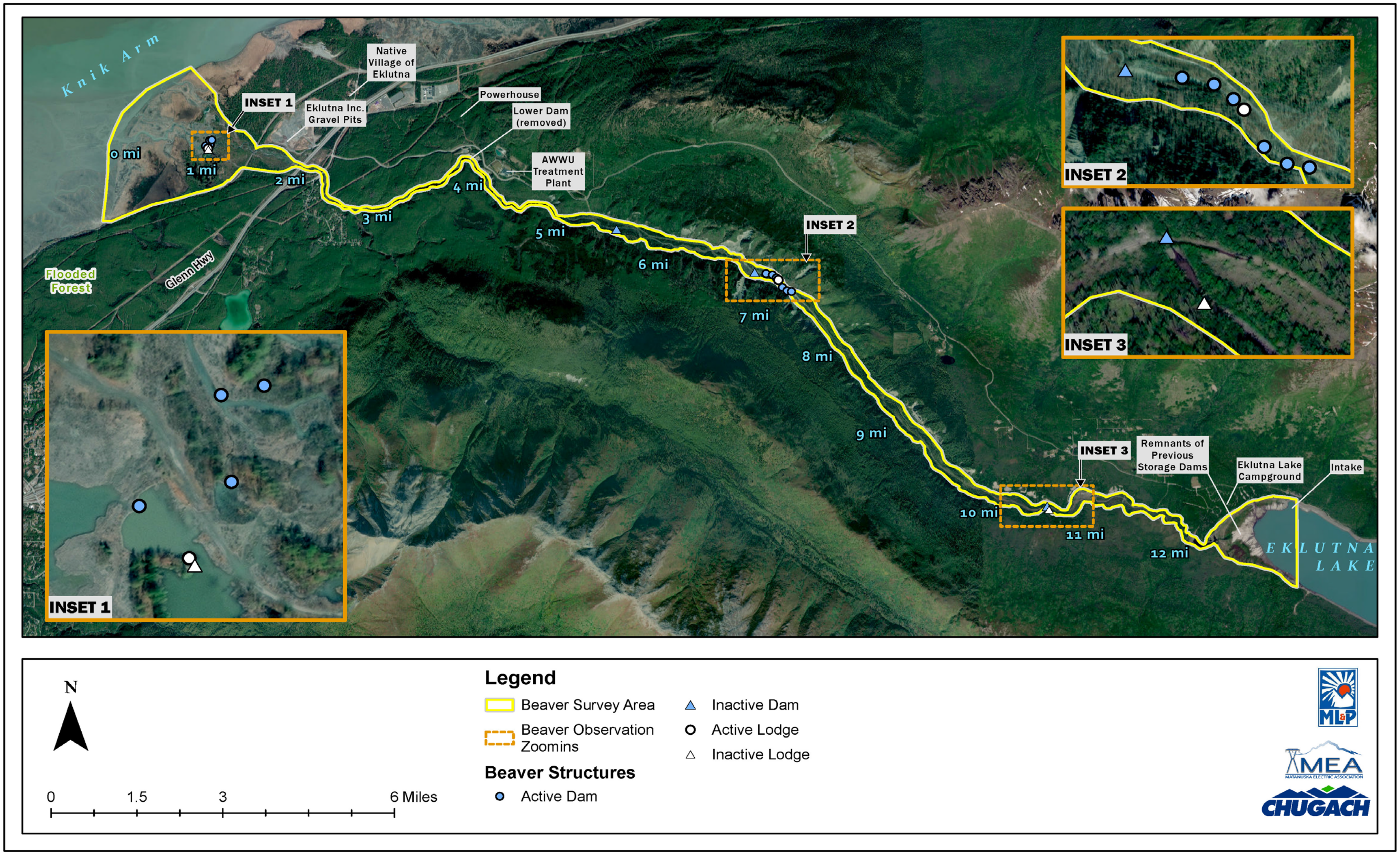

Figure 4.3-1. Study area and beaver colony aerial survey results, Eklutna Hydroelectric Project, 2022.

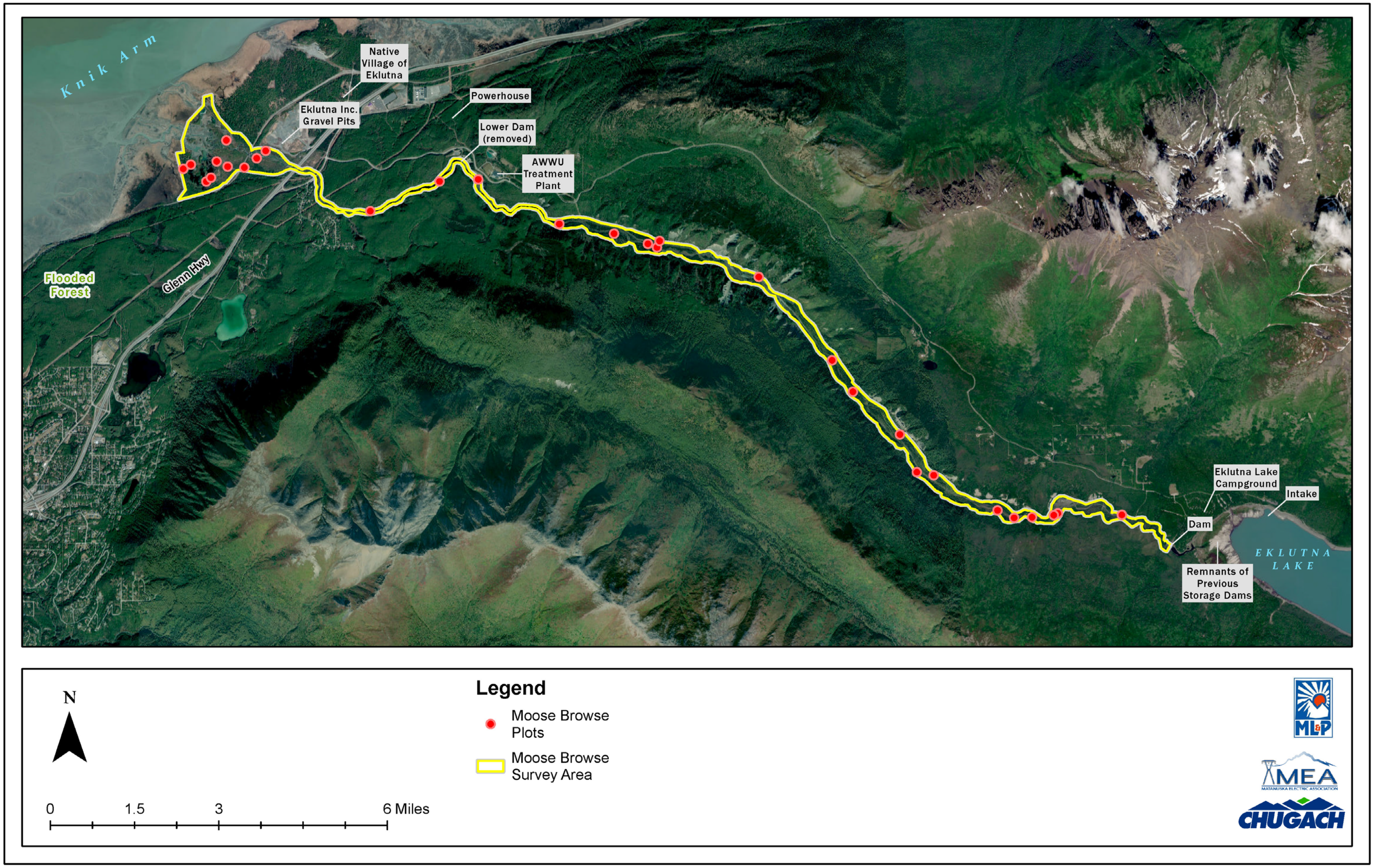

Figure 4.4-1. Study area and plot locations for the moose browse survey, Eklutna Hydroelectric Project, 2022.

Figure 4.4-2. Measuring the diameter at the point of browsing using a dial-caliper.

ADFG manages an online tool specifically designed for managing and analyzing browse survey data. The online tool provides data-entry forms and data analysis summaries and provides users with access to stem-biomass regression data from across the state necessary for calculating browse removal rates. We entered our recorded measurements and counts into the forms, incorporated available ADFG stem diameter-biomass regressions for browse species we encountered, and calculated standard summary statistics. We then bootstrapped browse removal estimates using the online tool. For the bootstrap analysis, we used 1,000 replicate runs and 30 plots per run.

4.5. Task 5: Camera Traps and Opportunistic Observations

We deployed 12 camera-traps (Reconyx Hyperfire 2; Reconyx Inc., Lacrosse, WI) set to record either time-lapse (7 cameras) or motion-sensor (5 cameras) photographs throughout the study area (Figure 4.5-1). Motion-sensing cameras were deployed at locations where animals were expected to pass close to the camera (trails, rivers, under bridges) and time-lapse cameras were generally placed at locations with views of large areas where animals may concentrate (ponds, meadows, forest edges). Logistical considerations including accessibility also affected camera placement. We placed 6 camera-traps in the upper and middle river: 2 time-lapse cameras overlooking beaver ponds, 3 motion-sensor cameras placed at intersections of the AWWU access road and the Eklutna River channel, and 1 motion-sensor camera placed along the Eklutna River channel just downstream from the Eklutna Dam spillway. We placed 6 camera-traps in the lower river: 1 motion-sensor camera in the lower Eklutna River canyon, 1 motion-sensor camera facing upstream from below the Glenn Highway bridge, 1 motion-sensor camera overlooking the Eklutna River on an existing trail between the Glenn Highway and Alaska Railroad bridges, and 3 time-lapse cameras overlooking coastal ponds or marshes. We deployed the 5

Figure 4.4-3. Example of broomed plant architecture, the result of multiple years of winter browsing.

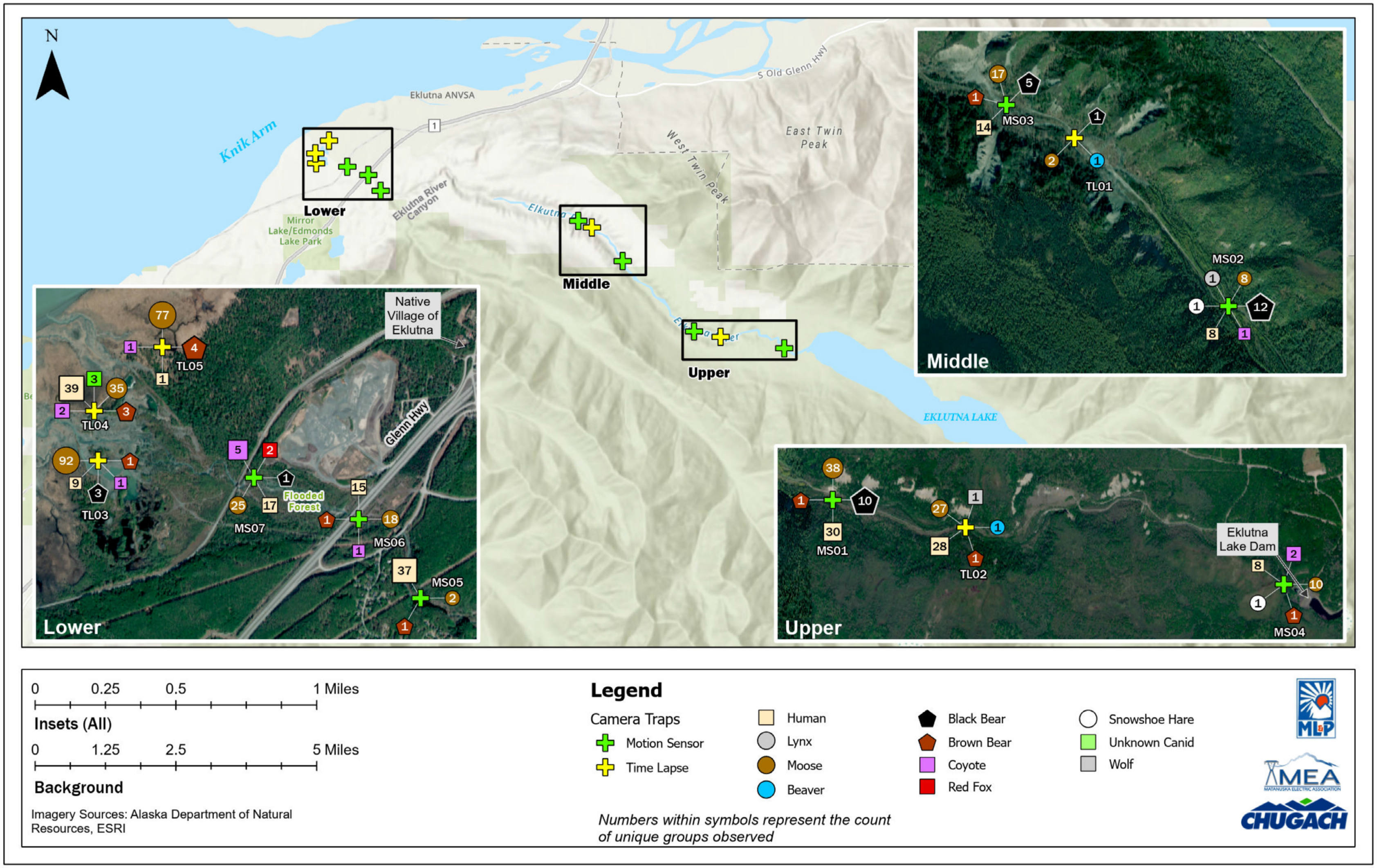

Figure 4.5-1. Locations of and counts of unique species groups photographed at camera-traps for the Eklutna Hydroelectric Project, April–November 2022.

camera-traps along the AWWU access road on 15 April while conducting the moose browse survey, the 3 coastal time-lapse cameras were deployed on 9 May during the aerial raptor survey, and the 3-remaining motion-sensing cameras in the lower river and the 1 motion-sensing camera below the Eklutna Dam spillway were deployed on 10 May.

Motion-sensor cameras were set to take 10 rapid-fire photographs when triggered. We checked cameras 3 times during the summer to change memory cards and service the cameras. Retrieval did not occur until mid-November in order to capture possible fall migration movements. Time-lapse cameras were set to record at 1-minute intervals during the first deployment but were subsequently switched to 5-minute intervals to preserve battery life. We reviewed the photographs after retrieval and recorded the number of adults and young per unique group observed in each photograph. We assumed all individuals observed >10 min apart were a separate unique group unless identifiable features were visible.

In addition to camera-traps, Project personnel recorded opportunistic observations and other signs of terrestrial wildlife when in the Project area. These observations included direct observations of animals or observations of tracks or scat. Because these data were recorded opportunistically, observations were likely concentrated in areas with more contractor activity and have to be interpreted with caution.

4.6. Task 6: Wildlife Habitat Evaluation

The first step in categorizing habitat values for the wildlife species assessed in this study was the development of a set of wildlife habitats specific to the study area. Wildlife habitats were defined and mapped for the study area in the Wetlands and Wildlife Habitat Study, and are described in full in that report. In short, wildlife habitats were derived by integrating information from U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) wetland types and Viereck Level IV vegetation classes (Viereck et al. 1992), incorporating additional macrotopography and disturbance attributes, as needed, and then aggregating composite map classes by key habitat characteristics known to be important to wildlife. A total of 23 wildlife habitat types were identified and mapped in the study area, which includes 7 freshwater habitats and adjacent littoral zones, 6 saline-influenced waters and wetlands, 4 palustrine wetlands, 5 well-drained uplands, and 1 human-modified type.

The wildlife habitat-use evaluations were conducted by creating matrices of wildlife species and the 23 mapped habitats, and assigning a categorical habitat-value ranking to each mapped wildlife habitat type for each bird, mammal, and amphibian species known or expected to occur regularly in the study area. To be considered as regularly occurring, a species had to be known to occur or could be expected to occur annually within the specific habitats mapped in the narrow riverine corridor of the Eklutna River. Casual, vagrant, and transient species that do not occur annually, and rare species that will not make use of habitats in the study area were not assessed for habitat values. The habitat-value classes (high, moderate, low, or negligible value; Table 4.6-1) were determined by focusing on wildlife use of habitats in the study area during important life-history stages (e.g., breeding, foraging, denning, migration, shelter, overwintering), and the

Table 4.6-1. Habitat-value classes used in the wildlife habitat evaluations.

Wildlife Group	Ranking Score	Value Class	Description
Birds	3	High	Known to be frequently used for nesting and/or foraging/hunting during the breeding season, these habitats also are often used during migration and in winter for resident species
	2	Moderate	Moderate-value habitats may be regularly used during the breeding, migration, or wintering seasons for foraging/hunting, but less so than high-value habitats
	1	Low	Low-value habitats would see little use by the species under consideration and in very low numbers
	0	Negligible	The species is not expected to occur, or will occur very rarely, in negligible-value habitats
Mammals	3	High	Known to be frequently used for breeding, shelter, denning, overwintering, and/or foraging/hunting during some portion of the year
	2	Moderate	Moderate-value habitats may be regularly used for foraging/hunting and as travel corridors, but less so than high-value habitats
	1	Low	Low-value habitats would see little use by the species under consideration and in very low numbers
	0	Negligible	The species is not expected to occur, or will occur very rarely, in negligible-value habitats
Frogs	3	High	Aquatic habitats and adjacent habitat types known to be frequently used for breeding and foraging during spring and summer
	2	Moderate	Moderate-value habitats may be regularly used for foraging, but less so than high-value habitats
	1	Low	Low-value habitats would see little use by frogs and in very low numbers
	0	Negligible	Frogs are not expected to occur, or will occur very rarely, in negligible-value habitats

rankings were made regardless of species abundance. This was done because some species (many raptors, owls, and some shorebirds) occur annually as breeders in suitable habitats but they have large territories and are naturally found in low densities.

Habitat-value rankings were derived in different ways for different species, depending on the level of Project-specific observational data available to assess habitat use in each mapped habitat type. Actual observations of habitat use were employed whenever possible but were limited by the lack of field data for many species, especially birds. For species with few or no observations, Project-specific data were augmented with other data sources including habitat-use information from studies conducted for the Chuitna Coal and Susitna-Watana Hydroelectric projects in southcentral Alaska (ABR 2008a,b,c; ABR 2017), the scientific literature assessing habitat use in Alaska and throughout the species range, and/or professional judgment based on extensive field observations in southcentral Alaska of the bird and mammal species in question. To compare wildlife habitats from the literature with those identified in the study area, the study team cross-walked habitat classifications in the literature to the wildlife habitat types mapped in the Eklutna Hydroelectric Project study area. Results from Project aerial and ground-based surveys were consulted to cross-check the literature-based rankings. In some cases, rankings were increased slightly based on the aerial survey results when habitats received more use than might be expected from published accounts, and decreased for species that occurred uncommonly in the study area for which literature-based rankings of 2 or 3 (moderate or high value) were inappropriate.

5 RESULTS

Across all field surveys conducted for the terrestrial wildlife studies in 2022, including those species detected in camera traps and those observed incidentally during field work for other Project studies, a total of 145 bird, mammal, and amphibian species were documented as occurring or are expected to occur regularly in the Project area (Table 5-1).

5.1. Task 1: Raptor Nesting Survey

We observed a total of 6 raptor nests in the survey area (Figure 3.1-1, Table 5.1-2, Appendix 1). We identified 4 bald eagle nests, all located in poplar trees along the coast. All 4 nests were in good or fair condition, one nest was occupied, and one nest showed inconclusive signs of occupancy. Nest EH001BAEA did not have any obvious fresh signs of occupancy but was in good condition. NVE staff informed us that a pair of adult bald eagles appeared to be repairing this nest in spring 2022 after a previously occupied nest located ~0.15 mi north of EH001BAEA collapsed when the nest tree fell (Carrie Brophil, NVE, pers. comm.) An adult bald eagle came off a perch near nest EH002BAEA but did not show any conclusive territorial behavior. This nest was also in very good condition. Nest EH002BAEA was located ~0.36 mi from EH001BAEA, and given this proximity, is likely part of the same breeding territory. An adult bald eagle was observed perching in nest EH003BAEA by the pilot a week prior to the raptor survey. No eagle was present in this nest during the raptor survey, however we observed an eggshell in the nest, likely from the previous year. The nest was in good condition, therefore we recorded it as an occupied nest. Nests EH002BAEA and EH003BAEA were ~1.06 mi apart. This distance is far enough apart to indicate separate territories (Shook et al. 2013, ABR 2014a, ABR 2015). Nest EH004BAEA was in fair condition and was located ~140 m from EH003BAEA and therefore was considered part of the same territory. Based on these observations, we conclude there were 2 bald eagle breeding territories in the area, one with a currently occupied nest and one likely also occupied but with inconclusive evidence of that. Staff at the NVE corroborate these observations and indicate the latter territory is likely still occupied (Carrie Brophil, NVE, pers. comm.).

