PEBBLE PROJECT
ENVIRONMENTAL BASELINE DOCUMENT
2004 through 2008

CHAPTER 17.
THREATENED AND ENDANGERED SPECIES
AND
SPECIES OF CONSERVATION CONCERN
Bristol Bay Drainages

PREPARED BY:
ABR, INC. ENVIRONMENTAL RESEARCH & SERVICES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
AKNHP	Alaska Natural Heritage Program
ASG	Alaska Shorebird Group
BBS	(North American) Breeding Bird Survey
BLM	Bureau of Land Management (U.S. Department of Interior)
BPIFWG	Boreal Partners in Flight Working Group
ESA	Endangered Species Act of 1973
NAWCP	North American Waterbird Conservation Plan
PIF	Partners in Flight
USFWS	U.S. Fish and Wildlife Service

17. THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONSERVATION CONCERN

17.1 INTRODUCTION

Information on vertebrate species of conservation concern that have been found in Pebble Project study areas in the Bristol Bay drainages region is presented in this chapter. This information is drawn from a review of wildlife survey work conducted in specific study areas in this region from 2004 to 2006 (see Section 17.3) and from a review of the scientific literature. Additionally, an analysis of the potential for a set of rare vascular plant species (tracked by the Alaska Natural Heritage Program [AKNHP]) to occur in the Bristol Bay drainages region is presented. No threatened or endangered species listed under the Endangered Species Act (ESA), or any proposed or candidate species for the ESA, is known to occur in this region. Similarly, no species listed as endangered by the State of Alaska is known to occur in the area.

For vertebrate animals, the information presented here is intended to summarize what is currently known about the conservation status of species considered of conservation concern. Other high-profile, large terrestrial mammal species (bears [*Ursus* spp.], moose [*Alces alces*], and caribou [*Rangifer tarandus*]), which are of concern for subsistence, sport hunting, and ecological reasons, but currently are not of conservation concern in this part of Alaska, are not discussed. The occurrence of large terrestrial mammals in the Bristol Bay drainages region is discussed in Chapter 16, Sections 16.2 and 16.7. Similarly, another high-priority, and federally protected species (Bald Eagle, [*Haliaeetus leucocephalus*]), is not discussed here because Bald Eagles are abundant in Alaska and are not considered of conservation concern. The occurrence of Bald Eagles in the Bristol Bay drainages region is discussed in Chapter 16, Sections 16.3 and 16.9. Details on the field surveys and specific survey results for the vertebrate species of conservation concern recorded in the Bristol Bay drainages region can be found in Chapter 16: Sections 16.3 and 16.9 (raptors), 16.4 and 16.10 (waterbirds), 16.5 and 16.11 (landbirds and shorebirds), 16.12 (wood frogs), and 16.8 (harbor seals in Iliamna Lake). For vascular plants, no specific surveys for rare species have been conducted in the Bristol Bay drainages region.

17.2 STUDY OBJECTIVES

This chapter largely represents a review of existing information. For plants, the objective was to determine which rare vascular taxa have a reasonable probability of occurring in the Bristol Bay drainages study areas, based on known ranges of the plants, their habitat associations, and the habitats available in the study areas. For vertebrate animals, the objective was to briefly summarize occurrence and conservation-status information for the species of conservation concern found in Pebble Project study areas in the Bristol Bay drainages region.

17.3 STUDY AREA

In other chapters for which field studies were conducted on the occurrence of biological resources, the mine study area and the transportation corridor, Bristol Bay drainages study area were usually addressed separately . In this chapter, however, to minimize duplication of information, the information on potential rare plant occurrence and background information on vertebrate species of conservation concern is combined into one chapter for those watersheds that eventually drain into Bristol Bay. Information on rare plants, vertebrate species of conservation concern, and threatened and endangered species in the Cook Inlet drainages area is presented in Chapter 45.

For this chapter, the area of evaluation for vertebrate species encompasses all the study areas used during field surveys for wildlife within the Bristol Bay drainages region from 2004 to 2006. Different specific study areas were used for field surveys in the area surrounding the Pebble Deposit and in the transportation corridor, Bristol Bay drainages area depending on the focus of the surveys. The wildlife study areas used are described in Chapter 16: for terrestrial mammals in Sections 16.2 and 16.7, for raptors in Sections 16.3, and 16.9, for waterbirds in Sections 16.4, and 16.10, for breeding landbirds and shorebirds in Sections 16.5 and 16.11, for wood frogs in Section 16.12, and for harbor seals in Lake Iliamna in Section 16.8. These study areas all encompass streams and rivers and lakes that flow westward and eventually drain into Bristol Bay.

For the evaluation of the potential occurrence of rare vascular plants, the study area used encompasses all plant habitats within a radius of 161 kilometers (100 miles) from the midpoint between the Pebble Deposit and the coastline of Cook Inlet at Iniskin Bay (see Section 17.6.1).

17.4 PREVIOUS STUDIES

A large number of biological studies have been conducted in a broad region surrounding the Bristol Bay drainages study areas and provide information on the vertebrate species of conservation concern discussed in this chapter. This information (too lengthy to discuss here) can be found in Chapter 16 in the sections for raptors (16.3 and 16.9), waterbirds (16.4 and 16.10), landbirds and shorebirds (16.5 and 16.9), wood frogs (16.12), and harbor seals in Iliamna Lake (16.8).

17.5 SCOPE OF WORK

Charles T. Schick, Wendy A. Davis, and Brian E. Lawhead of ABR, Inc., Anchorage and Fairbanks, Alaska conducted this study. This work included the following activities:

- A survey of existing information on distribution and habitat associations to determine which of the rarer vascular plant species in Alaska have the potential to occur the Bristol Bay drainages study areas.
- A review of Pebble Project field survey data to determine the presence or absence of vertebrate animal species of conservation concern in the Bristol Bay drainages study areas.
- A literature review to determine the conservation status of the vertebrate animal species recorded in the Bristol Bay drainages study areas.

17.6 METHODS

17.6.1 VASCULAR PLANTS

To compile a list of rare vascular plants that have a reasonable potential to occur within the Bristol Bay drainages study areas, researchers first submitted a formal data request to the AKNHP. The AKNHP maintains a database with collection-locality and habitat information for the rare and endemic plants that occur in Alaska. These rare plants are noted on the AKNHP *Vascular Plant Tracking List*, which included 363 plant taxa at the time of this rare plant assessment (AKNHP, 2006a). Each of the 363 taxa is assigned a global and state rarity ranking, which is derived from information prepared by the Conservation of Arctic Flora and Fauna (CAFF) program and a network of other worldwide conservation programs. The definitions of the rarity rankings used are presented in Table 17-1.

In the data request to the AKNHP, researchers requested information only on the rarer taxa, those with state ranks of S1, S2, S1S2, or S2S3 (the S1 and S1S2 ranks are listed as critically imperiled and the S2 and S2S3 ranks are listed as imperiled; Table 17-1). A broad search area for records of rare plants was defined for the data request, using a radius of 161 kilometers (100 miles) from the midpoint between the Pebble Deposit and the coastline of Cook Inlet at Iniskin Bay. This search area encompassed the three Pebble Project study areas in which wildlife habitat mapping studies in terrestrial and freshwater habitats were conducted (the mine study area; the transportation-corridor, Bristol Bay drainages study area; and the Cook Inlet drainages study area; see Chapter 16 [Sections 16.1 and 16.6] and Chapter 41 [Section 41.1]). This search area was large enough to include portions of both Lake Clark and Katmai national parks and preserves as well as a small portion of the Kenai Peninsula on the eastern side of Cook Inlet (Figure 17-1). Researchers specifically asked for a listing of all the rarer vascular plant taxa with known collection localities within this search area (these taxa were considered to have some potential of occurring in the Bristol Bay drainages study areas). The habitats in which these taxa typically occur (Table 17-2) were compared with the habitats that actually are available in the Bristol Bay drainages study areas to assess more accurately the potential for these species to occur in the study areas.

17.6.2 VERTEBRATE ANIMALS

Methods to determine which species of conservation concern occur in the Bristol Bay drainages study areas involved two activities: a review of field survey data and a literature review. The field surveys were part of the wildlife survey program for the Pebble Project (see Chapter 16 for survey information on terrestrial mammals, raptors, waterbirds, shorebirds, landbirds, and wood frogs, and for harbor seals in Iliamna Lake). The literature review was used to summarize information on which species are of conservation concern and why each species is of concern.