We observed a common raven or northern goshawk nest farther upstream in a poplar tree growing adjacent to a steep slumping bluff along the valley wall. This nest was in good condition but did not show any signs of occupancy. Farther upstream, we located an active common raven nest built on a gravel-covered cliff-ledge. This nest was also in good condition and 2 raven hatchlings were present in the nest.

Table 5-1. Common and scientific names of all wildlife species recorded during Project field surveys in 2022 or expected to occur in the terrestrial wildlife study area based on the habitats available (as mapped in the Wetlands and Wildlife Habitat Study). Species are listed in phylogenetic order within each species group.

Species Group	Common Name	Scientific Name
Amphibian	Wood frog	*Lythobates sylvaticus*
Waterbird	Snow goose	*Chen caerulescens*
Waterbird	Greater white-fronted goose	*Anser albifrons*
Waterbird	Cackling goose	*Branta hutchinsii*
Waterbird	Canada goose	*Branta canadensis*
Waterbird	Trumpter swan	*Cygnus buccinator*
Waterbird	Tundra swan	*Cygnus columbianus*
Waterbird	Northern shoveler	*Anas clypeata*
Waterbird	Gadwall	*Mareca strepera*
Waterbird	American wigeon	*Anas americana*
Waterbird	Barrow's goldeneye	*Bucephala islandica*
Waterbird	Mallard	*Anas platyrhynchos*
Waterbird	Northern pintail	*Anas acuta*
Waterbird	Green-winged teal	*Anas crecca*
Waterbird	Ring-necked duck	*Aythya collaris*
Waterbird	Greater scaup	*Aythya marila*
Waterbird	Harlequin duck	*Histrionicus histrionicus*
Waterbird	Long-tailed duck	*Clangula hyemalis*
Waterbird	Bufflehead	*Bucephala albeola*
Waterbird	Common goldeneye	*Bucephala clangula*
Waterbird	Common merganser	*Mergus merganser*
Waterbird	Red-breasted merganser	*Mergus serrator*
Waterbird	Horned grebe	*Podiceps auritus*
Waterbird	Red-necked grebe	*Podiceps grisegena*
Waterbird	Sandhill crane	*Grus canadensis*
Waterbird	Red-throated loon	*Gavia stellata*
Waterbird	Pacific loon	*Gavia pacifica*
Waterbird	Common loon	*Gavia immer*
Seabird	Bonaparte's gull	*Chroicocephalus philadelphia*
Seabird	Short-billed gull	*Larus brachyrhynchus* (previously *L. canus*)
Seabird	Herring gull	*Larus argentatus*
Seabird	Glaucous-winged gull	*Larus glaucescens*
Seabird	Arctic tern	*Sterna paradisaea*
Shorebird	Semipalmated plover	*Charadrius semipalmatus*

Table 5.1., continued.

Species Group	Common Name	Scientific Name
Shorebird	Whimbrel	*Numenius phaeopus*
Shorebird	Least sandpiper	*Calidris minutilla*
Shorebird	Semipalmated sandpiper	*Calidris semipalmatus*
Shorebird	Western sandpiper	*Calidris mauri*
Shorebird	Wilson's snipe	*Gallinago delicata*
Shorebird	Spotted sandpiper	*Actitis macularius*
Shorebird	Solitary sandpiper	*Tringa solitaria*
Shorebird	Lesser yellowlegs	*Tringa flavipes*
Shorebird	Greater yellowlegs	*Tringa melanoleuca*
Shorebird	Red-necked phalarope	*Phalaropus lobatus*
Raptor	Osprey	*Pandion haliaetus*
Raptor	Northern harrier	*Circus cyaneus*
Raptor	Sharp-shinned hawk	*Accipiter striatus*
Raptor	Northern goshawk	*Accipiter gentilis*
Raptor	Bald eagle	*Haliaeetus leucocephalus*
Raptor	Red-tailed hawk	*Buteo jamaicaensis*
Raptor	Great horned owl	*Bubo virginianus*
Raptor	Northern hawk owl	*Surnia ulula*
Raptor	Short-eared owl	*Asio flammeus*
Raptor	Boreal owl	*Aegolius funereus*
Raptor	American kestrel	*Falco sparverius*
Raptor	Merlin	*Falco columbarius*
Raptor	Peregrine falcon	*Falco peregrinus*
Landbird	Ruffed grouse	*Bonasa umbellus*
Landbird	Spruce grouse	*Canachites canadensis*
Landbird	Willow ptarmigan	*Lagopus lagopus*
Landbird	Belted kingfisher	*Megaceryle alcyon*
Landbird	American three-toed Woodpecker	*Picoides dorsalis*
Landbird	Downy woodpecker	*Dryobates pubescens*
Landbird	Hairy woodpecker	*Dryobates villosus*
Landbird	Northern flicker	*Colaptes auratus*
Landbird	Olive-sided flycatcer	*Contopus cooperi*
Landbird	Western wood-pewee	*Contopus sordidulus*
Landbird	Alder flycatcher	*Empidonax alnorum*
Landbird	Northern shrike	*Lanius borealis*
Landbird	Canada jay	*Perisoreus canadensis*
Landbird	Stellar's jay	*Cyanocitta stelleri*
Landbird	Black-billed magpie	*Pica hudsonia*

Table 5.1., continued.

Species Group	Common Name	Scientific Name
Landbird	Common raven	*Corvus corax*
Landbird	Black-capped chickadee	*Poecile atricapillus*
Landbird	Boreal chickadee	*Poecile hudsonicus*
Landbird	Bank swallow	*Riparia riparia*
Landbird	Tree swallow	*Tachycineta bicolor*
Landbird	Violet-green swallow	*Tachycineta thalassina*
Landbird	Cliff swallow	*Petrochelidon pyrrhonota*
Landbird	Ruby-crowned kinglet	*Regulus calendula*
Landbird	Golden-crowned kinglet	*Regulus satrapa*
Landbird	Bohemian waxwing	*Bombycilla garrulus*
Landbird	Red-breasted nuthatch	*Sitta canadensis*
Landbird	Brown creeper	*Certhia americana*
Landbird	American dipper	*Cinclus mexicanus*
Landbird	Townsend's solitaire	*Myadestes townsendi*
Landbird	Gray-cheeked thrush	*Catharus minimus*
Landbird	Swainson's thrush	*Catharus ustulatus*
Landbird	Hermit thrush	*Catharus guttatus*
Landbird	American robin	*Turdus migratorius*
Landbird	Varied thrush	*Ixoreus naevius*
Landbird	American pipit	*Anthus rubescens*
Landbird	Pine grosbeak	*Pinicola enucleator*
Landbird	Common redpoll	*Acanthis flammea*
Landbird	White-winged crossbill	*Loxia leucoptera*
Landbird	Pine siskin	*Spinus pinus*
Landbird	Lapland longspur	*Calcarius lapponicus*
Landbird	Snow bunting	*Plectrophenax nivalis*
Landbird	Fox sparrow	*Passerella iliaca*
Landbird	Dark-eyed junco	*Junco hyemalis*
Landbird	White-crowned sparrow	*Zonotrichia leucophrys*
Landbird	Golden-crowned sparrow	*Zonotrichia atricapilla*
Landbird	Savannah sparrow	*Passerculus sandwichensis*
Landbird	Lincoln's sparrow	*Melospiza lincolnii*
Landbird	Rusty blackbird	*Euphagus carolinus*
Landbird	Northern waterthrush	*Parkesia noveboracensis*
Landbird	Orange-crowned warbler	*Leiothlypis celata*
Landbird	Yellow warbler	*Setophaga petechia*
Landbird	Blackpoll warbler	*Setophaga striata*
Landbird	Yellow-rumped warbler	*Setophaga coronata*
Landbird	Townsend's warbler	*Setophaga townsendi*

Table 5.1., continued.

Species Group	Common Name	Scientific Name
Landbird	Wilson's warbler	*Cardellina pusilla*
Small Mammal	American red squirrel	*Tamiasciurus hudsonicus*
Small Mammal	Northern flying squirrel	*Glaucomys sabrinus yukonensis*
Small Mammal	Meadow jumping mouse	*Zapus hudsonius*
Small Mammal	Singing vole	*Microtus miurus*
Small Mammal	Tundra vole	*Microtus oeconomus*
Small Mammal	Meadow vole	*Microtus pennsylvanicus*
Small Mammal	Northern red-backed vole	*Myodes rutilus*
Small Mammal	Northern bog lemming	*Synaptomys borealis*
Small Mammal	Porcupine	*Erethizon dorsatum*
Small Mammal	Snowshoe hare	*Lepus americanus*
Small Mammal	Cinereus shrew	*Sorex cinereus*
Small Mammal	American pygmy shrew	*Sorex hoyi*
Small Mammal	Dusky shrew	*Sorex monticolus*
Small Mammal	Western water shrew	*Sorex palustris*
Small Mammal	Tundra shrew	*Sorex tundrensis*
Small Mammal	Holarctic least shrew	*Sorex minutissimus*
Small Mammal	Little brown bat	*Myotis lucifugus*
Furbearer	Beaver	*Castor canadensis*
Furbearer	Muskrat	*Ondatra zibethicus*
Furbearer	Lynx	*Lynx canadensis*
Furbearer	Coyote	*Canis latrans*
Furbearer	Red Fox	*Vulpes vulpes*
Furbearer	River otter	*Lontra canadensis*
Furbearer	American marten	*Martes americana*
Furbearer	Short-tailed weasel	*Mustela erminea*
Furbearer	Least weasel	*Mustela nivalis*
Furbearer	Mink	*Neovison vison*
Large Carnivore	Wolf	*Canis lupus*
Large Carnivore	Black bear	*Ursus americanus*
Large Carnivore	Brown bear	*Ursus arctos*
Large Carnivore	Wolverine	*Gula gulo*
Large mammal	Moose	*Alces alces*
Marine mammal	Beluga	*Delphinapterus leucas*

Table 5.1-2. Condition and status of raptor nests located during aerial surveys for the Eklutna Hydroelectric Project, 9 May 2022.

Nest ID	Species	General Location	Nest Condition	Nest Status
EH001BAEA	Bald Eagle	Coastal Poplars	Good	Unoccupied
EH002BAEA	Bald Eagle	Coastal Poplars	Good	Unknown Occupancy
EH003BAEA	Bald Eagle	Coastal Poplars	Good	Occupied
EH004BAEA	Bald Eagle	Coastal Poplars	Fair	Unoccupied
EH001XRAP	Common Raven or Northern Goshawk	Middle River	Good	Unoccupied
EH001CORA	Common Raven	Upper River	Good	Successful: ≥2 Hatchlings

5.2. Task 2: Migratory Waterfowl and Shorebird Surveys

Overall, waterfowl and shorebird numbers were moderate to low, respectively, in the study area during the field surveys, with waterfowl (ducks, geese, and swans) often accounting for over half the total number of birds present (Table 5.2-1). Shorebirds were absent on 3 of the 4 surveys, and only a small number were detected on the remaining survey. Gulls and terns were observed in moderate numbers, with small numbers of raptors, cranes, songbirds, and grebes accounting for most of the remaining sightings. Mammal numbers on the surveys were low and they were only detected on 3 surveys. Across all surveys, the vast majority (97%) of wildlife observations of all species were made in the lower river area (Table 5.2-1; Figures 5.2-1, 5.2-2, and 5.2-3), which in this study includes the beaver pond complex, the saltmarsh, and the intertidal mudflats. Note that during the surveys, we regularly observed waterfowl moving back and forth between the beaver pond complex and the mudflats.

We detected 11 species of waterfowl throughout the study period, with counts ranging from 37–143 individuals per survey (Table 5.2-1). The peak counts were recorded in early fall (143 individuals) and late spring (142 individuals), and the peaks for species richness were in late spring (9 species) and late fall (8 species). A pair of trumpeter swans was detected on each of the 4 surveys, typically in the large pond with emergent vegetation south of the Eklutna River mouth (Figures 5.2-1 and 5.2-2). Geese were only detected on the spring surveys, with 11 Canada geese and a single greater white-fronted goose observed on the early spring survey, and 4 Canada geese observed on the late spring survey. Canada geese were the most numerous waterfowl species on the early spring survey and northern pintail were most numerous in late spring. American wigeon were the most numerous species by far (133 individuals) on the early fall survey and mallards were most numerous in late fall. Combined, dabbling ducks of 4 species (American wigeon, mallard, northern pintail, and green-winged teal) were the most numerous waterfowl species across all surveys. Barrow’s goldeneye were only seen on Eklutna Lake during the late spring survey (Table 5.2-1; Figure 5-2-1).

Table 5.2-1. Bird and mammal species and numbers recorded during the waterfowl and shorebird surveys, Eklutna Hydroelectric Project, 2022. All surveys in the lower river area included both a ground and aerial survey component. Aerial surveys only were conducted for the Eklutna Lake outlet and the Eklutna River drainage.

		Spring					Fall					
		2 May		13 May			27 August			17–18 Sept		
		Lower River		Lower River		Eklutna Lake [a]	Lower River		River Drainage [a]	Lower River		Eklutna Lake [a]
Common Name	**Scientific Name**	**Ground**	**Aerial**	**Ground**	**Aerial**	**Aerial**	**Ground**	**Aerial**	**Aerial**	**Ground**	**Aerial**	**Aerial**
Birds												
Greater White-fronted Goose	*Anser albifrons*		1									
Canada Goose	*Branta canadensis*	3	11	2	4							
Trumpeter Swan	*Cygnus buccinator*		2	2	2			2			2	
Northern Shoveler	*Spatula clypeata*				4	1					2	
Gadwall	*Mareca strepera*			2	12						13	
American Wigeon	*Mareca americana*				5	8	133	80			2	
Mallard	*Anas platyrhynchos*	2	10		29	1	3	36		1	26	
Northern Pintail	*Anas acuta*		9		38		7				2	
Green-winged Teal	*Anas crecca*		2		34	2					14	
Unidentified Dabbling Duck	*Anas* sp.	3	2					20				
Ring-necked Duck	*Aythya collaris*										1	
Barrow's Goldeneye	*Bucephala islandica*					2						
Horned Grebe	*Podiceps auritus*				2							
Red-necked Grebe	*Podiceps grisegena*											4
Sandhill Crane	*Antigone canadensis*	1		2	3		5	5				
Semipalmated Plover	*Charadrius semipalmatus*						9					
Least Sandpiper	*Calidris minutilla*						1					
Spotted Sandpiper	*Actitis macularius*						3					
Short-billed Gull	*Larus brachyrhynchus*		68		38	1	2					
Cook Inlet Gull	*Larus argentatus x glaucescens*				5		7					
Unidentified Gull	*Larus* sp.							1				
Arctic Tern	*Sterna paradisaea*			4	8							
Unidentified Loon	*Gavia* sp.			1				1				
Northern Harrier	*Circus hudsonius*				2		1			1	1	
Bald Eagle	*Haliaeetus leucocephalus*		2		1		2	8		1		
Red-tailed Hawk	*Buteo jamaicensis*					1						
Merlin	*Falco columbarius*										1	
Black-billed Magpie	*Pica hudsonia*				1							
Common Raven	*Corvus corax*								2			
Tree Swallow	*Tachycineta bicolor*				5							

Table 5.2-1, continued.

		Spring					Fall					
		2 May		13 May			27 August			17–18 Sept		
		Lower River		Lower River		Eklutna Lake [a]	Lower River		River Drainage [a]	Lower River		Eklutna Lake [a]
Common Name	**Scientific Name**	**Ground**	**Aerial**	**Ground**	**Aerial**	**Aerial**	**Ground**	**Aerial**	**Aerial**	**Ground**	**Aerial**	**Aerial**
Mammals												
American Beaver	*Castor canadensis*		1									
Coyote	*Canis latrans*				1							
Moose	*Alces americanus*		2					1				
Beluga	*Delphinapterus leucas*						4	2				
	Totals [b]		119		207	15		333	2		67	4

[a] Birds were seen at the mouth of Eklutna Lake only on 13 May and 17–18 September, and in the Eklutna River drainage (above the lower river) only on 27 August.
[b] Totals for the Lower River include observations for both the ground and aerial surveys.

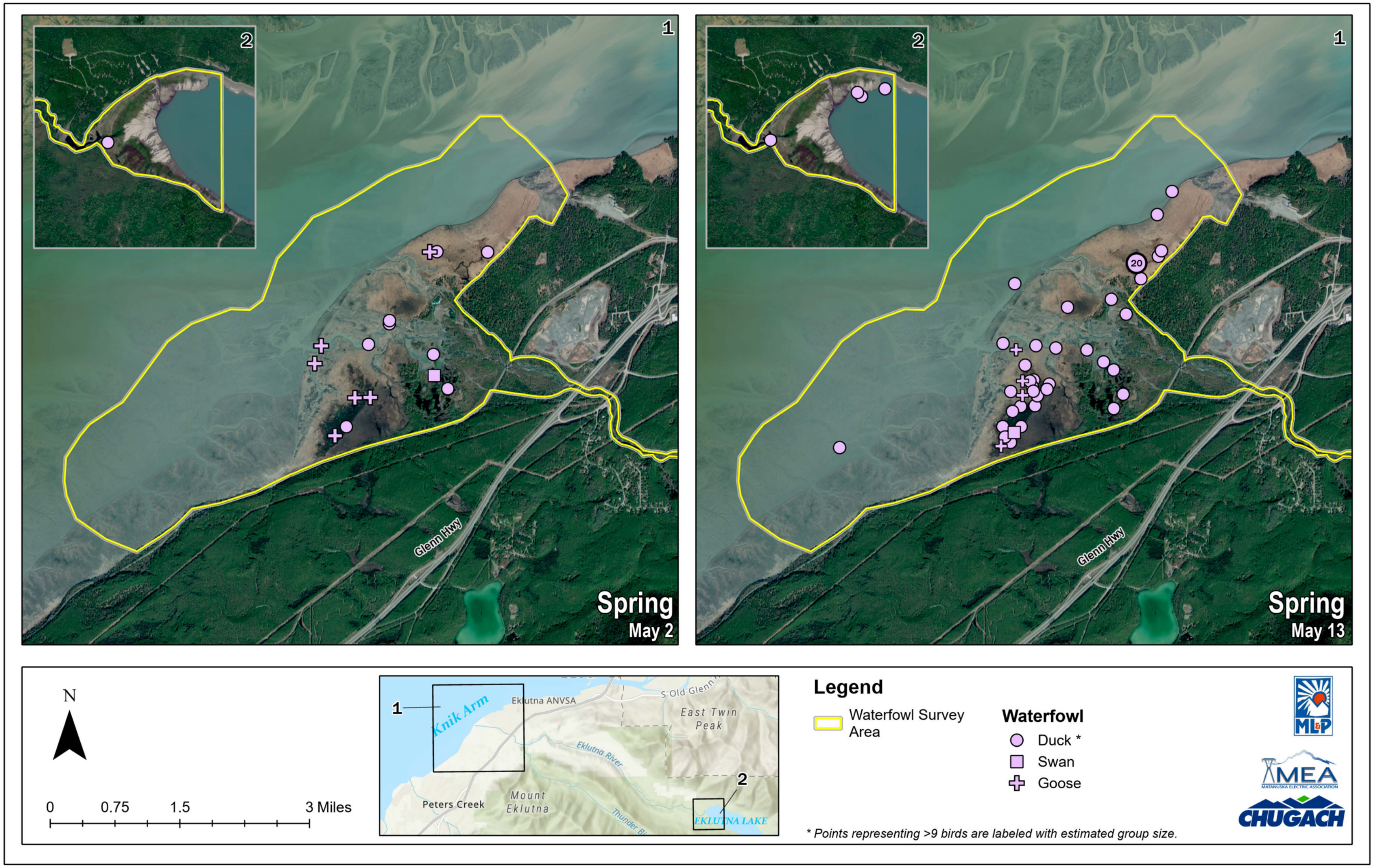

Figure 5.2-1. Location of waterfowl groups observed during the spring waterfowl and shorebird surveys, Eklutna Hydroelectric Project, 2022. No shorebirds were observed during the spring surveys. The observations at Eklutna Lake are in the inset maps in the upper left.