To determine which bird species occurring in the Bristol Bay drainages study areas currently are listed as of conservation concern, researchers consulted 10 bird-conservation lists from various federal- and state-level organizations that directly address the conservation concerns for Alaskan birds. Because of the jurisdiction of U.S. federal and state agencies and organizations were considered in this study. In general, the goal in preparing these lists is not to identify those species that already are treated formally by the USFWS under the ESA, rather it is to identify species that currently may be common but for which there are concerns about the long-term viability of their populations (see below). The bird-conservation lists reviewed were those that considered Alaskan birds specifically and were published as of 2010: USFWS's

Birds of Conservation Concern (USFWS, 2008); Bureau of Land Management's *Special Status Species List for Alaska* (BLM, 2005); U.S. Forest Service's *Alaska Region Sensitive Species List* (Goldstein et al, 2009), Alaska Department of Fish and Game's *Species of Special Concern* (ADF&G, 1998) and *Comprehensive Wildlife Conservation Strategy* (ADF&G, 2006), Alaska Natural Heritage Program's *Vertebrate Species Tracking List* (AKNHP, 2008), Audubon Alaska's *Watchlist 2010* (Kirchoff and Padula, 2010), Waterbird Conservation for the America's *North American Waterbird Conservation Plan* (Kushlan et al. 2002 and 2006), Alaska Shorebird Group's *Conservation Plan for Alaska Shorebirds* (ASG, 2008), and Boreal Partners in Flight Working Group's *Landbird Conservation Plan for Alaska Biogeographic Regions* (BPIFWG, 1999).

The 10 conservation lists reviewed here variously considered several criteria related to population persistence in Alaska that included information on population trend, population size, known threats during the breeding and nonbreeding seasons, and range size and dispersion, both during breeding and nonbreeding. On some lists (e.g., ADF&G, 2006), additional species-selection criteria were used that included information on known health concerns, the incidence of mortality, endemism (to Alaska), sensitivity to disturbance, the lack of information on population status, questionable taxonomy, representativeness (for habitat use), and international importance for monitoring. Some listing groups similarly considered monitoring concerns, both globally and in the state, when selecting species (BPIFWG, 1999) and others considered specialized habitat requirements (BLM, 2005). Of the 10 lists reviewed, seven address waterfowl, eight address waterbirds (loons in this study), eight address seabirds (terns in this study), seven address raptors, eight address shorebirds, and eight address landbirds. On some of these lists, species were quantitatively ranked and categorized by conservation class (e.g., high, moderate, or low concern), while on other lists, a single category of conservation concern was used. Alaska stewardship or monitoring concerns also were considered on some lists for those cases in which a large proportion of the global population of the species resides in Alaska. For this study, in an attempt to identify those species for which there is genuine conservation concern, as opposed to stewardship concern or moderate or low conservation concern, researchers selected species of conservation concern using two criteria:

- First, the species had to be listed in the highest conservation category(ies), if applicable, within the classification system used (species of moderate or low concern were not considered). On those lists in which a single conservation class was used, however, all species of conservation concern occurring in the study area were considered.
- Second, the species had to be listed as of conservation concern on at least two of the lists that considered the various species groups addressed in this study (waterfowl, waterbirds, raptors, shorebirds, and landbirds). This criterion helped to eliminate species of moderate or low concern that only occur on a single bird-conservation list.

Additional research reports were reviewed for each bird species of conservation concern recorded in the Bristol Bay drainages study areas to provide background ecological information on the reasons for conservation concern (see Section 17.7.2).

In contrast to birds, only five conservation lists directly address lower-level conservation concerns for Alaskan mammals (i.e., outside of threatened and endangered species and those marine mammal populations listed as depleted under the Marine Mammal Protection Act [MMPA]). In addition, only four of those five lists address the conservation concerns for terrestrial mammals and only two lists address

terrestrial small mammals. The five conservation lists reviewed for mammals were those prepared by NMFS (2010) for marine mammals, and those prepared by BLM (2005), ADF&G (1998; 2006), and AKNHP (2008) for marine and terrestrial mammals. Only ADF&G (2006) and AKNHP (2008) address the conservation status of terrestrial small mammals in Alaska. Because fewer lists are available, especially for terrestrial small mammals, the protocol for selecting mammal species of conservation concern was relaxed so that, if a species occurred on any conservation list, it was included here as a species of conservation concern.

Conservation concerns for amphibians were addressed on only two conservation lists (ADF&G, 2006; AKNHP, 2008), each of which was reviewed for this study. The single species of amphibian that occurs in Alaska north of the southeastern panhandle (wood frog [*Rana sylvatica*]) was listed as of conservation concern on one of these lists (ADF&G, 2006) and was included here as a species of conservation concern.

17.7 RESULTS

17.7.1 VASCULAR PLANTS

Only one vascular plant species in Alaska, *Polystichum aleuticum*, is federally listed as threatened or endangered; this species is restricted to two islands (Adak and Atka) in the central Aleutian Island chain (USFWS, 2010).

Seventeen vascular plant taxa with S1, S2, S1S2, or S2S3 state-rank categories were found to have collection records occurring within the 161-kilometer-radius search area used in this study (Table 17-2) and were considered to have some potential to occur within the Bristol Bay drainages study areas. In addition, 14 of these 17 taxa have known ranges that overlap with the 161-kilometer-radius search area, as indicated in Alaskan floras and published research reports (Hultén, 1968; Welsh, 1974; Lipkin and Murray, 1997; Anderson, 2005; Ada Hayden Herbarium, 2006; Carlson et al., 2006; FNA, 2006; and WANHP, 2006). One species, *Ceratophyllum demersum*, has a known range that overlaps with the 161-kilometer-radius search area only at its edges. The two remaining species, *Catabrosa aquatica* and *Smelowskia pyriformis*, have known ranges that come close to the edge of the search area but without direct overlap. These three species were included because it was thought by researchers at the AKNHP that the ranges of these species could be larger than currently known.

If the specific microenvironments in which these 17 rare plant taxa typically are found are not present, the potential for these plants to become established in the Bristol Bay drainages study areas would be low. The study areas, however, encompass a variety of plant habitats, including lowland scrub and graminoid-dominated wetlands; tall scrub and open mixed forests in upland, lowland, and riverine areas; and well-drained alpine dwarf scrub and alpine barrens. This range of habitats encompasses the habitats listed for 16 of the 17 rare taxa in Table 17-2 (coastal habitats are not present for *Eleocharis kamtschatica*), and the specific microenvironments important for these 16 plant taxa also are known or can reasonably be expected to be present within the habitats in the Bristol Bay drainage study areas. This analysis suggests that, based on available habitats and known ranges, 16 of the 17 rare taxa listed in Table 17-2 have some potential to occur in the Bristol Bay drainages study areas.

Of these 16 rare taxa, six are listed as critically imperiled in Alaska (S1 or S1S2 ranks; Table 17-2). All of these six taxa, however, are ranked as secure globally; they are considered S1 or S1S2 primarily because

there are few collection records and/or small populations of these species in Alaska (see Table 17-1). The remaining 10 taxa are listed as imperiled in Alaska (S2 or S2S3 ranks). Among these 10 taxa, three species (*Botrychium alaskense*, *Primula tschuktschorum*, and *Smelowskia pyriformis*) also are listed as globally imperiled (G2 or G2G3 ranks) primarily because there are few collection records and/or small populations of these species worldwide. All three of thesespecies are endemic to Alaska (Lipkin and Murray, 1997; Ada Hayden Herbarium, 2006; Carlson, 2006).

17.7.2 VERTEBRATE ANIMALS

No endangered, threatened, proposed or candidate vertebrate species listed under the ESA, and no endangered vertebrate species listed by the State of Alaska were recorded in the Bristol Bay drainages study areas.

Twenty-one bird species recorded during wildlife surveys in the study areas were considered of conservation concern (Table 17-3). In this group of 21 species, there were four species of waterfowl, one loon, one tern, three raptors, seven shorebirds, one woodpecker, and five passerines.

A single species of marine mammal, the harbor seal, which inhabits Iliamna Lake, was identified as a species of conservation concern. In the Bristol Bay drainages study areas, none of the terrestrial mammals known or expected to occur are listed as endangered or threatened, or as proposed or candidate species under the ESA. Similarly, none of the terrestrial large mammals that occur in the study areas currently are considered of conservation concern. Various species or subspecies of medium-sized furbearers and small mammals in south-central and southwestern Alaska have been identified as being of conservation concern (ADF&G 2006, AKNHP 2008), but nearly all of those taxa are insular populations or mainland populations with similarly restricted ranges that do not occur in the Bristol Bay drainages study areas. Only one small mammal species of conservation concern, the Alaska tiny shrew, may occur in the region (Table 17-4). The lynx is listed as a sensitive species by BLM (2005), presumably because of concern about its status as a threatened species under the ESA in the Lower 48 states (65 FR 16051) and because of concern about the potential for population declines occurring in Alaska. Population declines in Alaska, however, beyond the natural cyclical fluctuations with prey numbers, are not known for this species and the ADF&G has implemented more restrictive trapping seasons in the state with the goal of avoiding the over-trapping that led to population declines in the lower 48 (Stephenson, 2008). Currently, lynx are widespread in appropriate habitats in Alaska (MacDonald and Cook, 2009), and are not listed as of conservation concern by other state organizations that considered furbearers (ADF&G, 2006; AKNHP, 2008). Hence, lynx were not considered of conservation concern in this study.