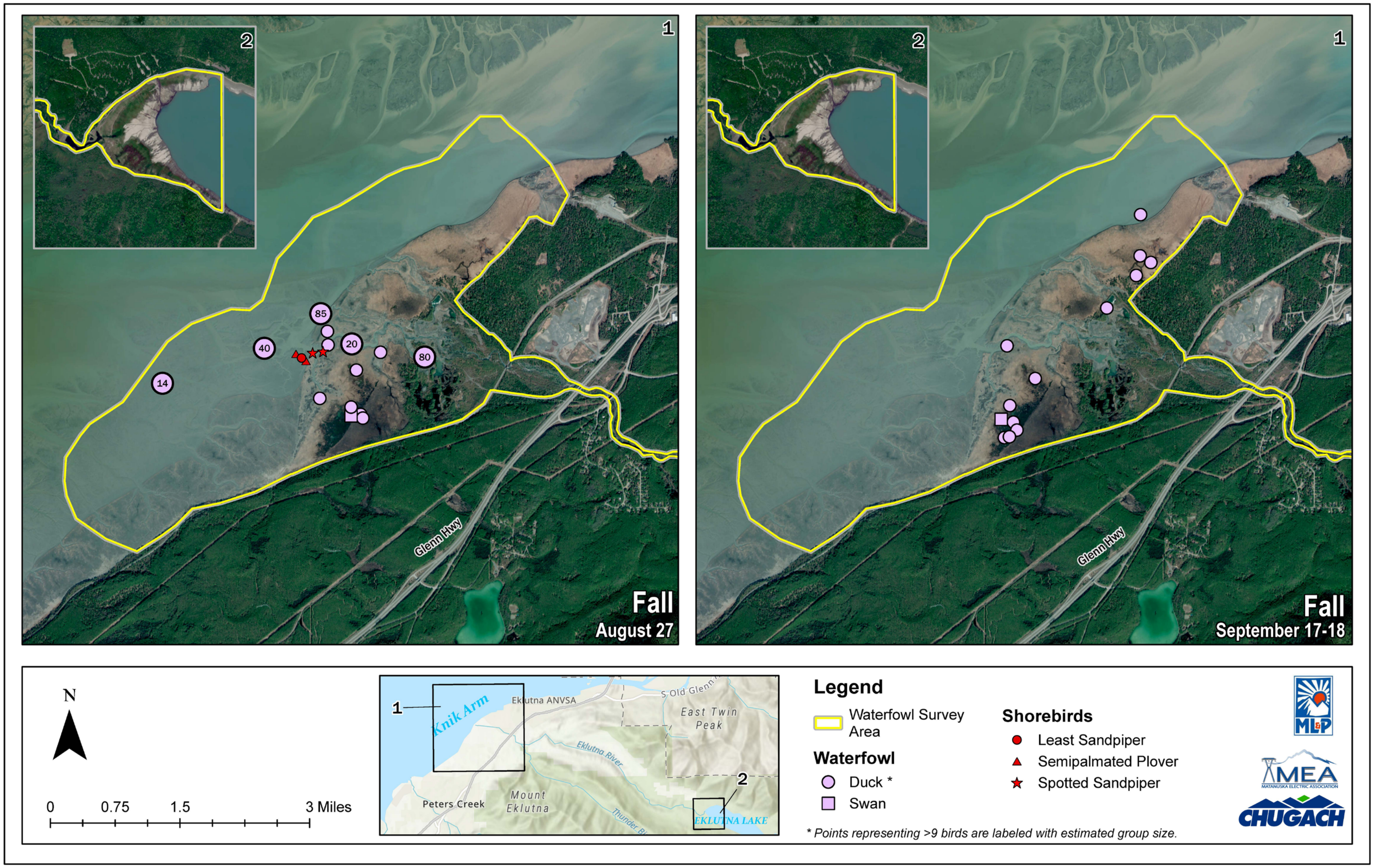

Figure 5.2-2. Location of waterfowl and shorebird groups observed during the fall waterfowl and shorebird surveys, Eklutna Hydroelectric Project, 2022. The observations at Eklutna Lake are in the inset maps in the upper left.

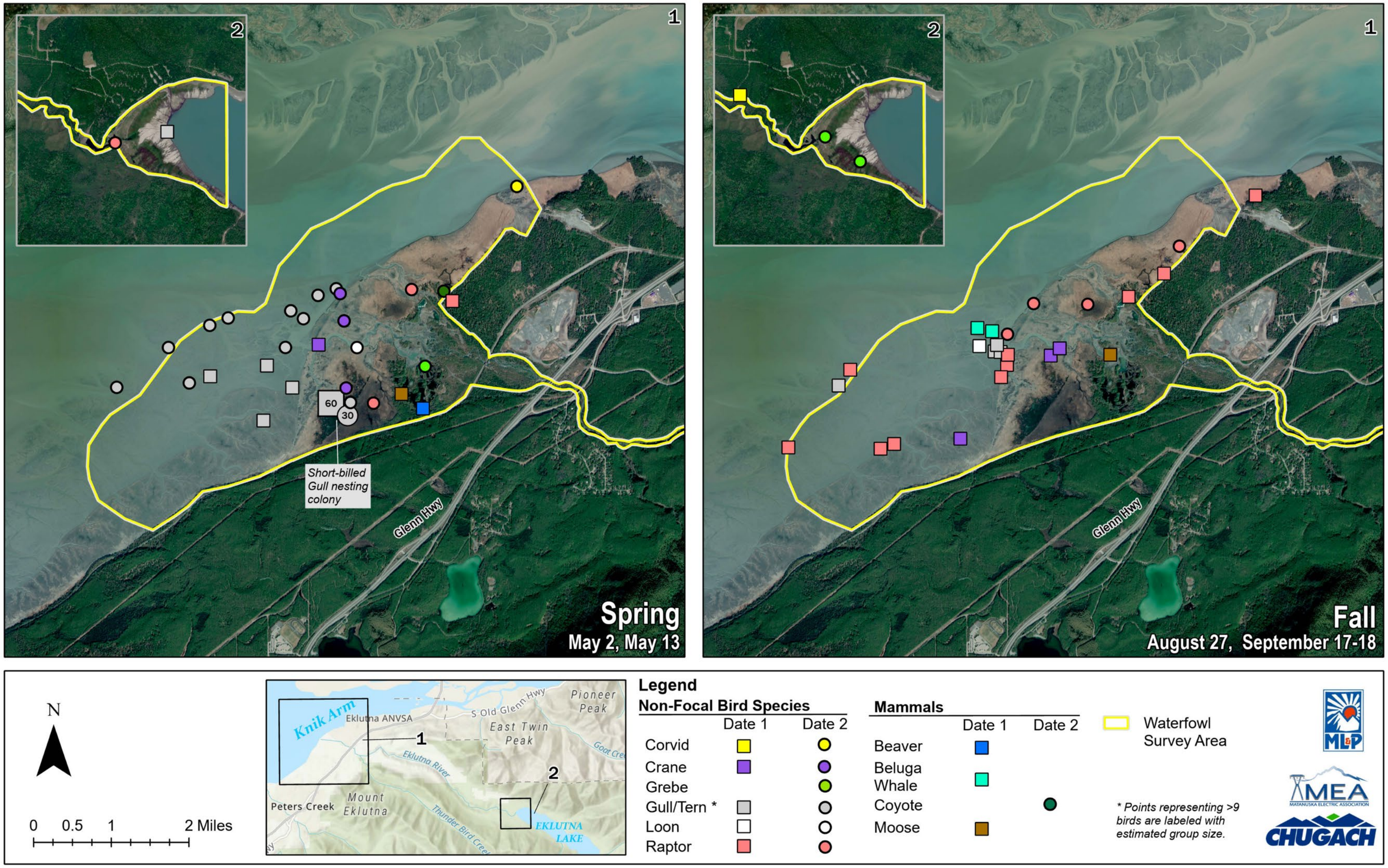

Figure 5.2-3. Location of non-focal bird and mammal species groups observed during the spring and fall waterfowl and shorebird surveys, Eklutna Hydroelectric Project, 2022. The observations at Eklutna Lake are in the inset maps in the upper left.

Shorebirds were noticeably absent during the spring surveys. We detected 13 individuals of 3 species (semipalmated plover, least sandpiper, and spotted sandpiper) only on the early fall survey, all on the mudflats at the mouth of the Eklutna River (Table 5.2-1; Figure 5.2-2). All 3 of these shorebird species nest in Upper Cook Inlet, so these individuals may have been using the area for post-breeding foraging rather than as a migration stopover site.

Although not a focus of the surveys, we identified 4 species of raptors during the surveys (Table 5.2-1; Figure 5.2-3). Bald eagles were seen on every survey with a high count of 8 on the late fall survey. At least one pair of bald eagles nested in the study area (see Section 5.1 above). Northern harriers were seen on every survey, except the early spring survey, with a high count of 2 individuals in late spring. We detected a single merlin in the coastal saltmarsh on the late fall survey and a single red-tailed hawk near Eklutna Lake in late spring.

We recorded 10 additional non-focal bird species during our surveys (Table 5.2-1; Figure 5.2-3). The most numerous of these were 68 short-billed gulls (previously mew gulls) on the early spring survey, which declined to 38 on the late spring survey and then 2 individuals in early fall. We recorded sandhill cranes on every survey except late fall and recorded a high of 5 birds in early fall. Other waterbirds detected included a pair of horned grebes in an abandoned gravel pit pond on the late spring survey, an unidentified loon over Cook Inlet in late spring, and 4 red-necked grebes on Eklutna Lake in late fall.

Mammals were generally scarce on our surveys (Table 5.2-1; Figure 5.2-3). A single American beaver and 2 moose were observed on the early spring survey. A single coyote was observed on the late spring survey, and a single moose during the early fall survey. Four belugas were observed at the Eklutna River mouth for about 45 min during the early fall survey. We assume these whales were foraging on adult silver salmon attempting to move upriver during the high tide because the survey timing (27 August) coincides with the late summer silver salmon runs in upper Cook Inlet rivers. It has also been documented that belugas will forage for salmon near river mouths in upper Cook Inlet, with the presence of the whales corresponding to the occurrence of different salmon runs from spring to fall (Castellote et al. 2020).

5.3. Task 3: Beaver Pond Mapping and Beaver Survey

Only 1 active beaver colony with a food cache was observed in the lower river area below the Alaska Railroad bridge; the active beaver lodge at this colony was located near an inactive lodge (Figure 4.3-1; Appendix 2, Figure A.2-1). The beavers in this colony were actively maintaining 4 dams (Figure 4.3-1; Appendix 2, Figures A.2-2 through A.2-5). While numerous nearby gravel-pit ponds looked suitable for beaver lodges, we did not observe any other lodges, dams, or tree cuttings indicative of a beaver colony.

Above the canyon, we located a single old, failed beaver dam near the lower AWWU access road at ~RM 5.75 (Figure 4.3-1; Appendix 2, Figure A.2-6), and an active beaver colony near RM 7.0, also in the middle river area (Figure 4.3-1; Appendix 2, Figure A.2-7). A food cache was not visible in the silty water near the active middle river colony, but we observed abundant fresh tree cuttings and fresh dam-building activity to identify the colony as active. A failed dam, 6 active dams, and a small lodge comprised the middle river colony complex (Figure 4.3-1; Appendix 2, Figures A.2-6 through A.2-13). All active dams in the middle river colony spanned most or all of the stream channel at the time of the field survey. The beaver lodge in the upper river area and a recently removed dam in the same area showed no signs of recent activity (Figure 4.3-1; Appendix 2, Figures A.2-14 and A.2-15).

During the ground-based survey, we spent 3 hours observing the middle river colony, but no beavers were observed. The 2 dams farthest downriver were estimated at ~6 ft tall and looked like potential barriers to adult fish, though juveniles may be able to pass through. We also observed the former upper river colony, but no signs of rehabilitation of the dam or lodge were evident.

5.4. Task 4: Moose Browse Survey

In general, moose browse was well distributed throughout the study area. The habitats downstream of the Alaska Railroad bridge are a mix of mid-successional shrublands and deciduous forests. The area between the Glenn Highway Bridge and Alaska Railroad bridge is also dominated primarily by shrublands and deciduous forests, but trees and shrubs were more mature, often with willows growing higher than the typical maximum moose browsing height of 9.8 ft (Figure 5.4-1). The Eklutna River canyon supported mature riparian habitat, with large alder and willow shrubs (Figure 5.4-2). Above the canyon in the middle river, willow was common along the stream banks and the AWWU road edges, but the AWWU pipeline corridor was primarily mid-successional poplar and early successional spruce (*Picea* spp.), while the remainder of the valley bottom was mature mixed forest.

During the field survey, we sampled 2,281 twigs from 241 plants within 30 plots. Feltleaf willow (*Salix alaxensis)* was the most common forage species sampled, followed by Alaska birch and poplar (Table 5.4-1). Mean proportional offtake per plant was 22% (95% CI = 17–27%). Browsing pressure was highest for feltleaf willow (40.8% removal) followed by Barclay's willow (*S. barclayi*; 30.0% removal), and diamond-leaf willow (*S. pulchra*; 25.0% removal; Table 5.4-1). Broomed architecture was observed on 35.7% of sampled plants (Table 5.4-1).

Figure 5.4-1. Mid-successional habitats common downstream of the Glenn Highway. Much of the willow and poplar current annual growth was above the maximum browsing height of moose (9.8 ft) and bark-stripping was common.

Figure 5.4-2. Eklutna River canyon habitat consists primarily of gravel bars, mature alder, willow, poplar, and birch.

Table 5.4-1. Moose browse survey results by species, Eklutna Hydroelectric Project, 2022.

Species	Number Twigs Sampled	Number Plants Sampled	Mean Biomass Removal Rate (%)	Proportion Broomed Plants
Betula neoalaskana	528	54	0.5	18.5
Cornus stolonifera	92	10	12.0	40.0
Populus balsamifera	490	54	0.2	0.6
Salix alaxensis	595	63	40.8	58.7
Salix arbusculoides	10	1	0.0	0.0
Salix barclayii	50	5	30.0	0.0
Salix bebbiana	217	22	18.0	54.5
Salix pulchra	60	6	25.0	100.0
Viburnum edule	239	26	16.3	34.6

5.5. Task 5: Camera Traps and Opportunistic Observations

5.5.1. Camera Traps

We deployed camera-traps on 16 April and 9–10 May, checked cameras on 25 May, 15–16 July and 26–27 August, and retrieved cameras on 21–22 November (Tables 5.5-1 and 5.5-2). Time-lapse cameras were placed on beaver ponds (*n* = 2) or coastal wetlands (*n* = 5), while motion-sensor cameras were placed on trails and river crossing areas that were expected channel mammal movements (Figure 5.5-1; see Appendix 3 for representative photographs). Breaks in recording occurred at cameras TL01 (17–25 May and 7 October–22 November), TL02 (17–25 May and 19 October–22 November), and MS07 (27 October–22 November) due to dead batteries. Black bears also moved 2 cameras so they were pointing towards the ground and were not recording as planned (Appendix 3: Figure A.3-3): camera MS02 from 18–25 May and MS01 from 8 September–21 November (Table 5.5-1).

After removing photographs that were not usable due to black bears knocking over the cameras, the 7 motion-sensor cameras recorded 10,263 photographs while the 5 time-lapse cameras recorded 383,363 photographs (Tables 4.5-1 and 5.5-2). Moose were the most frequently photographed terrestrial mammal species (352 groups), followed by black bears (32 groups), brown bears (14 groups), coyotes (13 groups), unknown canid (3 groups), red fox and snowshoe hare (2 groups each), and wolf and lynx (1 group each) (Figure 4.5-1; Tables 5.5-1 and 5.5-2; Appendix 3: Figures A.3-1 through A.3-15). Black bears and coyotes were more commonly photographed on motion-sensor cameras located along the river corridor, while brown bears and moose were more commonly photographed on time-lapse cameras, particularly those near the coastal flats (Tables 5.5-1 and 5.5-3). The only wolf photographed was at the upper beaver colony and the only lynx photographed was in the middle river (Table 5.5-1). Red foxes were only photographed by 1 camera in the flooded forest (Table 5.5-1). Other terrestrial or freshwater-aquatic mammals inhabiting southcentral Alaska but not photographed during this study include Dall's sheep, mountain goat, wolverine, river otter, mink, marten, least weasel, ermine, porcupine, marmot, pika, muskrat, and other small mammals (see Task 6). Photographs of humans were more common than photographs of wildlife at some cameras during certain time periods (Tables 5.5-1, 5.5-2).

Beavers were photographed numerous times at each beaver pond (Table 5.5-2). Cameras TL01 (middle colony; Figure 4.5-1) and TL02 (upper colony, Figure 4.5-1) recorded 1,869 and 717 photographs of beavers, respectively. A maximum of 3 beavers were photographed at the middle colony, while only 2 beavers were photographed at the upper colony. Beavers were photographed on most days at the upper colony until the beaver colony was removed by ADFG, at the request of AWWU, in early July. Beaver-traps were observed being installed on 1 and 3 July, and checked/removed on 4 and 6 July. The last observation of a beaver was a juvenile on 7 July, so the assumed colony size was ≥3. At the middle colony, beavers were most often photographed during the first photo period (16 April–18 May, 1,686 photographs), with few photographed from 25 May–26 August (149 photos) and from 26 August–7 October (34 photographs).

Table 5.5-1. Motion-sensor camera-trap results (count of unique groups photographed) for the Eklutna Hydroelectric Project, 2022. Cameras were set to take 10 rapid-fire photos whenever motion was detected.

Camera ID	Area	Camera Period	Photos	Species											
				Beaver	Black Bear	Brown Bear	Coyote	Human	Lynx	Moose	Red Fox	Snow-shoe Hare	Unknown Canid	Unknown Mammal	Wolf
MS04	Upper River: Below Existing Dam	10 May–25 May	70			1	2			1		1			
		25 May–15 Jul	860					2		3					
		15 Jul–26 Aug	350					1		3					
		26 Aug–21 Nov	260					5		3					
MS01	Upper River: AWWU Road and River Crossing	16 Apr–25 May	471		1			8		7					
		25 May–16 Jul	1,480		7	1		13		27					
		16 Jul–26 Aug	290		1			6		4					
		26 Aug–7 Sep [a]	90		1			3							
MS02	Middle River: AWWU Road and River Crossing	16 Apr–17 May [a]	214		1					3					
		25 May–26 Aug	210		6		1	1				1			
		26 Aug–21 Nov	410		5			7	1	5					
MS03	Middle River: AWWU Road and River Crossing	16 Apr–25 May	60							4					
		25 May–26 Aug	420		5	1		10		14					
		26 Aug–21 Nov	50					4							
MS05	Lower River: Eklutna River Canyon	10 May–25 May	300					7							
		25 May–15 Jul	2,030					8		2					
		15 Jul–26 Aug	100					5							
		26 Aug–21 Nov	480			1		17							
MS06	Lower River: Glenn Highway Bridge	10 May–25 May	150				1			6					
		25 May–15 Jul	480					7		6					
		15 Jul–24 Aug	250			1		6		4					
		26 Aug–22 Nov	220					2		3					
MS07	Lower River:	10 May–25 May	210				2	1		7	2				
	Flooded Forest ATV Trail and River Crossing	25 May–15 Jul	450		1		3	6		13					
		15 Jul–27 Aug	150					6		3					
		27 Aug–27 Oct [b]	210					4		2					

[a] A bear tilted the camera to the ground.
[b] Batteries died early.

Table 5.5-2. Time-lapse camera-trap results (count of unique groups photographed) for the Eklutna Hydroelectric Project, 2022. Cameras were set to take 10 rapid-fire photos whenever motion was detected. Numbers in parentheses denote total photos captured with beavers visible.

Camera ID	Area	Camera Check	Photos	Species Group											
				Beaver	Black Bear	Brown Bear	Coyote	Human	Lynx	Moose	Red Fox	Snow-shoe Hare	Unknown Canid	Unknown Mammal	Wolf
TL01	Middle River Beaver Pond	16 Apr–18 May [a]	45,658	(1,686)	1					1				2	
		25 May–26 Aug	26,739	(149)						1					
		26 Aug–7 Oct [b]	12,057	(34)											
TL02	Upper River Beaver Pond	16 Apr–17 May	44,020	(361)				2		2					1
		25 May–16 Jul	14,919	(356)		1		7		20					
		16 Jul–26 Aug	11,820					6		5					
		26 Aug–19 Oct [b]	15,526					13							
TL03	Lower River: Tidally Influenced Pond	9 May–25 May	22,892				1	1		6			3		
		25 May–15 Jul	14,683			3		8		11			2		
		15 Jul–27 Aug	12,363					12		3			1		
		27 Aug–22 Nov	25,048				1	16		15					
TL04	Lower River:Brackish Sedge Meadow	9 May–25 May	22,949				1	3		6			3		
		25 May–15 Jul	14,679			3		8		11			2		
		15 Jul–27 Aug	12,387					12		3			1		
		27 Aug–22 Nov	25,038				1	16		15					
TL05	Lower River: Brackish Sedge Meadow	9 May–25 May	22,885				1			7					
		25 May–15 Jul	14,670			4				48					
		27 Aug–22 Nov [c]	25,034					1		22					

[a] A bear tilted the camera to the ground.
[b] Batteries died early.
[c] The camera was inadequately repositioned, and no animals were recorded from 15 July–27 Aug.

Table 5.5-3. Number of groups observed with 0, 1, 2, or 3 young by species during the camera-trap study for the Eklutna Hydroelectric Project, 2022.

Species	Number of Young			
	0	1	2	3
Beaver	2	2	0	0
Black Bear	21	4	4	3
Brown Bear	7	5	2	1*
Coyote	13	0	0	0
Lynx	1	0	0	0
Moose	323	27	1	0
Red Fox	2	0	0	0
Wolf	1	0	0	0

* A brown bear with 3 cubs was observed during the aerial raptor survey.