A single amphibian species of conservation concern, the wood frog, is known to occur in the area of the Pebble Deposit (see Chapter 16, Section 16.12) and likely occurs elsewhere in the Bristol Bay drainages region in appropriate habitat.

17.7.2.1 BIRD SPECIES OF CONSERVATION CONCERN

Trumpeter Swan

During the waterbird studies (Chapter 16, Sections 16.4 and 16.10), Trumpeter Swans were definitively identified, from ground-based observations, only in the transportation-corridor, Bristol Bay drainages study area. Trumpeter Swans were not identified in the mine study area. The species appears to be

uncommon in the transportation-corridor; Bristol Bay drainages study area relative to the more commonly occurring Tundra Swan. In the late 1950s, only Tundra Swans were recorded in the Iliamna Lake region, but the possible occurrence of Trumpeter Swans in the area was recognized (Williamson and Peyton, 1962). Trumpeter Swan populations had declined dramatically by the early 1900s, largely due to over-harvesting, but have since rebounded because of conservation efforts (Mitchell and Eichholz, 2010). Both Trumpeter and Tundra swan populations in Alaska have increased substantially since 1965 (Conant and Groves, 2005). Current conservation concern for Trumpeter Swans is based on the species' sensitivity to disturbance (Henson and Grant, 1991) and contaminants in aquatic environments, and its vulnerability to habitat loss, especially on the wintering grounds along the northern Pacific coast of North America and in interior regions in the western U.S. states (Mitchell and Eichholz, 2010; NAS, 2010). The Trumpeter Swan was listed as a species of conservation concern by two of the seven U.S. management agencies or organizations that considered waterfowl in their conservation-status lists (Table 17-3).

Surf Scoter

Surf Scoters were recorded as uncommon migrants during the waterbird studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.4 and 16.10). This species was considered uncommon in the Iliamna Lake region by Williamson and Peyton (1962). Surf Scoters are of conservation concern primarly because the breeding population in Alaska declined between 1957 and 1992 (Henny et al., 1995). A decline of up to possibly two percent annually since 1950 has been documented, although numbers may have increased since 1980 (USFWS, 1999). There also are concerns about the species' vulnerability to oil spills in marine waters during the nonbreeding season and to mineral and oil development activities, both onshore and offshore (ADF&G, 2006). The Surf Scoter was listed as a species of conservation concern by two of the seven U.S. management agencies or organizations that considered waterfowl in their conservation-status lists (Table 17-3).

Black Scoter

Black Scoters were recorded as uncommon breeders in the mine study area during the waterbird studies and were categorized as uncommon, probable breeders in the transportation corridor; Bristol Bay drainages study area (Chapter 16, Sections 16.4 and 16.10). This species was considered relatively uncommon in the Iliamna Lake region by Williamson and Peyton (1962). The Black Scoter is considered a species of conservation concern primarily because of declines in breeding populations (two percent annually) in western Alaska from 1977 to 1998 (USFWS, 1999). Declines in breeding populations in that area apparently are continuing (Kirchoff and Padula, 2010). The species also is vulnerable to oil spills during the marine phase of its annual cycle and to other contaminants (ADF&G, 2006). The Black Scoter was listed as a species of conservation concern by four of the seven of the U.S. management agencies or organizations that considered waterfowl in their conservation-status lists (Table 17-3).