We photographed 323 groups of moose without calves (cows, bulls, or mixed groups), 27 groups with a single calf, and 1 group with twins (Table 5.5-3, Appendix 3: Figure A.3-13). We photographed 21 groups of black bears without cubs, 4 with a single cub, 4 with two cubs, and 3 with 3 cubs (Appendix 3: Figure A.3-1). We photographed 7 groups of brown bears without cubs, 5 with a single cub, and 2 with two cubs (Appendix 3: Figure A.3-2). Many of these observations were likely repeated observations of the same individuals and family groups and some calves or cubs could have been missed if they remained off-camera or behind dense vegetation.

Due to programming errors, some of our motion-sensor cameras also recorded time-lapse photographs during the first period and some time-lapse cameras also recorded motion-sensor photographs. These additional photographs captured 19 moose, 2 black bears, 1 brown bear, 2 coyotes, and 1 red squirrel. The red squirrel was the only mammal species not photographed during scheduled photographs.

In addition to mammals, we also recorded sporadic photographs of birds during the first photo period. Identifying birds to species was often difficult in photographs. Results are summarized in Appendix 4.

5.5.2. Opportunistic Observations

There were a limited number of opportunistic observations of mammals recorded by researchers conducting other studies in 2022. During the aerial raptor survey on 9 May, we observed a sow brown bear with 3 cubs-of-the-year near the group campground and the AWWU portal, and some small-to-medium sized canid tracks were observed in the lower river near the coast. A single dead black bear was observed on the south shore of Eklutna Lake on 21 June. During the spring waterfowl and shorebird surveys, 1 beaver, 1 coyote, and 2 moose were observed near the coast, and during the fall waterfowl and shorebird surveys, 4 beluga whales were observed at the Eklutna River mouth (presumably foraging on silver salmon), and 1 moose was observed near the coast. Belugas are well known to forage on salmon at river mouths in upper Cook Inlet, with the whales presence corresponding to the various salmon runs occurring from spring through fall (Castellote et al. 2020).

For birds, one ruffed grouse was observed on the north edge of the flooded forest while deploying camera-traps in the spring, and a number of additional bird observations in the Eklutna River drainage were made during salmon spawning surveys in August. Those additional observations were of bird species expected to occur in the study area and are addressed in the Wildlife Habitat Evaluation (see Section 5.6).

5.6. Task 6: Wildlife Habitat Evaluation

5.6.1. Bird Habitat Values

The habitat-value matrix for birds includes species that were recorded in the study area during Project field surveys for the Raptor Nesting Survey, the Migratory Waterfowl and Shorebird Surveys, and the Camera Traps and Opportunistic Observations study, plus species that are likely to occur in the habitats available in the study area based on eBird observation data and records of species occurrence and habitat use from field studies conducted in similar riverine habitats in upper Cook Inlet (ABR 2008a,b,c) and southcentral Alaska (ABR 2017). Habitat values for these bird species were assessed for both the breeding and migration seasons, and for resident species, the overwintering period as well. In the text that follows for birds, the individual accounts for the species or group of species in question from the Birds of the World online database are being referenced when citing Billerman et al. (2022).

5.6.1.1. Waterbirds

A total of 32 waterbird and seabird species (collectively referred to as waterbirds in this study and including waterfowl, loons, grebes, gulls, terns, and cranes) were assessed for habitat values for each of the 23 wildlife habitat types mapped in the study area. Most waterbirds frequent rivers, river outlets, and coastal freshwater or brackish wetlands during migration because they are rich in food and because they are the first areas to become ice-free in spring. Waterbirds breed in a variety of aquatic habitats. Some species specialize in using primarily one habitat type (e.g., common and Pacific loons prefer large lakes), while other species use many different habitat types (e.g., mallards use lakes, ponds, bogs, rivers, and palustrine wetlands). Stable water levels, irregular shorelines, emergent vegetation, organic content, and water clarity, acidity, and depth are some of the important features that determine whether a waterbody is used during the breeding season by waterfowl for foraging, nesting, and/or brood-rearing (Billerman et al. 2022). Use of meadow and forest habitats for nesting by waterbirds depends on their proximity to a waterbody that serves as foraging and/or brood-rearing habitat. Distance of a nest from water depends on each species' habitat preferences and requirements and can even vary widely within a species. Meadow and forest-edge habitats adjacent to waterbodies are most frequently used for nesting and for protective cover during brood-rearing.

We assessed 5 larid species (gulls and terns and their allies)—Bonaparte's, short-billed, herring, and glaucous-winged gull, and arctic tern—that were either recorded during migration surveys (see Section 5.2) or expected to occur regularly in the study area. Bonaparte's, short-billed, and herring gulls are found on rivers in the upper Cook Inlet area (ABR 2008a,b,c). Short-billed gulls breed in a variety of wetland habitats (tundra, marshes, ponds, lakes, rivers, streams, coastal cliffs), and can nest in trees and on the ground (Billerman et al. 2022; ABR 2008a,b,c). They have been seen in most aquatic habitats, and in high numbers in palustrine waterbodies, where nests have also been recorded (ABR 2008a,b,c). Bonaparte's gulls usually nest in coniferous trees near a wide variety of waterbody and wetland types. They prefer sparsely wooded areas and avoid dense, continuous stands of tall evergreens (Billerman et al. 2022). The species winters in large flocks in coastal areas close to human activity, but it breeds solitarily or in very loose colonies in habitats remote from human settlements, around ponds, bogs, bays, and fiords in the taiga and boreal forests of Alaska and Canada. In the upper Cook Inlet area, broods of Bonaparte's gulls were observed on palustrine and lacustrine waterbodies, and in a seasonally flooded wetland (ABR 2008a,b,c). Glaucous-winged gulls are year-round residents in southcentral Alaska and frequent coastal areas. Arctic terns have been observed in a variety of habitats in upper Cook Inlet, including rivers and streams, lacustrine and palustrine waterbodies, and broods were observed in semipermanently flooded wetlands (ABR 2008a,b,c). Arctic terns usually nest in treeless terrain or in large wetlands in forested areas (Billerman et al. 2022). Based on this habitat-use information and the observations in the study area for 3 species (Section 5.2), we considered 13 coastal, riverine, lacustrine, forest, and human-modified habitats in the study area to be of high and moderate value for this group of larid species (Table 5.6-1).

We assessed 5 loon and grebe species—red-throated, Pacific, and common loons, and horned and red-necked grebes—that were either recorded during migration surveys (see Section 5.2) or expected to occur regularly in the study area. Common and Pacific loons, and red-necked grebes have similar habitat preferences and are dependent on lakes and ponds for foraging, nesting, and brood-rearing. Loons and grebes have specialized nesting requirements and are indicator species for the health of lakes (Billerman et al. 2022). Common loons prefer large, clear lakes with fish, which is their primary food source, and feed primarily from the nest lake. Pacific loons are generalists that occupy a variety of waterbody types, ranging from lacustrine ponds to relatively large, deep lakes, and they feed on fish and aquatic invertebrates (Billerman et al. 2022). Pacific loons may forage in their nest pond, nearby lakes, rivers, and nearshore marine waters (Billerman et al. 2022). Both common and Pacific loons return to the same breeding territory each year and sometimes reuse the same nest site (Billerman et al. 2022). Red-necked grebes primarily inhabit lowlands and nest on shallow, freshwater lakes or shallow protected marsh areas, usually with some emergent vegetation (Billerman et al. 2022). In southcentral Alaska, nests of all three species were often found on emergent vegetation in the middle of a lake or along the shoreline (ABR 2017). Horned and red-necked grebes prefer river mouths and sheltered bays along the coast during migration, but occasionally rest along rivers (Billerman et al. 2022). Common and Pacific loons prefer nearshore marine waters or protected bays during migration. Grebes nest over water on platforms constructed out of emergent vegetation or built up from the pond bottom. Based on this habitat-use information, the observations in the study area for 2 species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 6 riverine and lacustrine habitats in the study area to be of high and moderate value for this group of loon and grebe species (Table 5.6-1).

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Table 5.6.1. Habitat value rankings [a] for bird species known or expected to occur regularly in the study area. Species are listed in phylogenetic order within each species group.

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Waterbird	Snow goose	1	1	1	1	2	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Greater white-fronted goose	1	1	1	1	2	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Cackling goose	1	1	1	2	2	1	1	1	2	1	1	1	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Canada goose	1	1	1	2	2	1	1	1	2	1	1	1	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Trumpter swan	1	1	1	2	2	0	2	2	2	2	1	1	0	2	0	0	0	0	0	0	0	0	0
Waterbird	Tundra swan	1	1	1	2	2	0	2	2	2	2	1	1	0	2	0	0	0	0	0	0	0	0	0
Waterbird	Northern shoveler	1	1	1	3	2	1	3	2	3	3	1	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Gadwall	1	1	1	3	2	1	2	2	3	3	1	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	American wigeon	1	1	1	3	2	1	3	2	3	3	2	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Barrow's goldeneye	0	2	1	2	0	0	3	0	3	3	2	2	0	1	0	0	2	0	2	2	2	1	0
Waterbird	Mallard	1	2	1	3	2	1	2	2	3	3	1	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Northern pintail	1	1	1	3	2	1	3	2	3	3	1	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Green-winged teal	1	1	1	3	2	1	3	2	3	3	2	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Ring-necked duck	2	2	1	2	2	0	2	1	2	2	2	1	0	2	1	1	0	0	0	0	0	0	0
Waterbird	Greater scaup	0	2	1	2	2	1	2	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Waterbird	Harlequin duck	1	2	1	1	0	1	1	0	1	1	3	2	0	0	0	0	0	0	0	2	1	0	0
Waterbird	Long-tailed duck	1	2	1	1	1	0	2	1	2	2	1	1	0	1	1	0	0	0	0	0	0	0	0
Waterbird	Bufflehead	0	2	1	2	0	0	2	1	3	3	0	0	0	0	0	0	1	0	2	2	2	0	0
Waterbird	Common goldeneye	0	2	1	2	0	0	3	0	3	3	2	2	0	1	0	0	2	0	2	2	2	1	0
Waterbird	Common merganser	0	2	1	0	0	0	3	0	2	2	3	2	0	0	0	0	2	0	2	2	2	0	0
Waterbird	Red-breasted merganser	1	2	1	2	0	0	2	0	2	2	3	1	0	0	0	0	0	0	0	0	0	1	0
Waterbird	Horned grebe	0	1	0	2	1	0	2	1	3	3	2	1	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Red-necked grebe	0	1	0	2	1	0	2	1	3	3	2	1	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Sandhill crane	2	2	2	0	3	3	0	2	0	0	0	0	1	3	0	1	0	1	0	0	0	0	0
Waterbird	Red-throated loon	0	2	0	1	0	0	3	0	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Waterbird	Pacific loon	0	2	0	0	0	0	3	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Waterbird	Common loon	0	2	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Seabird	Bonaparte's gull	3	3	3	3	0	0	2	2	2	2	1	1	0	0	1	0	0	0	3	0	3	0	0
Seabird	Short-billed gull	3	3	3	3	1	1	3	2	3	2	3	2	0	1	1	0	0	0	3	0	3	0	2
Seabird	Herring gull	2	2	2	2	1	1	2	1	2	2	2	2	0	1	1	0	0	0	0	0	0	0	2
Seabird	Glaucous-winged gull	3	3	3	3	1	1	2	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	1

Table 5.6.1, continued.

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Seabird	Arctic tern	3	3	3	3	0	0	2	2	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0
Shorebird	Semipalmated plover	2	0	2	2	2	0	2	2	2	2	0	2	0	1	2	0	0	0	0	0	0	0	1
Shorebird	Whimbrel	3	0	3	3	3	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Shorebird	Least sandpiper	3	0	3	2	2	0	2	2	2	2	0	0	0	3	1	0	0	0	0	0	0	0	0
Shorebird	Semipalmated sandpiper	3	0	3	3	3	0	2	2	3	3	0	0	0	3	0	0	0	0	0	0	0	0	0
Shorebird	Western sandpiper	3	0	3	3	3	0	2	2	3	3	0	0	0	3	0	0	0	0	0	0	0	0	0
Shorebird	Wilson's snipe	1	0	1	2	2	2	2	3	3	3	0	1	2	2	2	2	1	2	2	1	1	0	0
Shorebird	Spotted sandpiper	1	0	2	2	2	1	3	2	3	3	0	3	1	2	1	2	1	1	1	1	1	0	0
Shorebird	Solitary sandpiper	1	0	1	2	1	1	2	1	3	3	0	0	1	3	1	0	0	0	2	0	2	0	0
Shorebird	Lesser yellowlegs	3	0	3	3	3	2	2	3	3	3	0	1	0	3	1	0	0	0	0	0	0	0	0
Shorebird	Greater yellowlegs	3	0	3	3	3	2	2	3	3	3	0	1	0	3	1	0	0	0	0	0	0	0	0
Shorebird	Red-necked phalarope	1	2	1	3	2	0	2	1	3	3	0	0	0	3	0	0	0	0	0	0	0	0	0
Raptor	Osprey	2	2	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptor	Northern harrier	2	0	2	3	3	3	0	1	1	1	0	0	1	3	1	0	0	0	0	0	0	0	0
Raptor	Sharp-shinned hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	0	0
Raptor	Northern goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	0	0
Raptor	Bald eagle	3	3	3	0	0	0	3	2	2	2	3	3	0	0	0	0	0	0	3	1	2	1	1
Raptor	Red-tailed hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0
Raptor	Great horned owl	0	0	0	0	2	2	0	1	0	0	0	0	1	2	0	2	2	2	3	2	3	1	0
Raptor	Northern hawk owl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	1	3	0	0
Raptor	Short-eared owl	2	0	0	1	2	2	0	0	0	0	0	0	0	2	0	1	0	1	0	0	0	0	0
Raptor	Boreal owl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0
Raptor	American kestrel	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0
Raptor	Merlin	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	1	2	1	0
Raptor	Peregrine falcon	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Landbird	Ruffed grouse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	2	0	0
Landbird	Spruce grouse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	3	0	0
Landbird	Willow ptarmigan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	1	0	0	0	0
Landbird	Belted kingfisher	0	0	0	0	0	0	3	3	3	2	3	0	0	1	2	1	1	1	1	1	1	0	0
Landbird	American three-toed Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	0	0
Landbird	Downy woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	3	1	0	0

Table 5.6.1, continued.

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Landbird	Hairy woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	2	2	0	0
Landbird	Northern flicker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	0	0
Landbird	Olive-sided flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	0	0
Landbird	Western wood-pewee	0	0	0	0	0	0	1	1	1	1	0	1	0	0	1	0	1	0	2	1	2	0	0
Landbird	Alder flycatcher	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	2	3	3	2	1	0	0
Landbird	Northern shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	1	1	1	0	0
Landbird	Canada jay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	3	2	3	0	1
Landbird	Stellar's jay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	0
Landbird	Black-billed magpie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	2	2	1	0	1
Landbird	Common raven	3	2	3	2	2	2	2	3	2	2	1	3	1	1	1	2	1	2	2	1	2	3	1
Landbird	Black-capped chickadee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	2	0	0
Landbird	Boreal chickadee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	0	3	0	0
Landbird	Bank swallow	0	0	0	0	0	0	2	1	2	2	3	0	1	1	2	2	0	0	0	0	0	2	2
Landbird	Tree swallow	0	0	0	0	0	0	3	1	3	3	3	0	2	2	2	1	2	1	2	2	1	0	1
Landbird	Violet-green swallow	0	0	0	0	0	0	3	1	3	3	3	0	2	2	2	0	1	0	1	1	1	2	0
Landbird	Cliff swallow	0	0	0	0	0	0	1	1	1	1	3	0	1	1	2	1	0	0	0	0	0	2	2
Landbird	Ruby-crowned kinglet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	2	3	0	0
Landbird	Golden-crowned kinglet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	2	3	0	0
Landbird	Bohemian waxwing	0	0	0	0	0	0	2	0	2	2	0	1	1	1	1	1	1	2	2	1	3	0	0
Landbird	Red-breasted nuthatch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	0	0
Landbird	Brown creeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	1	2	0	0
Landbird	American dipper	1	1	1	0	0	0	0	0	0	0	3	2	0	0	1	0	0	0	0	0	0	2	0
Landbird	Townsend's solitaire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	2	0	0
Landbird	Gray-cheeked thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	2	2	2	0	0
Landbird	Swainson's thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	3	3	3	0	0
Landbird	Hermit thrush	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	3	2	2	2	0	0
Landbird	American robin	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	1	2	3	2	3	0	2
Landbird	Varied thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	3	3	0	0
Landbird	American pipit	2	0	2	0	2	0	0	2	0	0	0	2	0	0	1	0	0	1	0	0	0	0	1
Landbird	Pine grosbeak	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	3	0	0
Landbird	Common redpoll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3	2	1	0	1
Landbird	White-winged crossbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	3	0	0

Table 5.6.1, continued.

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Landbird	Pine siskin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	3	2	3	0	0
Landbird	Lapland longspur	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Landbird	Snow bunting	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Landbird	Fox sparrow	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	1	3	3	3	2	0	0
Landbird	Dark-eyed junco	0	0	1	0	0	0	0	0	1	0	0	1	1	0	1	2	1	2	3	3	3	0	1
Landbird	White-crowned sparrow	0	0	0	0	1	2	0	0	0	1	0	0	1	1	0	3	0	3	2	1	2	0	0
Landbird	Golden-crowned sparrow	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	3	2	2	2	0	1
Landbird	Savannah sparrow	0	0	0	0	1	2	0	0	0	2	0	0	0	3	0	2	0	2	1	1	1	0	0
Landbird	Lincoln's sparrow	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	3	1	3	2	2	2	0	0
Landbird	Rusty blackbird	0	0	0	2	2	1	1	1	3	3	1	1	2	2	1	2	0	1	0	0	1	0	0
Landbird	Northern waterthrush	0	0	0	0	0	0	1	1	2	2	0	2	1	0	2	3	2	2	2	2	1	0	0
Landbird	Orange-crowned warbler	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	3	2	3	2	0	0
Landbird	Yellow warbler	0	0	0	0	0	2	1	0	1	1	0	2	1	0	1	3	2	2	1	3	1	0	0
Landbird	Blackpoll warbler	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	3	0	3	2	2	1	0	0
Landbird	Yellow-rumped warbler	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	3	3	3	0	0
Landbird	Townsend's warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	1	3	0	0
Landbird	Wilson's warbler	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3	2	3	3	2	2	0	0

[a] Habitat value classes: 3 = high, 2 = moderate, 1 = low, and 0 = negligible value (see Table 4.6-1 for value class descriptions).

Nine diving duck species—Barrow's goldeneye, ring-necked duck, greater scaup, harlequin duck, long-tailed duck, bufflehead, common goldeneye, common merganser, and red-breasted merganser—that were either recorded during migration surveys (see Section 5.2) or expected to occur regularly in the study area were assessed for habitat values. Staff at the NVE have records of harlequin duck males and pairs using the Eklutna River in summer near the Old Glenn Highway bridge between 2002 and 2017 (Marc Lamoreaux, NVE, pers. comm.).

Diving ducks dive below the water surface while feeding and they commonly occupy deep, open lacustrine water bodies as well as shallower palustrine waterbodies with emergent vegetation. Bufflehead, Barrow's and common goldeneye, and common mergansers are cavity nesters and require mature forests with suitable tree cavities near waterbodies for foraging opportunities and brood-rearing (Billerman et al. 2022). Bufflehead prefer poplar or aspen (*Populus* spp.) stands but also nest in coniferous stands near small, permanent ponds or lakes with shallow margins and minimal emergent vegetation (Billerman et al. 2022). Both goldeneyes and common mergansers nest in coniferous or mixed forests, but occasionally use rock cavities in the northern part of their breeding range (Billerman et al. 2022). Common mergansers also may use spaces among tree roots and holes in banks (Billerman et al. 2022). In addition to lakes and ponds, common goldeneye and common mergansers will nest along shallow stretches of rivers and slower stretches of streams (Billerman et al. 2022). Drainage systems are particularly important to common mergansers because females move broods downstream to larger rivers to rear young (Billerman et al. 2022). Nests of bufflehead, common goldeneye, and common mergansers are typically within 1 mile of a waterbody (Billerman et al. 2022). Red-breasted mergansers breed near deep lakes and rivers with moderate currents, and occur more frequently in salt water and estuaries than do common mergansers (Billerman et al. 2022). Red-breasted mergansers typically nest on the ground (Billerman et al. 2022). Ring-necked ducks and greater scaup prefer shallow ponds and lakes surrounded by emergent vegetation and sedge marshes for nesting and brood-rearing (ABR 2017; Billerman et al. 2022). Harlequin ducks specialize in riverine habitats instead of lacustrine waterbodies and nest primarily adjacent to rivers (ABR 2008a,b,c; ABR 2017). Based on this habitat-use information, the observations in the study area for two species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 10 coastal, riverine, lacustrine, and marsh habitats, and 4 forest types in the study area to be of high and moderate value for this group of diving duck species (Table 5.6-1).

Six dabbling duck species—northern shoveler, gadwall, American wigeon, mallard, northern pintail, and green-winged teal—that were either recorded during migration surveys (see Section 5.2) or expected to occur regularly in the study area were assessed for habitat values. Dabbling ducks favor shallow waters and feed near the surface, rarely diving. They generally prefer waterbodies with emergent and/or submergent vegetation and other forms of cover for feeding and escape. Dabbling ducks prefer fresh-water ponds, lakes, marshes, bogs, and sedge meadows for nesting and brood-rearing (Billerman et al. 2022). Mallard, northern pintail, and green-winged teal also are found breeding in Alaska along small streams (Billerman et al. 2022). Gadwall breed in various types of freshwater or brackish wetlands, particularly shallow ones with abundant vegetation (Billerman et al. 2022). Based on this habitat-use information, the observations in the study area for these 6 species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 9 coastal, riverine, lacustrine, and marsh habitats in the study area to be of high and moderate value for this group of dabbling duck species (Table 5.6-1).

Four goose and 2 swan species—snow, greater white-fronted, cackling, and Canada goose, and trumpeter and tundra swan—that were either recorded during migration surveys (see Section 5.2) or expected to occur regularly in the study area were assessed for habitat values. Published accounts of habitat use for snow geese (Billerman et al. 2022), greater white-fronted geese, and Canada geese indicate a wide variety of waterbody, marsh, and wet meadow habitats are used for foraging (Billerman et al. 2022). Non-breeding greater white-fronted geese typically roost on tidal marshes, sheltered bays, estuaries, brackish and freshwater marshes, lakes and reservoirs, and in Cook Inlet, small flocks of the Tule subspecies use tidal mudflats (Billerman et al. 2022). Greater white-fronted geese in Cook Inlet nest along coastal sloughs and in freshwater marshes and shrub bogs (Billerman et al. 2022). Published accounts of habitat use for trumpeter swans (Billerman et al. 2022) indicate that they nest on a wide variety of freshwater lakes, ponds, marshes, and rivers. Based on this habitat-use information, the observations in the study area for 3 species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 7 coastal, lacustrine, and marsh habitats in the study area to be of high and moderate value for these goose and swan species (Table 5.6-1).

Sandhill cranes were recorded during spring and fall migration surveys in the study area (Section 5.2). On the eastern Copper River Delta in southcentral Alaska, cranes roost primarily in shrub wetlands and intertidal mudflats, and feed primarily in wet meadow habitats (Billerman et al. 2022). On the Yukon-Kuskokwim Delta in western Alaska, they typically nest near small ponds, in marshes, or in sedge meadow tundra. Broods frequent taller graminoid vegetation (*Leymus mollis*) along slough banks, heath tundra, and short-grass meadows. Based on this habitat-use information, the observations in the study area, and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 7 coastal, riverine, lacustrine, marsh, and shrub habitats in the study area to be of high and moderate value for cranes (Table 5.6-1).

5.6.1.2. Shorebirds

A total of 11 shorebird species were assessed for habitat values for each of the 23 wildlife habitat types mapped in the study area. The species that are known or expected to occur regularly in the study area in either the breeding season or during migration are semipalmated plover, whimbrel, least, semipalmated, and western sandpiper, Wilson’s snipe, spotted and solitary sandpiper, lesser and greater yellowlegs, and red-necked phalarope. Four of these species—semipalmated plover, least sandpiper, spotted sandpiper, and lesser yellowlegs—were confirmed to occur in the lower river area during the fall migration in August 2022 (see Section 5.2; Emily Schmeltz, ADFG, pers. comm.).

Breeding shorebirds in southcentral Alaska generally are adapted to utilize open scrub forests, forest openings in the lowlands (e.g., scrub bogs and graminoid-dominated wetlands), lacustrine waterbodies, gravelly river bar and coastal habitats, and dwarf-scrub habitats in upland and alpine areas. Upper Cook Inlet is used by a variety of migrant shorebird species during spring and fall, and one species, rock sandpiper, also winters in the area (Gill and Tibbitts 1999, ABR 2007, Billerman et al. 2022). Only 3 species were observed during the migration surveys in the

Eklutna survey area in 2022 (Section 5.2), but another 8 species are expected to occur in the study area, as breeders and/or migrants, based on the habitats available.

In subarctic areas, semipalmated plovers nest in well-drained gravels and broken shale, along streams and in the mountains, and during migration they can be found on mudflats, saltmarshes, and beaches above the tideline or in shallow water typically less than their tarsus length (Billerman et al. 2022). Whimbrels are tundra and tundra-treeline transition nesters. During migration, they primarily move along coastal and oceanic routes, although some individuals fly overland (Billerman et al. 2022) and have been documented doing so in Alaska (Ruthrauff et al. 2021).

Least sandpipers prefer coastal wetlands or subalpine sedge meadows for nesting. On migration they use inland habitats more often than other small *Calidris* sandpipers; on coastal mudflats, they typically use dendritic drainage channels on upper portions of flats and open areas between patches of saltmarsh vegetation (Billerman et al. 2022). In upper Cook Inlet, they prefer the upper sections of mudflats near the saltmarsh edge and typically do not follow the receding or advancing waterline (ABR 2008c). Western sandpipers are tundra nesters and during migration they frequent intertidal mud and sandflats, roosting during high tide on exposed tussocks in the saltmarsh (Billerman et al. 2022). At interior stopover sites, the margins of lakes and ponds are preferred habitat, particularly salt lakes and ponds. Wilson's snipe breed in sedge bogs, fens, willow and alder swamps, and marshy edges of ponds, rivers, and streams (Billerman et al. 2022). Spotted sandpipers occupy almost all habitats near water, including the shorelines of rivers and lakes, and urban and agricultural ponds and pools (Billerman et al. 2022). They nest in a variety of habitats (shoreline, sagebrush, grassland, and forest) but only near water. During migration they prefer freshwater habitat such as lakes, rivers, and marshes over estuaries and beaches. Unlike virtually all other shorebirds, the solitary sandpiper is a bird of forests near ponds and lakes, often at high elevation (Billerman et al. 2022). They are rarely seen on coastal saltmarshes. Solitary sandpipers are arboreal nesters, often reusing the tree nests of several different song birds (Billerman et al. 2022). Red-necked phalaropes breed in tundra or tundra-forest transition areas near freshwater lakes and ponds, in bogs and marshes, and in or near small, slow-flowing streams (Billerman et al. 2022). During migration, they primarily occur in offshore and nearshore marine waters, but also inland on virtually all sizes and kinds of wetlands and lacustrine waterbodies. Based on this habitat-use information, the limited observations in the study area for 3 species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 18 coastal, riverine, lacustrine, marsh, shrub, and forest habitats in the study area to be of high and moderate value for this set of 11 shorebird species (Table 5.6-1).

5.6.1.3. Raptors

A total of 13 raptor and owl species that are known or expected to occur regularly in the study area in either the breeding season or during migration were assessed for habitat values for each of the 23 mapped wildlife habitat types. No cliff-nesting raptors were detected in the study area during the raptor nesting survey and cliff and bluff habitats were generally of lower quality for cliff-nesting species (Section 5.1). Nine tree-nesting species (osprey, sharp-shinned hawk, northern goshawk, bald eagle, red-tailed hawk, great horned owl, northern hawk owl, boreal owl, American kestrel), 2 ground-nesting species (northern harrier, short-eared owl), and 1 species (merlin) that can nest on cliffs, trees, and on the ground were assessed for habitat values. Peregrine falcons likely occur in the area only during migration and were assessed for foraging habitats only. Four raptor species— northern harrier, bald eagle, red-tailed hawk, and merlin— were confirmed to occur in the study area in 2022 (see Sections 5.1 and 5.2; Emily Schmeltz, ADFG, pers. comm.).

Some raptors display flexibility in the nest substrate they use regularly (e.g., merlin), some have regional differences (e.g., bald eagles can nest on bluff tops where trees are absent), and some have occasional deviations from the nest substrate they typically use (e.g., red-tailed hawks and great horned owls can nest on cliffs and bluffs).

Most raptors and owls make use of a wide variety of habitats for foraging. Many of the species expected to occur in the study area (osprey, northern harrier, bald eagle, red-tailed hawk, great horned owl, short-eared owl, American kestrel, merlin, and peregrine falcon) prefer hunting for fish, small mammals, and/or birds in open habitats (Billerman et al. 2022). These habitats can include open graminoid- and shrub-dominated meadows, riverine and lacustrine areas, and coastal saltmarshes and mudflats. Bald eagle, the single raptor species documented to occur in the study area in 2022 (Section 5.1), forages predominantly in aquatic and coastal habitats.

As a group, forest-dwelling and tree-nesting species (sharp-shinned hawk, northern goshawk, northern hawk owl, and boreal owl) tend to focus their hunting in forest and occasionally tall shrub habitats (Billerman et al. 2022). Great horned owls are flexible and can forage in open habitats as well as shrub and forest types.

Based on this habitat-use information, the limited observations in the study area for 1 species (Section 5.2), and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 19 coastal, riverine, lacustrine, marsh, shrub, and forest habitats in the study area to be of high and moderate value for this set of 13 raptor and owl species (Table 5.6-1).

5.6.1.4. Landbirds

A total of 55 landbird species were assessed for habitat values for each of the 23 wildlife habitat types mapped in the study area. For landbirds, which are comprised of a diversity of species adapted to many different habitats, each of the 23 habitats in the study area was considered to be of high or moderate value for one or more species during breeding, migration, or wintering.

Three resident woodpecker species—American three-toed, downy, and hairy woodpecker—and the migratory northern flicker were considered to occur regularly in the study area. As a group, these 4 woodpecker species depend on a variety of deciduous, coniferous, and mixed forest habitats for both foraging and breeding (ABR 2008a,b,c; Billerman et al. 2022). In recent years in the Cook Inlet region, American three-toed woodpeckers have often been associated with beetle-killed white spruce trees. Based on this habitat-use information and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 4 forest habitats in the study area to be of high or moderate value for these woodpecker species (Table 5.6-1).

Three migratory flycatcher species—olive-sided flycatcher, western wood-pewee, and alder flycatcher—are known or expected to occur regularly in the study area. As a group, these species use shrub, open forest, and forest edge habitats for foraging and breeding, and prefer areas that provide perches with adjacent open air spaces for surveying and catching flying insects (Benson 2004; Billerman et al. 2022). Based on this habitat-use information and additional observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 6 shrub and forest habitats in the study area to be of high or moderate value for these flycatcher species (Table 5.6-1).

A group of 4 resident corvid species (jays, crows, and their allies) are known or expected to occur regularly in the study area. These species—Canada and Steller's jay, black-billed magpie, and common raven—are generalists that are known to use a variety of forest, shrub, open meadow, and barren habitats for foraging, breeding, and during winter (Billerman et al. 2022). Based on this habitat-use information, including the observation of nesting common ravens on a cliff face in the Eklutna River canyon in June 2017 (Marc Lamoreaux, NVE, pers. comm.), an observation of a group of black-billed magpies in August 2022 near the New Glenn Highway bridge (Emily Schmeltz, ADFG, pers. comm.), and additional observations of corvid habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 17 of the 23 habitats in the study area to be of high or moderate value for these corvid species (Table 5.6-1). The large number of habitats of high and moderate value for corvids is primarily a result of the broad habitat preferences of common ravens in particular.

Four migratory swallow species are known or expected to occur regularly in the study area. These species—bank, tree, violet-green, and cliff swallow—are most commonly seen foraging for insects in the air directly over waterbodies. However, they also forage aerially over a diversity of vegetated habitats, and as a group, are known to use forests, cliffs, and other human-constructed vertical surfaces for nesting (Billerman et al. 2022). Based on this habitat-use information, augmented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 13 of the 23 habitats in the study area to be of high or moderate value for these swallow species (Table 5.6-1).

Six species of migratory thrushes are known or expected to occur regularly in the study area. As a group, these species—Townsend's solitaire, gray-cheeked, hermit, and Swainson's thrush, American robin, and varied thrush—use a variety of shrub, forest, and disturbed habitats for foraging and nesting, and during migration (Benson 2004; Billerman et al. 2022). Based on this habitat-use information, augmented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 8 shoreline, shrub, forest, and human modified habitats in the study area to be of high or moderate value for these thrush species (Table 5.6-1).

Four resident finch species—pine grosbeak, common redpoll, white-winged crossbill, and pine siskin—are likely to occur regularly in the study area. As a group, these species are known to use a variety of shrub and forest habitats for breeding, foraging, and during winter (Billerman et al. 2022). Based on this habitat-use information, supplemented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 5 shrub and forest habitats in the study area to be of high or moderate value for this group of finch species (Table 5.6-1).

Two migratory calcarid species—lapland longspur and snow bunting—are likely to occur regularly in the study area but only during migration. These species are known to use open meadow, tundra, and disturbed habitats for breeding, foraging, and during migration (Billerman et al. 2022. Both species also use open coastal habitats in Alaska during migration. Based on this habitat-use information, supplemented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 2 coastal and human-modified habitats in the study area to be of high or moderate value for these calcarid species (Table 5.6-1).

Six migratory passerellid species (sparrows and their allies) including fox sparrow, dark-eyed junco, white-crowned, golden-crowned, savannah, and Lincoln's sparrow are likely to occur regularly in the study area. Dark-eyed juncos were confirmed to occur in the study area in August 2022 (Emily Schmeltz, ADFG, pers. comm.). These six species are known to use a variety of shrub, open meadow and wetlands, and forest habitats for breeding and foraging, and during migration (Kessel et al. 1982; Benson 2004; Billerman et al. 2022). Based on this habitat-use information, supplemented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 9 waterbody, marsh, shrub, and forest habitats in the study area to be of high or moderate value for this group of passerrellid species (Table 5.6-1).

Seven migratory warbler species—northern waterthrush, orange-crowned, yellow, blackpoll, yellow-rumped, Townsend's, and Wilson's warbler—are likely to occur regularly in the study area. These species are known to breed, forage, and migrate in a range of shrub and forest habitats, from disturbed early and mid-successional shrub thickets to mature deciduous, coniferous and mixed forests (Kessel et al. 1982; Benson 1999; Sowl 2003; Benson 2004; Billerman et al. 2022). Northern waterthrushes and yellow warblers to a lesser extent also prefer shrub and forest habitats in proximity to streams and rivers and lacustrine waterbodies. Based on this habitat-use information, augmented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 11 riverine and lacustrine waterbody, shrub, and forest habitats in the study area to be of high or moderate value for this group of species (Table 5.6-1).

Three landbird species that use waterbody habitats and/or adjacent wetlands with standing water—belted kingfisher, American dipper, and rusty blackbird—are likely to occur regularly in the study area. A single dipper was recorded in June 2017 in Eklutna River below the Lower Eklutna River Dam and another near the confluence with Thunderbird Creek (Marc Lamoreaux, NVE, pers. comm.). Two belted kingfishers were recorded in the lower river area and a single dipper near the New Glenn Highway bridge in August 2022 (Emily Schmeltz, ADFG, pers. comm.). As a group, these species depend on riverine and lacustrine waterbodies and nearby marsh habitats for foraging, and resident American dippers make exclusive use of fast-flowing streams year round (Billerman et al. 2022). Nesting habitat varies widely, including eroding bluffs (belted kingfisher), streamside crevices and ledges (American dipper), and tall shrubs, open forests, and woodlands (rusty blackbird; Billerman et al. 2022). Based on this habitat-use information, augmented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 13 riverine and lacustrine waterbody, marsh, and shrub habitats in the study area to be of high or moderate value for this group of species (Table 5.6-1).

The remaining 12 landbird species expected to occur regularly in the study area are grouse and ptarmigan (3 species), northern shrike, chickadees (2 species), kinglets (2 species), bohemian waxwing, red-breasted nuthatch, brown creeper, and American pipit. Black-capped chickadees were confirmed to occur in the study area in August 2022 (Emily Schmeltz, ADFG, pers. comm.). These species are known to use a wide diversity of habitats, ranging from open coastal areas, lentic waterbody margins, marshes and wet meadows, to shrub and forest types for breeding, foraging, and during migration (Benson 2004; Billerman et al. 2022). Based on this habitat-use information, augmented with specific observations of habitat use in the upper Cook Inlet area (ABR 2008a,b,c), we considered 13 mudflat, ponds, river bars, marsh, shrub, and forest habitats in the study area to be of high or moderate value for this diverse group of species (Table 5.6-1).

5.6.2. Mammal Habitat Values

5.6.2.1. Moose

Moose are typically found at the highest density in areas with abundant early successional woody vegetation, especially willow species (Salix sp.), resulting from disturbances such as fires logging, and flooding (Franzmann 1981). In the Susitna River basin, moose selected early shrub and old poplar sites during winter, and feltleaf willow (*Salix alexensis*) was the most important forage species, but high bush cranberry (*Viburnum edule*) and rose (*Rosa acicularis*) were also important (Collins and Helms 1997). Forest cover and snow depth also influenced moose distribution during winter. Aquatic plants are an important forage source for moose in spring (MacCracken et al. 1993). Results of the moose browse study (Section 5.4) indicated high rates of broomed shrub architecture, indicating heavy browsing pressure during previous winters. Current year winter browsing rates, however, were low to moderate throughout the study area, suggesting the moose population was below carrying capacity. Moose browse was concentrated in Upland Low and Tall Alder-Willow Shrub Scrub, Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub, Flooded Forest, Brackish Deciduous Shrub Scrub, and along the edges of Human Modified Barrens, although upland forests and marshes also provide food, protection from predators, and thermal refugia. During the Camera Traps and Opportunistic Observations study (Section 5.5), moose were the most commonly observed wildlife species in all portions of the study area. Based on this Project-specific habitat-use information collected in 2022 and information from the scientific literature, we considered 14 lacustrine, marsh, riverine, shrub, forest, and human-modified habitats in the study area to be of high or moderate value for moose (Table 5.6-2). Reflecting their broad use of habitats in the study area, another 6 habitats were considered low value for moose.

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Table 5.6.2. Habitat value rankings [a] for mammal and amphibian species known or expected to occur regularly in the study area. Species are listed in phylogenetic order within each species group.

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Amphibian	Wood frog	0	0	0	1	1	1	2	3	3	3	0	0	3	3	1	2	2	2	2	2	1	0	0
Small Mammal	American red squirrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	1	3	0	0
Small Mammal	Northern flying squirrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	3	3	0	0
Small Mammal	Meadow jumping mouse	0	0	0	1	0	0	0	0	2	2	1	1	2	3	1	2	2	1	1	1	1	1	1
Small Mammal	Singing vole	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	1	1	1
Small Mammal	Tundra vole	0	0	0	0	3	2	0	1	0	0	1	1	1	3	1	1	1	1	1	1	1	0	2
Small Mammal	Meadow vole	0	0	0	0	3	2	0	1	0	0	1	1	1	3	1	1	1	1	1	1	1	0	2
Small Mammal	Northern red-backed vole	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	2	2	2	2	2	2	1	1
Small Mammal	Northern bog lemming	0	0	0	0	3	2	0	0	0	0	0	0	2	3	0	1	1	0	0	0	0	0	1
Small Mammal	Porcupine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	2	3	1	0
Small Mammal	Snowshoe hare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	2	3	2	1	3	0	0
Small Mammal	Cinereus shrew	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	3	3	2	3	3	1	0	0
Small Mammal	American pygmy shrew	0	0	0	1	1	1	0	0	1	1	1	1	2	2	1	2	2	1	1	2	1	1	0
Small Mammal	Dusky shrew	0	0	0	1	0	2	0	0	1	1	1	1	2	2	1	3	3	2	1	2	1	1	0
Small Mammal	Western water shrew	0	0	0	3	3	2	1	1	3	3	2	1	2	2	1	3	3	1	1	1	1	0	0
Small Mammal	Tundra shrew	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	0	1
Small Mammal	Holarctic least shrew	0	0	0	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	0
Small Mammal	Little brown bat	0	0	0	3	1	1	1	1	3	3	2	0	0	3	1	1	1	1	3	3	2	3	2
Furbearer	Beaver	1	1	1	3	2	2	1	1	3	3	3	1	2	3	1	3	1	2	2	3	0	0	0
Furbearer	Muskrat	1	2	1	3	3	1	1	1	3	3	2	2	0	3	1	1	1	0	0	0	0	0	0
Furbearer	Lynx	0	0	0	0	0	1	0	0	0	0	2	1	1	0	1	3	3	2	3	2	3	0	2
Furbearer	Coyote	0	0	0	0	2	2	0	1	1	1	2	2	1	2	1	3	3	3	2	2	2	1	2
Furbearer	Red Fox	0	0	0	0	2	2	0	1	1	1	2	2	1	2	1	3	3	3	3	2	3	1	2
Furbearer	River otter	2	3	3	3	3	1	1	1	3	3	3	2	0	2	1	1	1	1	0	0	0	0	0
Furbearer	American marten	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	3	2	3	0	0
Furbearer	Short-tailed weasel	0	0	0	0	0	1	0	0	0	0	1	1	2	1	1	2	2	2	2	2	2	2	1
Furbearer	Least weasel	0	0	0	0	1	1	0	0	0	0	1	1	2	2	1	2	2	2	2	2	2	2	1
Furbearer	Mink	1	1	1	3	2	2	1	1	3	3	3	3	1	3	1	3	3	1	1	1	1	0	0
Large Carnivore	Wolf	0	0	0	1	1	1	0	0	0	0	2	2	1	1	1	2	2	2	2	2	2	1	2
Large Carnivore	Black bear	1	0	0	1	2	1	1	1	1	1	2	3	0	2	1	3	2	2	3	3	3	2	2

Species Group	Common Name	Intertidal mudflat	Tidal river	Tidal river bar	Brackish pond	Brackish sedge marsh	Brackish deciduous shrub scrub	Freshwater lake	Intermittently exposed freshwater littoral zone	Freshwater pond	Freshwater pond (beaver modified)	Upper perennial river	Upper perennial river bar	Freshwater seeps or springs	Freshwater sedge marsh	Intermittent stream	Seasonally flooded low and tall alder-willow shrub scrub	Flooded forest	Upland low and tall alder-willow shrub	Mixed deciduous-spruce forest	Black cottonwood forest	Spruce forest	Rocky cliff and steep banks	Human modified barrens
Large Carnivore	Brown bear	1	0	0	1	3	3	1	2	1	1	3	3	0	3	1	3	2	2	1	1	1	2	2
Large Carnivore	Wolverine	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	1	1	2	1	1
Large mammal	Moose	1	1	1	2	2	3	0	0	2	2	1	2	1	2	1	3	3	3	2	2	2	0	2
Marine mammal	Beluga	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Habitat value classes: 3 = high, 2 = moderate, 1 = low, and 0 = negligible value (see Table 4.6-1 for value class descriptions).

5.6.2.2. Large Carnivores

Habitat values for black and brown bears were assessed through a literature review and sightings of bears during Project field surveys or on wildlife cameras. Sightings of bears during field surveys were influenced heavily by differential sightability among various habitat types; although those observations do not necessarily reflect habitat use accurately, they were considered as supporting information.

Both black bears and brown bears are found throughout the Project area. Brown bears were photographed at 9 of 12 motion-sensing or time-lapse cameras deployed throughout the study area in the Camera Traps and Opportunistic Observations study (Section 5.5), but most bear groups were photographed in open habitats near the coast. Black bears were photographed at 6 of 12 camera sites and were most frequently photographed by cameras in the middle and upper river areas. In other areas of Alaska, black bears are often more common in forested lower elevations and near the coast, whereas brown bears tend to be more common at higher elevations inland or in coastal wetlands (MacDonald and Cook 2009). Bears of both species are highly opportunistic and show a great degree of variability in food habits and behavior, making generalizations difficult between different sex and age classes and from one area to another. Nevertheless, some broadly consistent patterns are evident in the literature.

Brown bears tend to use habitats with open vegetation canopies, whereas black bears avoid open habitats and select closed forest and shrub habitats (Holm et al. 1999). In areas where they occur together, black bears typically avoid areas used consistently by brown bears, such as salmon-spawning streams (Jacoby et al. 1999, Belant et al. 2006); in such areas, there is an inverse relationship between brown bear density and the proportion of salmon in black bear diets (Belant et al. 2006). In areas of spatial overlap, brown bears are often more carnivorous, feeding heavily on salmon, and black bears are largely herbivorous and frugivorous (Jacoby et al. 1999, Fortin et al. 2007). Coastal sedge meadows and intertidal zones can also be important habitats for bears (Smith and Partridge 2004, Monson et al. 2022).

In southcentral Alaska, black bears are predominantly found in lower elevation areas (Miller 1987, Prichard et al. 2013), and feed primarily on newly emergent vegetation (sedges, grasses, horsetails, and cottonwood buds) and berries in late summer, and they make some use of terrestrial prey, including moose calves during early summer. Brown bear habitat use varies with differing levels of availability of plants, berries, salmon, and terrestrial prey. Brown bears feed heavily on moose calves during some seasons in southcentral Alaska (Brockman et al. 2017). Berries are an important food resource in late summer and fall, and overwintered berries are used in the spring. Early season herbaceous vegetation, such as sedges, grasses, and forbs are also important brown bear foods (Van Daele et al. 2013), and arctic ground squirrels are an important prey species in some areas. Brown bears typically den at higher elevations (Miller 1987, Miller 1990) on steep slopes and away from roads and trails (Goldstein et al. 2010).

Based on both the Project-specific habitat-use information collected in 2022 and information from the scientific literature, we considered 12 marsh, riverine, shrub, forest, cliff and bank, and human-modified habitats in the study area to be of high or moderate value for black bears (Table 5.6-2). Reflecting their broad use of habitats in the study area, another 8 habitats were considered low value for black bears.

For brown bears, we considered 11 marsh, shrub, lacustrine, riverine, open forest, cliff and bank, and human-modified habitats in the study area to be of high or moderate value (Table 5.6-2). Reflecting their broad use of habitats in the study area, another 9 habitats were considered low value for brown bears.

Wolves are wide-ranging predators whose habitat preferences are dictated primarily by the availability of prey species (MacDonald and Cook 2009). Wolves appear to be rare in the study area; only one wolf was photographed during the Camera Traps and Opportunistic Observations study, but they likely use a wide variety of habitats and various prey species, including moose, beaver, snowshoe hares, porcupines, small mammals, and salmon. Because they are wide ranging and use a diversity of prey, wolves can be found in most habitats (Paquet and Carbyn 2003). In transit, wolves may preferentially use riverine areas as travel corridors. Because of their occurrence in many habitat types on the landscape, no habitats in the study area were classified as high value for wolves (Table 5.6-2). Nine riverine, shrub, forest, and human-modified habitats were considered to be of moderate value, and 7 additional habitats as low value for wolves.

Wolverines have large home ranges and travel extensively over long distances (Gardner et al. 1986), using many different habitats. They depend on a broad range of foods, consisting mostly of small mammals and birds, but also including carrion. They occasionally prey on larger mammals (Pasitschniak–Arts and Larivière 1995). Wolverines in the middle Susitna River basin of southcentral Alaska moved to higher elevations during summer compared to winter and tended to use broad habitat categories (forest, shrub, rock/ice) in relation to availability, although they tended to avoid forests in summer and tundra in winter (Whitman et al. 1986). Previous habitat studies have reported that wolverines select forest and shrub habitats and avoid open habitats (UAF 2015). Arctic ground squirrels and ground-nesting birds likely can be important components of the spring and summer diet, and moose and caribou carrion can be a major winter food source. No wolverines were photographed during the Camera Traps and Opportunistic Observations study, but wolverines are most likely to use the Eklutna River area during the winter and then primarily in middle and upper river upland habitats. Based on this information, only 2 shrub and forest habitats were considered to be of moderate value, and 6 additional habitats were classified as low value for wolverines (Table 5.6-2).

5.6.2.3. Furbearers

Lynx prey heavily on snowshoe hares and their population cycles are closely linked. Lynx prefer habitats used by snowshoe hares, although lynx tend to avoid the densest shrub stands used by hares, presumably because hunting is difficult there (MacDonald and Cook 2009); both species used more open habitats when hares were abundant (Mowat et al. 1999). Lynx typically select seral habitats and regenerating stands of forest > 20 years in age, and appear to hunt along habitat edges (e.g., where dense riparian shrub stands meet more open habitats; Mowat et al. 1999). Only one lynx was photographed during the Camera Traps and Opportunistic Observations study (Section 5.5). In southcentral Alaska, lynx occurred most commonly in white and black spruce and shrub habitats (UAF 2015). Given this information, a set of 8 riverine, shrub, forest, and human-modified habitats in the study area were considered to be of high or moderate value for lynx (Table 5.6-2).

Coyotes and red foxes are opportunistic predators that take a wide variety of small mammals, concentrating on snowshoe hares when they are abundant (Bekoff 1977, Larivière and Pasitschniak–Arts 1996); coyotes also feed readily on carrion and fruits. Availability of prey is the most important factor governing habitat use for these canids and they use a wide variety of habitats (MacDonald and Cook 2009); thus, the habitats of greatest value to these predators are those favored by hares and other small mammals. Red foxes use all habitat types but were most commonly found in spruce and alder in southcentral Alaska, while coyotes were more likely in shrub habitats (MacDonald and Cook 2009, UAF 2015). During the camera-trap study, coyotes were observed throughout the study area, but the camera located in the flooded forest had 2.5-times the number of observations than any other camera; this same camera also recorded the only 2 observations of red fox in the study area. Given this information, a set of 12 marsh, shrub, riverine, forest, and human-modified habitats were ranked as high or moderate value for both coyotes and red foxes, with most forest types classified as moderate for coyotes and high valued for red foxes (Table 5.6-2).

Short-tailed weasels are present in woodland black spruce and also medium shrublands (Gipson et al. 1982), though they are known to inhabit a wide range of habitats (MacDonald and Cook 2009, Peirce 2003, Svendson 2003). Short-tailed and least weasels are specialist predators on small mammals (primarily voles and mice) and birds, and their local distribution is largely related to the abundance of prey (King 1983, Sheffield and King 1994); seral and forest-edge habitats, scrub, meadows, marshes, and riparian forest and bank habitats all may be inhabited if small mammals are present. Least weasels are moderately general in their habitat preferences, but may favor grasslands, marshes, and riparian habitats for hunting rodents (MacDonald and Cook 2009, Svendson 2003). Given this information, a set of 8 seeps and springs, shrub, forest, and cliff and bank habitats were considered to be of moderate value for short-tailed weasels, and the same habitats plus freshwater marshes were classified as moderate value for least weasels. No habitats in the study area were classified as high value for either species.

American marten prey on a variety of animals, mainly voles, squirrels, hares, and birds, and consequently use a variety of habitats, ranging from mature open coniferous or mixed forests with well-established shrub and forb understories to post-fire seral stages of vegetation (Clark et al. 1987, Magoun and Dean 2000). A key habitat feature appears to be sufficient structural complexity near the ground in the form of dense shrub cover or coarse woody debris, regardless of forest canopy. In southcentral Alaska, marten occurred most commonly in black spruce forests (UAF 2015). Given this information, only 2 coniferous and mixed forest types in the study area were considered to be of high value, and 1 deciduous forest habitat was classified as moderate value for marten (Table 5.6-2).

Both river otters and mink are closely tied to productive aquatic habitats, feeding heavily on fishes, but mink tend to prefer drier shorelines and eat more small mammals and birds than do otters (Larivière 1999). River otters require suitable shorelines for winter denning, preferring beaver-influenced lakes and ponds with banked shores and burrows (Larivière and Walton 1998). River otters are also known to forage in brackish intertidal areas of streams in southcentral Alaska. Neither species was observed during the Camera Traps and Opportunistic Observations study, which could indicate that much of the river system, particularly the upper river, does not currently have enough fish to support large populations of these species. Given this habitat-use information, a set of 9 intertidal, riverine, lacustrine, and marsh habitats in the study area were considered to be of high or moderate value for river otters (Table 5.6-2). For mink, a set of 10 lacustrine, marsh, shrub, riverine, and forest habitats were ranked as high or moderate value.

Muskrats and beaver inhabit lakes, ponds, and slow-moving streams if water depth is sufficient to permit construction of shelters, and aquatic vegetation and riparian deciduous trees and shrubs are plentiful; muskrat have also been recorded using human-altered waterbodies at strip mines and on farms (Willner et al. 1980). While no muskrats were recorded in the study area during the Camera Traps and Opportunistic Observations study, they have been observed in the Eklutna Lake area (Marc Lamoreaux, NVE, pers. comm.). Beaver, on the other hand, are common throughout the study area, including in brackish and freshwater ponds near the coast and in perennial stream habits in the middle and upper river. Given this information, a set of 8 riverine, lacustrine, and marsh habitats in the study area were considered to be of high or moderate value for muskrats. For beaver, a broader set of 12 riverine, lacustrine, marsh, shrub, seeps and springs, and forest habitats were classified as high or moderate value.

5.6.2.4. Small Mammals

The scientific literature indicates that shrews have fairly broad habitat relationships. Cinereus shrews in southcentral Alaska were numerous in every habitat, although more so in deciduous forests (particularly balsam poplar), grasslands, and tall shrubs (Kessel et al. 1982; MacDonald and Cook 2009). Cinereus shrews were rare in alpine rocky dry dwarf shrub, and more numerous in lower elevation moist open habitats in Wrangell-St. Elias National Park and Preserve (Cook and MacDonald 2003). Similar patterns were found in interior Alaska in the Yukon-Charley Rivers National Preserve (MacDonald and Cook 2001), although in both studies the authors also concluded that cinereus shrews were largely habitat generalists, as noted by Peirce (2003). Dusky shrews are also fairly general in their habitat preferences, although ground cover from predators is likely important (Kessel et al. 1982, MacDonald and Cook 2009). Tundra shrews, American pygmy shrews, western water shrews, and Holarctic least shrews are somewhat more restrictive in their habitat preferences than the aforementioned shrews. Tundra shrews are fairly general in their habitat preferences, but have been reported to be more common below treeline in open forests and mesic meadows (Kessel et al. 1982; MacDonald and Cook 2001), and may prefer drier, non-forested sites such as grasslands at low elevations and low shrubs above treeline (Kessel et al. 1982). Similar to tundra shrews, pygmy shrews appear to prefer forests and mesic meadows below treeline (Kessel et al. 1982; MacDonald and Cook 2001; Cook and MacDonald 2002). Western water shrews are aquatic animals that prefer habitats with dense ground cover along streams, lakes, beaver ponds, and marshes at all elevations (MacDonald and Cook 2009). Little is known about Holarctic least shrews but they have been trapped along streams in a birch forest in Denali National Park and Preserve (Cook and MacDonald 2002). The habitat value rankings for shrews in the study area reflect this general habitat-use information for each species (Table 5.6-2).

Northern red-backed voles are common in most terrestrial habitats, with some preference for open and woodland spruce and balsam poplar forests, and are less common in wetter sites and paper birch forests (Kessel et al. 1982, MacDonald and Cook 2009). In coastal southcentral Alaska, researchers have found that red-backed voles avoid lowland gravelly mixed forests, lowland bog meadows, and subalpine rocky moist low scrub (Peirce 2003). Because of their general habitat preferences, and some avoidance for wetter areas, shrub and forest habitats were ranked as moderate value, whereas riverine, seeps and springs, and marsh habitats were ranked as low value for red-backed voles (Table 5.6-2).

Tundra voles, singing voles, meadow voles, meadow jumping mice, and northern bog lemmings all prefer more open habitats (Kessel et al. 1982; Peirce 2003; Cook and MacDonald 2002). Singing voles prefer drier habitats and meadow voles, as their name indicates, prefer meadows. Singing voles were common in open low willow-birch shrub on relatively dry soils, whereas meadow voles were most often trapped in meadows and moist scrub at varying elevations, and appeared to avoid alpine dry dwarf shrub and forests (Kessel et al. 1982; Cook and MacDonald 2002). In contrast, meadow jumping mice, tundra voles, and northern bog lemmings all prefer wetter habitats (Kessel et al. 1982; MacDonald and Cook 2001; Cook and MacDonald 2002; Pierce 2003). Northern bog lemmings were primarily captured in wet grass-shrub meadows, open tussock bogs, and other wetland habitats, and the species may be restricted to lower elevation forested regions (MacDonald and Cook 2009). In a coastal southcentral Alaska study, all 8 of the meadow jumping mice were captured either in brackish meadows or lowland lake and aquatic habitats (Peirce 2003). Meadow jumping mice are known for their preference for riparian herbaceous and shrubby habitats, and may require nearby standing water (MacDonald and Cook 2009; Cook and MacDonald 2002). The habitat value rankings for voles, jumping mice, and bog lemmings in the study area reflect this general habitat-use information for each species (Table 5.6-2).

Red squirrels, snowshoe hares, and porcupines are generally found in forest and shrub-dominated habitats (Kessel et al. 1982), and porcupines often den in cliffs and rocks (Roze and Ilse 2003). Red squirrels are found primarily in conifer and mixed forests, and snowshoe hares prefer thick conifer forests and shrub thickets (Kessel et al. 1982; MacDonald and Cook 2009). Little is known about the abundance and distribution of northern flying squirrels in southcentral Alaska, although the species in Alaska broadly is generally associated with mature and old-growth forests, although some exceptions have been found in various locations across the species' range (MacDonald and Cook 2009). The habitat value rankings for squirrels, hares, and porcupines in the study area reflect this general understanding of forest and shrub habitat-use for each species (Table 5.6-2).

In the Susitna River drainage, little brown bats were found to occur most commonly in stream habitats, followed by pond, cliff, and upland habitats (ABR 2014b). In that study, bats selected closed forest, followed by shrub, open, and dwarf vegetation types. Loeb et al. (2014) studied little brown bats in southcentral Alaska and found that bats were detected more often in deciduous forests than coniferous forests, although the difference was not statistically significant. In that study, 7 of the 8 sites with the highest bat activity were at streams, ponds, or lakes, which is consistent with the data indicating that little brown bats feed heavily on aquatic insects (Fenton and Barclay 1980). Whitaker and Lawhead (1992) found that small moths were the dominant prey species for little brown bats in central Alaska. The habitat value rankings for little brown bats in the study area reflect this general understanding of a preference for foraging near aquatic habitats and the use of forest and cliff and bank areas for roost sites (Table 5.6-2).

5.6.3. Wood Frog Habitat Values

Wood frogs occur throughout most of Alaska south of the Brooks Range and inhabit diverse vegetation communities, including tundra, open forests, grassy meadows, and muskeg (MacDonald 2010). They breed in standing water and ponds, and those aquatic habitats are crucial to successful reproduction as males call to attract mates and females then lay egg masses in the same waterbodies, usually in emergent vegetation along pond margins. In southcentral Alaska, breeding wood frogs preferred ponds with deep water and emergent vegetation (ABR 2015). Overwintering frogs also use terrestrial habitats near their breeding ponds. Given this habitat-use information, we considered 11 lacustrine, seeps and springs, marsh, shrub, and forest habitats in the study area to be of high or moderate value for wood frogs (Table 5.6-2).

5.6.4. Species Richness by Habitat Type

Across all species of birds, mammals, and amphibians known or expected to occur in the study area, all but 3 of the 23 mapped habitat types was considered to be of high value for at least 1 of the 145 species assessed (Table 5.6-3). In this habitat evaluation, the most species-rich habitats were Mixed Deciduous-Spruce Forest and Spruce Forest, with those 2 forested habitat types considered to be of high value for 39 and 33 wildlife species, respectively. This result is driven primarily by the large number of landbird species that are expected to make use of the more complex vegetation structure in these forest types (mixed deciduous and coniferous trees, multi-layered tree canopy, shrub understory, and ground cover). Other species-rich habitats were Freshwater Pond, Freshwater Pond (Beaver Modified), Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub, and Brackish Pond, which were considered to be of high value for 30, 28, 27, and 23 wildlife species, respectively. A set of 8 marsh, shrub, lacustrine, forest, riverine and mudflat habitat types (Freshwater Sedge Marsh, Upland Low and Tall Alder-Willow Shrub Scrub, Freshwater Lake, Black Cottonwood Forest, Upper Perennial River, Brackish Sedge Marsh, Tidal River Bar, and Intertidal Mudflat) closely followed, and were considered to be of high value for 19–12 wildlife species. After that, species richness dropped off noticeably, with a set of 5 forest, riverine, lacustrine, and shrub habitats considered to be of high value for 8–4 wildlife species. Types with the lowest levels of species richness were a set of 4 cliffs and banks seeps and springs, intermittent stream, and barren habitats, which were considered to be of high value for 1–0 wildlife species.

Table 5.6-3. Expected species richness for birds, mammals, and amphibians ranked as high value in each mapped habitat type.

Habitat Type	Number of Species Ranked as High Value
Mixed Deciduous-Spruce Forest	39
Spruce Forest	33
Freshwater Pond	30
Freshwater Pond (Beaver Modified)	28
Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub	27
Brackish Pond	23
Freshwater Sedge Marsh	19
Upland Low and Tall Alder-Willow Shrub Scrub	18
Freshwater Lake	16
Black Cottonwood Forest	15
Upper Perennial River	15
Brackish Sedge Marsh	14
Tidal River Bar	13
Intertidal Mudflat	12
Flooded Forest	8
Tidal River	7
Upper Perennial River Bar	6
Intermittently Exposed Freshwater Littoral Zone	5
Brackish Deciduous Shrub Scrub	4
Rocky Cliff and Steep Banks	1
Freshwater Seeps or Springs	0
Intermittent Stream	0
Human Modified Barrens	0

6 CONCLUSIONS

The results and conclusions from this study will be utilized during the alternatives analysis to evaluate any potential impacts to terrestrial wildlife that may result from future water management changes.

6.1. Task 1: Raptor Nesting Survey

Leaf emergence in spring 2022 was earlier than anticipated, but at the time of the field survey leaves were still emerging and we were able to easily cover the entire survey area at multiple angles, so sightability of bald eagle nests was not affected. Sightability of possible cliff-nesting raptor nests, which have little, if any, vegetation to obscure nests was also not affected. However, smaller nest platforms in trees were more difficult to locate when viewed obliquely through the canopy of multiple trees with small leaves. Therefore, we flew directly over the canopy as much as possible. Potential nesting habitat for bald eagles was limited to large poplar trees in the river floodplain along the coast. Most of the large trees suitable for bald eagle nesting were on the north side of the Eklutna River. Within the floodplain and south of the area previously excavated for gravel, trees were younger and sub-optimal or not suitable for nesting bald eagles.

Peregrine falcons usually nest on cliffs overlooking waterbodies. The Eklutna River canyon appeared to contain suitable habitat for peregrine falcon nesting, but no nests or adults were observed. It is possible we missed a falcon incubating a clutch of eggs, but we did not observe streaks of whitewash (defecation) on the cliffs that often indicate the presence of nesting raptors.

The valley upstream of the canyon is characterized by steep slopes covered by either mature deciduous (birch and poplar), coniferous (black and white spruce), or mixed forest interspersed with exposed glacial material. The glacial material was often loose and unstable, showing numerous signs of recent slumping, but some cliff areas were stable enough to support vertical faces. Along the valley-bottom, trees were often early successional due to disturbance from possible river flooding or tree-clearing for the AWWU pipeline and access road. Off-channel habitats supported some mature mixed and coniferous forests. In general, the habitats upstream of the canyon were well-suited for tree-nesting raptor species like red-tailed hawks, goshawks, and tree-nesting ravens, and far less suitable for cliff-nesting species such as falcons or golden eagles.

Goshawks in Alaska typically nest below the canopy, often in deciduous trees with open understories (Squires et al. 2020). Nest site selection by common ravens is highly variable, ranging from trees to cliffs to man-made structures (Boarman and Heinrich 2020). The nest located just above the canyon in a poplar tree was the appropriate size and had characteristics of being built by either a common raven or northern goshawk. Unfortunately, there were no recent signs of occupancy and no adults of either species were nearby to offer clues as to which species built the nest. Forests with little understory are abundant in the region, providing good hunting habitat for goshawks, whereas ravens are generalists adept at occupying a variety of habitats.

Farther upstream, we located a common raven nest, in which at least 2 young were present. This nest was built on a small ledge on a stable gravel cliff. These more stable cliffs were not rare but based on the amount of material at the base, it is clear these cliffs are eroding rapidly, making ledges rare and nest building risky. We did not locate any ledges that were large and stable enough to support a golden eagle nest upstream of the canyon.

Overall, the Raptor Nesting Survey area appears to be lightly used by nesting raptors. There are 2 likely bald eagle territories near the coast, with nest platforms in suitable large poplar trees, and TEK from the NVE indicates that at least 1 bald eagle pair has nested in the area for a number of years. Other tree-nesting raptor species likely occur in the area, but our survey is best-suited for locating large raptor nests in the upper canopies and is less suited for locating nests of species that nest in tree cavities, witches' brooms, or under the canopy of conifer trees, such as merlins, kestrels, owls, and some northern goshawks. During the Migratory Waterfowl and Shorebird Surveys (see Section 5.2 above), observers located numerous northern harriers, 1 merlin, and 1 red-tailed hawk. Northern harriers build cryptic ground-nests that are easy to miss while merlin are small falcons that do not build their own nests and instead repurpose nests of other species like ravens, crows, and magpies; merlin can also nest on the ground or on small ledges (Smith et al. 2020, Warkentin et al. 2020). Because of this, nests of these other raptor species are more difficult to locate during aerial surveys. Red-tailed hawks, on the other hand, often build nests on the tops of tall trees (Preston and Beane 2020), and we believe we would have observed the presence of a red-tailed hawk nest in the study area. Finally, the quality of the typically eroding cliffs in the survey area is generally low to support larger cliff-nesting raptor species, such as peregrine falcons or golden eagles.

6.2. Task 2: Migratory Waterfowl and Shorebird Surveys

Overall, waterfowl and shorebird numbers were moderate to low, respectively, at the Eklutna River mouth. Total waterfowl numbers were always below 150 individuals, whereas during aerial surveys of the nearby Eagle River Flats in fall 2021, waterfowl numbers above 1,000 individuals were often recorded in early September, and the lowest waterfowl count during the Eagle River Flats surveys was 456 individuals (Bankert and Obritschkewitsch 2021). The Eklutna River salt marsh does have fewer ponds where waterfowl can feed, which may explain the low number of waterfowl present.

The limited survey data collected in 2022 suggest that the Eklutna River mouth is also not heavily used as a migratory stopover site for shorebirds. Previous researchers have successfully detected and identified shorebird species in intertidal areas of Cook Inlet from fixed-wing aircraft (Gill and Tibbitts 1999) as well as helicopters paired with ground-based observers, as done in this study (ABR 2007). After completing the late spring Eklutna survey, an ABR observer detected over 220 individual shorebirds of 13 species on the same day at a site in Anchorage, and on the same day as the early fall survey, other observers detected 87 individual shorebirds of 11 species in Anchorage. Combined, this evidence indicates that the timing of the surveys and the survey methods used were appropriate to detect shorebirds had they been present in substantial numbers at the Eklutna River mouth. Other researchers with extensive field experience studying shorebirds in Cook Inlet have also noted the general lack of use of the mudflats in both Knik and Turnagain Arm by migratory shorebirds (Dan Ruthrauff, U.S.

Geological Survey, pers. comm.). This is in contrast to heavy use of the mudflats by migratory shorebirds on the west side of Cook Inlet (Gill and Tibbitts 1999, ABR 2007).

6.3. Task 3: Beaver Pond Mapping and Beaver Survey

Three active beaver colonies were present in the Eklutna River drainage during 2022, one in the upper river near the AWWU portal, one in the middle river at RM 7.0, and one in the lower river below the Alaska Railroad bridge. The upper river colony was causing flooding and inhibiting access on the AWWU pipeline access road, which was disrupting pipeline monitoring activities. In response, AWWU personnel obtained a permit to remove all beavers and the beaver dam. ADFG personnel set traps on 3 July 2022 and time-lapse photos show that at least one trap was successful that same day. ADFG only trapped 2 adult beavers; the last beaver observed was a juvenile on 7 July. AWWU personnel then removed the beaver dam on 22 July with heavy machinery. Based on the ground and aerial survey observations conducted in this study in September and October 2022, respectively, beavers no longer inhabit the upper river colony.

The middle river colony was composed of a single lodge and 7 dams (6 intact, 1 failed). Some of these dams and associated ponds appeared to be new in 2022 based on new flooding of the AWWU access road that occurred during late summer 2022 (Appendix 2, Figure A.2-13). The lowest dam in the colony, a failed dam, was intact in aerial videography collected in 2020 for the Project but was breached by spring 2022. It likely was breached during study flow releases in 2021. Another failed dam observed during aerial surveys near the lower portion of the AWWU access road in the middle river was also intact in the 2020 aerial videography, indicating a failed colonization attempt. Another dam previously detected by other Project personnel in the upper canyon near RM 4.75 was not observed during our aerial survey as it was located in an incised, forested part of the upper canyon, making it difficult to detect from the air. This small dam was observed in 2019 when Project personnel breached the dam to draw down the pond to provide access on foot upriver. At the time, the dam looked newly constructed. Project personnel observed no repairs made to the dam afterwards, indicating the site may have been abandoned, but ponding was still evident in aerial videography in 2020. Project personnel noted that the study flow releases in 2021 removed much or all of this dam as it was in a narrow portion of the canyon that would have had high flows (Audrey Thompson, Kleinschmidt Associates, pers. comm.). These past and present colonization events indicate that much of the middle and upper river is suitable for beaver colonization. However, colonization of the middle and upper river was unlikely prior to the removal of the Lower Eklutna River Dam in 2018, which resulted in greater connectivity in the riverine system. Colonization could have occurred soon after connectivity was restored.

We only found 1 active beaver colony below the Alaska Railroad bridge and found no evidence to indicate more colonies have become established in lower river area in recent years.

Established beaver colonies are usually composed of a pair of breeding adults, last year's pups, and pups of the year (Shepherd and Golden 2008). Unfortunately, neither the ground-based observations in this study nor the camera-trap study (Task 5) provided adequate data on colony sizes. We do know, however, that the upper river colony was composed of just 2 beavers, indicative of a newly established colony. Beavers mate in the winter and give birth to an average of 2–4 kits each spring (Shepherd and Golden 2008). The young typically stay with their parents for 2 years, although they occasionally disperse at 1 or 3 years. There are, therefore, typically 3 generations within a colony for much of the year (Shepherd and Golden 2008, Sun et al. 2011), with an average of 5.6 beavers per colony observed in other studies (McTaggart and Nelson 2003). A single colony can produce a surplus of young that will likely disperse each year.

In Allegany State Park, New York, beaver females and males dispersed an average of 2.2 mi (SE 0.5 mi) and 6.3 mi (SE 1.5 mi), respectively (Sun et al. 2011). In Illinois, 95% of linear home range lengths were 2.2 mi for beavers in rivers and 1.1 mi for beavers in smaller streams (Havens et al. 2013), while in eastern Oregon, 95% of linear home ranges were 1.0 mi (Maenhout 2013). However, along the Susitna River upstream of Talkeetna, numerous active lodges were located within 0.3 mi of one-another, sometimes within 656 ft of one-another (ABR 2014c). The pond complex and river braids downstream of the Alaska Railroad bridge in the Eklutna River drainage is ~0.6 mi across at the widest point, and the existing beaver colony is roughly in the center of this area. The Glenn Highway bridge is ~0.8 mi upstream of the lower river beaver lodge. While it is possible that more colonies could be present below the canyon in the future, we found no evidence that another colony has recently occupied the area. However, much of the middle and upper river could still be suitable for colonization. Given how rapidly colonization of the Eklutna River above the canyon appeared to occur after the Lower Eklutna River Dam was removed, it is likely that colonization events will continue.

Depending on where and how future beaver dams are constructed, beaver dams could provide additional juvenile salmon rearing habitat and/or they could become barriers to adult salmon migrations. Beaver ponds adjacent to the main channels of salmon spawning streams are often highly productive juvenile salmon rearing habitat (Malison et al. 2015, Murphy et al. 1989). But large dams may act as barriers to migrating adult salmon (Malison et al. 2016). The Year 1 Fish Species Composition and Distribution Study found Chinook, Coho, Sockeye, and Chum salmon juveniles using the lower river beaver ponds and found this area to be important to rearing salmonids in the lower Eklutna River (Thompson and Trim 2022). In contrast, the middle river colony and its multiple tall dams (~ 6 ft) may represent a barrier to adult salmon, though juveniles may be able to navigate them.

It is unlikely that the middle and upper river dams will remain intact each year. Aside from AWWU personnel periodically removing dams and colonies that restrict their operations, high-water events are likely to cause dam failures. Between 1965 (after the current dam was built) and 2019, there were 9 high-flow events during which lake water overtopped the Eklutna Lake Dam spillway, and during this period flows ranged from 85–1,022 cfs (MJA 2020). Study flow releases for the Project in 2021 (25, 75, and 150 cfs) caused the middle river colony dam to fail (see above). Therefore, unless spill events can be avoided, it is very likely that some or all of the dams within or above the canyon will be periodically blown-out. While colonies can survive the destruction of their dams as long as the beavers are not killed, as was observed at the middle river colony in 2021, it will result in an ever-changing hydrological and biological system. If high-water events are frequent or average flows of the Eklutna River are too high, beavers may only occupy off-channel habitats (if available), which would provide an uninterrupted migratory path for adult salmon and high-quality rearing habitat for juveniles.

6.4. Task 4: Moose Browse Survey

The estimated mean browse removal rate of 22% calculated in this study is consistent with a stable or increasing moose population (Boertje et al. 2007), which can exhibit twinning rates of ~20–50% (Seaton et al. 2011). Browse removal rates of ~40% or higher are associated with low twinning rates (<15%) and decreasing populations, as population numbers are over the carrying capacity of the habitat (Boertje et al. 2007, Seaton et al. 2011). The highest browsing pressure in this study was on willows of various species, the preferred moose browse taxa in Alaska (Risenhoover 1989, Welch et al. 2015). There was only moderate browsing pressure on high-bush cranberry and red-osier dogwood, and relatively little browsing pressure on birch and poplar. Mid- and early-successional poplar was abundant along the AWWU pipeline corridor, but little of it was browsed. Birch and poplar constituted a relatively large component of the winter diet of a high-density moose population on nearby Joint Base Elmendorf-Richardson (Welch et al. 2015). The relative lack of use of those forage species in the Eklutna River drainage suggests there was adequate preferred willow browse to support the moose population in the Project area during the winter of 2021–2022.

A moderate proportion of birch plants in the Eklutna study area had broomed architecture, whereas the current year browsing pressure appeared to be low. This may indicate that the local moose population and browsing pressure was higher in recent years. There was evidence of bark stripping in the study area as well, primarily on willow, and to a lesser extent, on poplar. Bark stripping often occurs at the end of winter (Renecker and Hudson 1992) when the abundance of preferred browse has been reduced and is often considered to be a sign of nutritional stress (Miquele and Van Ballenberghe 1989). Tree and shrub bark, however, may be a relatively nutritious and abundant diet item in the spring when xylem begins flowing again (MacCracken et al. 1997, White 2019).

When generating randomly located plots for sampling, we inaccurately assumed that shrub scrub wetlands near the coast would be dominated by sweetgale (*Myrica gale*) and other non-preferred shrub species and would receive little moose browse. However, while sampling we noticed abundant diamond-leaf and other willow species in the transition zone between forest and coastal marsh habitats (mapped as Brackish Deciduous Shrub Scrub in the Wetland and Wildlife Habitat Study). Most willows in this area were heavily broomed indicating heavy removal rates occurred during the winter prior to sampling. Diamond-leaf willow twigs are typically small with low biomass, so including this area in our sampling would have been unlikely to substantially increase our mean browse biomass removal estimate for the full study area. While this coastal habitat is likely important and heavily used by moose in the winter, overall, shrub habitat in the Eklutna River drainage experienced only low to moderate browsing pressure during the 2021–2022 winter.

Comparison of imagery in the study area from 1950 to 2022 indicates several habitat changes that are likely to have affected moose populations (see the Wetland and Wildlife Habitat Study). The gravel extraction operation downstream of the Alaska Railroad, which occurred in the 1970s and 1980s (MJA 2020), removed the overburden and recontoured the ground surface into a series of depressions and mounds. These depressions and mounds have since revegetated and become a complex of wetlands and upland low and tall alder-willow shrub habitats, creating abundant high-quality moose browse. However, this area is experiencing continued plant succession and some of the shrub habitats, particularly in undisturbed portions of the previously braided estuary, have grown too tall and some of the new stem growth is above the maximum browsing height for moose. The flooded forest between the Glenn Highway and Alaska Railroad is a result of aggradation of alluvial material upstream of the railroad. This region used to be a braided outwash plain with abundant riparian habitat. The surface material is now higher than the groundwater level and combined surface and groundwater flooding events have been reduced. As a result of the better drainage, this community is now transitioning to a poplar forest. Currently, there are abundant tall willows and poplar trees in the flooded forest, and many of the trees have grown above the maximum browsing height for moose.

The middle and upper river in 1950 had more abundant seasonally flooded low and tall alder-willow shrub habitats, providing abundant moose browse. With the reduced flows as a result of the construction of the Eklutna Lake Dam and the water diversions, the river no longer has the landscape-altering force it once did, flooding and meandering, and creating abundant riparian shrub habitat, which provides abundant preferred moose browse. The completion of the AWWU water pipeline project in the upper and middle river in 1988 (MJA 2020) created a corridor of well-drained gravel (the access road and pipeline corridor). The riparian willow-dominated habitats that previously occurred in this area are now transitioning to lower quality browse composed of well-drained upland poplar and spruce forests.

6.5. Task 5: Opportunistic Observations and Camera Traps

We identified numerous wildlife species occurring in the area during the camera trap study. Moose were the most frequently photographed terrestrial wildlife species, followed by black bears, brown bears, and coyotes. High quality moose habitat was concentrated throughout the study area along the AWWU access road, upper and middle Eklutna River, flooded forest, and coastal shrublands, but the lands downstream of the Glenn Highway have more acres of habitat with abundant preferred moose browse. Moose were more commonly photographed near the coast, and a bull moose and a harem of at least 5 cows was photographed near the coast in September, indicating this area may be used as a rutting area.

Our estimated browse removal rate (22%, Task 4) was similar to other moose populations with twinning rates of ~20–50% (Seaton et al. 2011), however we only recorded a single photograph of a cow moose with twins. It would have been challenging to detect calves in dense vegetation at a distance in time-lapse photographs, but there were numerous time-lapse photo series with cow moose with and without a calf. This discrepancy between the predicted twinning rate based on available moose browse and the low number of twins photographed could be explained by a high predation rates of moose calves. Twinning rates are measured as the ratio of parturient moose with twins:parturient moose with singletons at the time of birth, and are unaffected by calf mortality rates after birth. Bears are effective predators of moose calves and both bear species were common throughout the study area. On one camera, a cow with a < 2-week-old calf walked past a motion-sensor camera heading downstream on the Eklutna River; 6 minutes later, a sow brown bear with 2 cubs walked down the AWWU access road, intercepted the moose path, and turned to follow the moose downstream.

Brown bears prefer open habitats like alpine tundra and coastal marshes while black bears prefer forested habitats (MacDonald and Cook 2009), and these patterns were reflected in our camera-trap results. Black bears were more common along the river corridor, while brown bears were more common near the coast. We photographed brown and black bears with 1–2 cubs and at least 1 sow black bear with 3 cubs numerous times. We also observed a sow brown bear with 3 cubs in the upper river during the aerial raptor survey, indicating this area is productive habitat for bears.

Coyote and red fox are generalist species that tend to occur more commonly where small prey are abundant. While coyotes were photographed throughout the study area, they may have been more common closer to the coast, particularly in the flooded forest which was the only camera to capture >2 photographs of coyotes. A coyote was also observed in the coastal area during a spring shorebird and waterfowl survey. The only two red foxes photographed were also in the flooded forest. Only a single lynx was photographed. Lynx populations cycle with the 10-year snowshoe hare population cycle, though lagging one year behind. Snowshoe hare populations in southcentral Alaska peaked in 2020/2021 and appear to have crashed in 2021/2022 (Merizon and Carroll 2022), which may explain why we only photographed 2 hares. The previous Lynx population high in southcentral was 2012/2013 (Smith 2022), so we would expect Lynx populations to have remained high through 2022. However, Lynx populations in Game Management Unit 14C (GMU 14C), which includes Anchorage and Eklutna, have been crashing over the past year (D. Battle, personal communication). Snowshoe hare populations in GMU 14C could be slightly out of sync with the rest of southcentral Alaska and thus both populations crashed 1 year earlier, or the Eklutna River drainage may not contain preferred lynx habitat. Only a single wolf was photographed during this study. The photograph was taken at the upper beaver colony in the spring when the pond was still frozen. According to ADFG, there is at least one wolf pack that uses the greater Eklutna Lake area based on track sightings, but it is unclear how much of the Project area is used by the pack or if multiple packs use the area (D. Battle, personal communication). Based on our limited results, it did not appear that the Eklutna River drainage was an important component of any wolf-pack home range from April–November 2022.

We did not photograph any wolverine, river otter, mink, marten, ermine, least weasels, or muskrat. Wolverine naturally occur at low densities (Smith 2022), have large home ranges, and prefer alpine habitats in the summer. The population status of the remaining species in unit 14C is largely unknown (Smith 2022). The smaller weasel species could possibly be too small to trigger the cameras as we recorded no photographs of red squirrels or birds with the motion-sensor cameras (only time-lapse). River otters and mink both require healthy populations of fish for prey. The lower river supports juvenile and adult salmon, eulachon, dolly varden, and smaller fish like stickleback and sculpin, but above the canyon, only dolly varden were present during sampling in 2021 (Thompson and Trim 2022). Therefore, there may not be enough food in the system to support large populations of these piscivorous mustelids. Muskrat are known to occur in coastal wetlands in GMU 14C (Smith 2022) and are likely present in the study area, but were not observed on camera-traps.

The motion-sensing and time-lapse cameras were used in different locations to collect different types of data. The time-lapse cameras near the coast had large viewsheds and took photographs at regular intervals, which resulted in more sampling both spatially and temporally. Motion-sensor cameras can only detect motion within ~98 ft of the camera and are better suited near travel corridors with smaller viewsheds. Sampling bias is exacerbated by the size of the animal. Time-lapse photographs near the coast are effective at capturing photographs of large, conspicuous animals like moose and bears. This could explain why we photographed more moose near the coast. However, within camera types, black bears were consistently photographed more often than brown bears by motion sensor cameras in the middle and upper river while black bear and brown bear were nearly equally observed in the lower river by both motion-sensor and time-lapse cameras. Smaller species like fox, snowshoe hare, and possibly moose calves, lynx, and coyotes, are more likely to be obscured by tall vegetation in time-lapse photographs.

At the middle river colony, beavers were photographed nearly 7 and 13 times more often in the first photo session compared to the second period and third period, respectively; therefore they appeared to be present more frequently even after accounting for 1 vs 5 minutes photograph intervals during the different sessions. By late summer, the uppermost and newest dam in this complex of 6 active dams was flooding a new portion of the AWWU access road. At the upper colony, AWWU personnel excavated an approximately 6-foot-wide hole in the dam with heavy machinery on 17 June to drain the beaver pond and allow passage of AWWU inspection vehicles (Appendix 3: Figure A.3-16). Within 30 minutes of AWWU personnel finishing their inspections and leaving the site, 2 adult beavers were visible in photographs repairing the dam. The dam was almost completely rebuilt by the next morning. The beavers and the dam were permanently removed a few weeks later.

Two suspected travel corridors, the Eklutna River Canyon and the riverine habitats under the Glenn Highway bridge, had average or below average wildlife activity levels based on photographs at those 2 cameras. The canyon camera detected only 2 observations of moose and a single observation of a brown bear with a cub. We deployed this camera in a location where a game and recreational trail is funneled into the river near a cliff, a location that was expected to be well positioned to photograph wildlife traversing the corridor. In an infrared night series of photographs, , , the brown bear sow can be seen walking along the shore but a cub appeared to be getting swept downstream by the river. While it is possible wildlife, particularly smaller wildlife, may have been traveling on the other side of the river to avoid a deep river crossing, moose are less likely to be affected by the deeper water. Numerous people were photographed by this camera, so it appeared to be in a good location to capture wildlife traveling up and down the canyon. It is therefore possible that moose and other animals do not use the canyon as a major travel corridor.

The camera under the Glenn Highway bridge recorded more photographs of moose than the camera in the canyon but the level of wildlife activity at that camera was similar to the remaining motion-sensor cameras in the flooded forest and middle and upper river. This camera was placed on a cottonwood tree on the shore of the Eklutna River looking upstream from the bridge at a 45 degree angle, with ~15 feet of shoreline between the camera and the bridge where wildlife could walk to get under the overpass. Unfortunately, there were limited suitable trees to attach and lock the camera to; therefore, it is quite likely that some wildlife crossed under the bridge without being photographed. However, the overpass may not be a major funnel for wildlife, at least no more so than the AWWU access road and upper Eklutna River channel. Habitat around the Glenn Highway bridge is higher value for moose than in the canyon and similar to that in the flooded forest and along the upper Eklutna River.

6.6. Task 6: Wildlife Habitat Evaluation

The results of this study provide a basis to assess impacts on the habitats important to those bird and mammal species that are known or expected to occur regularly in the study area. By evaluating changes to habitats ranked as high and moderate value, we can quantitatively assess habitat loss or alteration effects for each bird and mammal species expected to use the available habitats in the study area. To meet the stipulations in the 1991 Fish and Wildlife Agreement for the Project, this study, in conjunction with the Wetlands and Wildlife Habitat Study, provides a method to make a determination of the likely historical impacts of the current hydroelectric project on wildlife in the Eklutna River drainage.

The mapping of historical (1950) wildlife habitats in the Wetlands and Wildlife Habitat Study indicates that prior to the construction of the upper dam and water diversion for the hydroelectric Project in 1959, riparian habitats were more extensive in the Eklutna River drainage. This was especially true in the middle and upper reaches of the river where Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub covered approximately 151 acres in the August 1950 aerial photographs compared to approximately 47 acres in the May 2022 imagery. This change is almost certainly due to the dewatering of the river and the reduction in peak flood flow events, which ranged from 1,420 to 2,530 cfs between 1947 and 1954 and began to drop in 1955 after construction of the earthen dam at the outlet of Eklutna Lake; peak flow then dropped substantially to 162 cfs in 1959 after the Goat Mountain diversion tunnel began operation (USGS 2022). The operation of the connected AWWU waterline project starting in 1988 would not have resulted in additional reductions in peak flows because the waterline project involves only a pipeline branching off the main Goat Mountain diversion tunnel (i.e., the same volume of lake water is diverted for both the hydroelectric and waterline projects). The AWWU pipeline accounts for approximately 10% of the diverted lake water and the remaining 90% is used for hydroelectric power generation (MJA 2020).

The substantial historical overbank flows in the Eklutna River, which could have occurred twice or more annually (with the spring snowmelt and late summer/fall rains), apparently were enough to maintain riparian areas along the river in an early to mid-successional shrub phase. The extent of riparian shrub habitat in 1950 may also be underestimated because in the August 1950 aerial photography, the typical late summer fall rains in southcentral Alaska could have resulted in increased river flow covering and obscuring some riparian shrubs. Note that both Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub and Upper Perennial River were substantially greater in extent in the 1950 habitat map (see the Wetlands and Wildlife Habitat Study report). As noted in the Wetlands and Wildlife Habitat Study, many of the areas historically covered by Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub are now transitioning to more well-drained deciduous and spruce forest habitats.

This habitat change indicates that those species that rely on Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub during important stages in their life histories (e.g., foraging, breeding, overwintering) would have had at least 104 acres more habitat available to them historically. It follows that local population numbers of those species would also have been greater historically prior to the construction and operation of the current Project. A set of 27 bird and mammal species that were ranked as high value for Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub in this study (Table 6.6-1) could have been most affected. However, the habitat generalist species in this group that can also use deciduous and spruce forest habitats, may have been unaffected.

For example, within the group of 27 species ranked as high value for Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub, 8 species are known to be flexible in their habitat preferences and were also ranked as high value for Mixed Deciduous-Spruce Forest (Table 6.6-1). These 8 species therefore are unlikely to have experienced negative effects from the reduction in acreage of Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub.

This leaves a group of 19 species that could have been most negatively affected by this habitat change (Table 6.6-1). Landbirds are the species group most likely to have been negatively affected because all of the 11 species ranked as high value for Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub (and not ranked as high value for Mixed Deciduous-Spruce Forest) are known to use riparian shrub habitats for nesting and rearing their young. Other species likely to have been negatively affected include moose, which strongly favor early and mid-successional shrub habitats. In these historically riverine-influenced areas, the transition to upland deciduous forest habitat means the new stem growth on many shrub and tree species now likely occurs above the maximum browsing height for moose (see Section 6.4 above). Various prey and predator mammal species, including snowshoe hare, coyote, and brown bears also were likely affected by this change in habitat availability from shrub-dominated riparian areas (with good cover for snowshoe hares, for example) to more open upland deciduous and spruce forest.

On the other hand, wildlife species that prefer more mature forest habitats likely have experienced positive effects of the expansion in upland deciduous and spruce forests in the Eklutna River drainage. A group of 31 species ranked as high value for Mixed Deciduous-Spruce Forest (and not ranked as high value for Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub) likely have benefited from expansion of this forest habitat in the river drainage. This group includes typical forest-dwelling species such as grouse, hawks, owls, woodpeckers, a diversity of forest landbird species, furbearers, and small mammals (Table 6.6-1). Overall, however, upland deciduous and spruce forests are quite common in southcentral Alaska, whereas riparian habitats because of their narrow, linear nature represent much smaller portions of the landscape. Because riparian areas are less common, they are widely recognized as being important to wildlife that depend on them for foraging, breeding, overwintering, and as travel corridors.

Table 6.6-1. Wildlife species in the Eklutna River drainage expected to have been negatively or positively affected or unaffected by a reduction in the extent of Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub and an increase in the extent of Mixed Deciduous-Spruce Forest, and at Eklutna Lake by an increase in the extent of Intermittently Exposed Freshwater Littoral Zone.

		Habitat-Value Ranking and Effects Direction		
Species Group [a]	**Common Name**	**Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub**	**Mixed Deciduous-Spruce Forest**	**Intermittently Exposed Freshwater Littoral Zone**
Amphibian	Wood frog	- [b]	-	high, positive
Shorebird	Wilson's snipe	-	-	high, positive
Shorebird	Lesser yellowlegs	-	-	high, positive
Shorebird	Greater yellowlegs	-	-	high, positive
Seabird	Bonaparte's gull	-	high, positive	-
Seabird	Short-billed gull	-	high, positive	-
Raptor	Sharp-shinned hawk	-	high, positive	-
Raptor	Northern goshawk	-	high, positive	-
Raptor	Bald eagle	-	high, positive	-
Raptor	Great horned owl	-	high, positive	-
Raptor	Northern hawk owl	-	high, positive	-
Landbird	Ruffed grouse	-	high, positive	-
Landbird	Spruce grouse	-	high, positive	-
Landbird	Belted kingfisher	-	-	high, positive
Landbird	Downy woodpecker	-	high, positive	-
Landbird	Hairy woodpecker	-	high, positive	-
Landbird	Alder flycatcher	high, no change	high, no change	-
Landbird	Northern shrike	high, negative	-	-
Landbird	Canada jay	-	high, positive	-
Landbird	Black-billed magpie	high, negative	-	-
Landbird	Common raven	-	-	high, positive
Landbird	Black-capped chickadee	-	high, positive	-
Landbird	Boreal chickadee	-	high, positive	
Landbird	Ruby-crowned kinglet	-	high, positive	
Landbird	Golden-crowned kinglet	-	high, positive	-
Landbird	Red-breasted nuthatch	-	high, positive	-
Landbird	Brown creeper	-	high, positive	-
Landbird	Gray-cheeked thrush	high, negative	-	-
Landbird	Swainson's thrush	-	high, positive	-
Landbird	Hermit thrush	high, negative	-	-

Table 6.6-1. Continued.

Species Group	Common Name	Habitat-Value Ranking and Effects Direction		
		Seasonally Flooded Low and Tall Alder-Willow Shrub Scrub	Mixed Deciduous-Spruce Forest	Intermittently Exposed Freshwater Littoral Zone
Landbird	American robin	-	high, positive	-
Landbird	Varied thrush	-	high, positive	-
Landbird	Pine grosbeak	-	high, positive	-
Landbird	Common redpoll	high, no change	high, no change	-
Landbird	Pine siskin	-	high, positive	-
Landbird	Fox sparrow	high, no change	high, no change	-
Landbird	Dark-eyed junco	-	high, positive	-
Landbird	White-crowned sparrow	high, negative	-	-
Landbird	Golden-crowned sparrow	high, negative	-	-
Landbird	Lincoln's sparrow	high, negative	-	-
Landbird	Northern waterthrush	high, negative	-	-
Landbird	Orange-crowned warbler	high, negative	-	-
Landbird	Yellow warbler	high, negative	-	-
Landbird	Blackpoll warbler	high, negative	-	-
Landbird	Yellow-rumped warbler	-	high, positive	-
Landbird	Townsend's warbler	-	high, positive	-
Landbird	Wilson's warbler	high, no change	high, no change	-
Furbearer	Beaver	high, negative	-	-
Furbearer	Lynx	high, no change	high, no change	-
Furbearer	Coyote	high, negative	-	-
Furbearer	Red Fox	high, no change	high, no change	-
Furbearer	American marten	-	high, positive	-
Furbearer	Mink	high, negative	-	-
Small Mammal	American red squirrel	-	high, positive	-
Small Mammal	Northern flying squirrel	-	high, positive	-
Small Mammal	Porcupine	-	high, positive	-
Small Mammal	Snowshoe hare	high, negative	-	-
Small Mammal	Cinereus shrew	high, no change	high, no change	-
Small Mammal	Dusky shrew	high, negative	-	-
Small Mammal	Western water shrew	high, negative	-	-
Small Mammal	Little brown bat	-	high, positive	-
Large Carnivore	Black bear	high, no change	high, no change	-
Large Carnivore	Brown bear	high, negative	-	-
Large mammal	Moose	high, negative	-	-

[a] Species are listed in phylogenetic order within each species group.
[b] Dash indicates a moderate, low, or negligible habitat-value ranking.

Comparison of the historical and current habitat mapping in the study area also indicates that fluctuations in the level of Eklutna Lake throughout the year, as a result of water diversion from the lake, have exposed a substantial littoral zone at the mouth of the lake, which was far smaller in extent in 1950. In the Wetlands and Wildlife Habitat Study, this area is mapped as Intermittently Exposed Freshwater Littoral Zone, which reflects that fact that the area is gradually exposed over the winter as lake levels drop, and gradually inundated in late summer and fall as lake levels rise with the increased precipitation and glacial meltwater input. This lacustrine littoral zone habitat encompassed approximately 13 acres in August 1950 and in May 2022 it covered approximately 114 acres. The acquisition of the aerial photography in late summer 1950, however, suggests that the extent of this littoral zone habitat was likely greater than the 13 acres indicated in the August 1950 photographs because of the natural increase in lake levels over the summer that would inundate this habitat.

The change in extent of this seasonally available lacustrine shoreline habitat from historical conditions indicates that those species expected to regularly use the habitat could have up to 101 acres more of this habitat available to them today compared to 1950. The 6 species most likely to have benefited from this habitat change (ranked as high value for Intermittently Exposed Freshwater Littoral Zone in this study) are wood frog, Wilson's snipe, lesser yellowlegs, greater yellowlegs, belted kingfisher, and common raven (Table 6.6-1). Because of the lack of vegetation structure and cover, this habitat will primarily be used as a foraging area for this group of species. However, the proximity of the area to the Eklutna Lake Campground means disturbance from human activities is likely to be common throughout the summer, and this will limit use of the area by wildlife.

7 VARIANCES FROM FINAL STUDY PLAN

The terrestrial wildlife studies were completed as described in the Year 2 Proposed Final Study Plans (MJA 2022). with the exception of the following variances for the Camera Traps and Opportunistic Observations study.

The study plan called for cameras to be installed in spring, retrieved in late November and checked 4 times (at least every 45 days). Cameras were deployed and retrieved as planned; 5 of the cameras were installed in April, 7 were installed on 9–10 May, and all 12 cameras were retrieved on 21–22 November. However, due to logistical constraints, camera checks were less frequent than planned. Nine cameras were checked 3 times instead of 4 times and 3 cameras were only checked twice due to accessibility issues along the AWWU access road. The average length of deployment was 55 days, but between April and late August, the average deployment was 43 days and then cameras were deployed from 26–27 August to 21–22 November during which time 4 cameras stopped functioning, likely due to battery failures associated with cold weather. As expected, some cameras also failed to record usable photographs during some periods as a result of being moved by bears or camera malfunctions. Overall, cameras functioned properly for 90% of camera-days. Rather than record videos with the motion-sensing cameras, to save memory and preserve battery life, we recorded 10 photos in quick succession each time the motion-sensor was activated. The camera-trap photographs taken during this study were adequate to achieve the objectives regarding recording wildlife use of the Project area from spring to early winter 2022.

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Appendix 1: Photos of raptor nests located during aerial surveys for the Eklutna Hydroelectric Project, 9 May 2022

Figure A.1-1. Bald eagle nest EH001BAEA, close-up.

Figure A.1-2. Bald eagle nest EH001BAEA, wide angle.

Figure A.1-3. Bald eagle nest EH002BAEA, close up.

Figure A.1-4. Bald eagle nest EH002BAEA, wide angle.

Figure A.1-5. Bald eagle nest EH003BAEA, close up.

Figure A.1-6. Bald eagle nest EH003BAEA, wide angle.

Figure A.1-7. Bald eagle nest EH004BAEA, close up.

Figure A.1-8. Bald eagle nest EH004BAEA, wide angle.

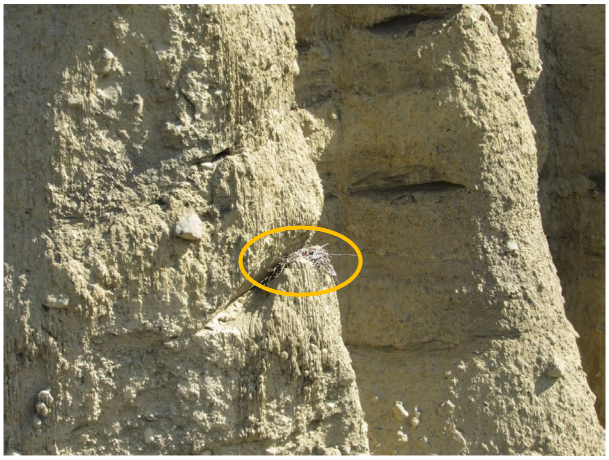

Figure A.1-9. Common raven nest EH001CORA, close up.

Figure A.1-10. Common raven nest EH001CORA, wide angle.

Figure A.1-11. Unidentified raptor nest EH001XRAP, close up.

Figure A.1-12. Unidentified raptor nest EH001XRAP, wide angle.

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Appendix 2: Photos of beaver lodges and dams taken during aerial colony surveys for the Eklutna Hydroelectric Project, 10 October 2022

Figure A.2-1. Active Lodge-01 (right) with fresh food cache built next to Inactive Lodge-02 (left) in the lower Eklutna River area.

Figure A2-2. Active Dam-01 in the lower Eklutna River area (lower right). Active Lodge-01 with cache and Inactive Lodge-02 are visible in lower left.

Figure A.2-3. Active Dam-02 in the lower Eklutna River area (middle left). This dam could be considered a continuation of Dam-01.

Figure A.2-4. Active Dam-03 in the lower Eklutna River area (middle). Dam-04 is just off-photo to the right.

Figure A.2-5. Active Dam-04 in the lower Eklutna River area (middle). Dam-03 is just off-photo to the left.

Figure A.2-6. Inactive Dam-05 in the middle Eklutna River drainage just upstream of the canyon and near the lower AWWU access road.

Figure A.2-7. Active Lodge-03 in the middle river beaver colony. No food cache was visible in the silty water, but fresh tree cuttings were abundant.

Figure A.2-8. Inactive Dam-06 in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-9. Active Dam-07 in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-10. Active Dam-08 in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-11. Active Dam-09 in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-12. Active Dam-10 (bottom) and Dam-11 (top) in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-13. Active Dam-12 in the middle Eklutna River area. This dam is part of the middle river colony complex.

Figure A.2-14. Inactive Lodge-04 in the upper river colony. Beavers from this colony were trapped and removed by the Alaska Department of Fish and Game and the dam was removed with heavy machinery.

Figure A.2-15. Removed Dam-13 in the upper Eklutna River area.

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Appendix 3: Example photos from individual camera-trap locations, Eklutna Hydroelectric Project, 2022

Figure A.3-1. View of a sow black bear with 3 cubs from MS01 in the upper river.

Figure A.3-2. View of a sow brown bear with 2 cubs from MS01 in the upper river.

Figure A.3-3. View of a black bear with a cub from MS02 in the middle river tilting the camera towards the ground.

Figure A.3-4. View of a lynx (yellow circle) from MS02 in the middle river.

Figure A.3-5. View of a large bull moose from MS03 in the middle river.

Figure A.3-6. View of a brown bear from MS04 in the middle river.

Figure A.3-7. View of project researchers and a bear guard from MS05 in the Eklutna River canyon.

Figure A.3-8. View of a cow moose from MS06 looking upstream from under the Glenn Highway bridge.

Figure A.3-9. View of a coyote from MS07 in the flooded forest.

Figure A.3-10. View of a red fox from MS07 in the flooded forest.

Figure A.3-11. View of a beaver from TL01 in the middle river.

Figure A.3-12. View of a wolf (yellow circle) from TL02 in the upper river.

Figure A.3-13. View of a cow moose with twins from TL03 on a coastal pond.

Figure A.3-14. View of a group of moose from TL04 on a coastal sedge marsh.

Figure A.3-15. View of a moose from TL05 on a coastal wetland.

Figure A.3-16. Photograph series documenting the mechanical breaching of a beaver dam and the nearly complete repair by the following day.

Appendix 4: Miscellaneous bird group observations during the camera-trap study for the Eklutna Hydroelectric Project, 16 April–25 May 2022.

Camera	American Robin	American Widgeon	Bald Eagle	Black-billed Magpie	Canada Goose	Canada Jay	Dark-eyed Junco	Mallard	Northern Goshawk	Northern Harrier	Northern Shoveler	Rusty Blackbird	Sandhill Crane	Tree Swallow	Unknown Blackbird	Unknown Goose	Unknown Gull	Unknown Raptor	Unknown Shorebird	Unknown Songbird	Unknown Swan	Unknown Waterfowl	Varied Thrush
TL02			1																				
TL03		3			1			2					5			1	1	1				7	
TL04	3		2	2							1		4					2	1	1			
TL05	1		1						1	1		1	3	2	1				2	3	2	4	
MS01																						1	
MS04	1					1	7													5			1