Long-tailed Duck

Long-tailed Ducks were recorded as uncommon breeders in the waterbird studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.4 and 16.10). This species, previously known as Oldsquaw, was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). The Long-tailed Duck is considered a species of conservation concern primarily because of the large population declines (75 percent) that occurred in Alaska since 1977

(USFWS, 1999); south of the Brooks Range in 1999, a decline of 51 percent in breeding populations was found compared to the long-term average from 1975 to 1998 (Conant et al., 1999). Analyses of data from various surveys in recent years indicate that numbers may have stabilized or increased slightly in several areas of the state, but population levels remain below historical averages (AKNHP, 2006b). The species also is vulnerable to habitat alterations, hunting pressure, and to oil spills and other contaminants during the marine phase of its annual cycle (AKNHP, 2006b). The Long-tailed Duck was listed as a species of conservation concern by two of the seven U.S. management agencies or organizations that considered waterfowl in their conservation-status lists (Table 17-3).

Red-throated Loon

Red-throated Loons were recorded as uncommon migrants in the waterbird studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.4 and 16.10). This species was considered rare in the Iliamna Lake region by Williamson and Peyton (1962). The Red-throated Loon is considered a species of conservation concern primarily because populations in western Alaska south of the Brooks Range declined by 53% between 1977 and 1993 (Groves et al. 1996). Populations in that area currently appear to be increasing (Mallek and Groves, 2009). The species also is vulnerable to habitat loss, disturbance and predation (including human harvest) during breeding, fishing-related bycatch, and to oil spills and other contaminants in marine waters (AKNHP, 2004a). The Red-throated Loon was listed as a species of conservation concern by five of the eight U.S. management agencies or organizations that considered waterbirds in their conservation-status lists (Table 17-3).

Golden Eagle

Golden Eagles were recorded as common breeders in the raptor studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.3 and 16.9). This species was not recorded previously in the Iliamna Lake region by Williamson and Peyton (1962). The Golden Eagle is considered a species of conservation concern primarily because declines in breeding populations in the western U.S. have been observed; populations in Denali National Park are stable, but trends in the rest of Alaska are unknown (Kochert et al., 2002). In addition to the uncertainty regarding population trends in the state, there is concern about the uncertainty of the presumed small population size in Alaska and about habitat loss on the wintering grounds in the central and western states (ADF&G, 2006). The Golden Eagle was listed as a species of conservation concern by two of the seven U.S. management agencies or organizations that considered raptors in their conservation-status lists (Table 17-3).

Gyrfalcon

Gyrfalcons were recorded as uncommon breeders in the raptor studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.3 and 16.9). This species was considered rare in the Iliamna Lake region by Williamson and Peyton (1962). Breeding populations of Gyrfalcons in Alaska are presumed to be stable (with annual fluctuations; Swem et al., 1994), but there are concerns about direct and indirect effects on breeding from expanded industrial development in remote areas of the state where the species nests (BPIFWG, 1999; ADF&G, 2006). There also are concerns about the species' restricted range and small breeding population in Alaska (estimated at 375 to 675 nesting pairs; Swem et al., 1994). Declines in Gyrfalcon populations have been found in populations outside Alaska. The Gyrfalcon was listed as a species of conservation concern by two of the

seven U.S. management agencies or organizations that considered raptors in their conservation-status lists (Table 17-3).

Peregrine Falcon

Peregrine Falcons were recorded as rare breeders in the raptor studies, but only in the transportation-corridor, Bristol Bay drainages study area; they were not observed in the mine study area (Chapter 16, Sections 16.3 and 16.9). The nesting habitats and plumage of the birds observed suggested they were of the *anatum* subspecies (Ritchie, pers. comm., 2006). Peregrine Falcons were considered rare in the Iliamna Lake region by Williamson and Peyton (1962). Although the species has been delisted from endangered status under the ESA (USFWS, 2010), the Peregrine Falcon is considered a species of conservation concern because of small population sizes, both worldwide and in Alaska (where probably less than 2,000 birds breed), and because of continuing threats from contaminants acquired outside of Alaska by migrant prey species (ADF&G, 2006). The Peregrine Falcon was listed as a species of conservation concern by three of the seven U.S. management agencies or organizations that considered raptors in their conservation-status lists (Table 17-3).

American Golden-Plover

During the landbird and shorebird studies, American Golden-Plovers were recorded as common breeders in the mine study area and were uncommon but suspected of breeding in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was considered a rare migrant in the Iliamna Lake region by Williamson and Peyton (1962), but also was suspected of breeding in the area. American Golden-Plovers are widely dispersed across arctic regions in Alaska where they defend large territories and breed at low densities. The American Golden-Plover is considered a species of conservation concern because substantial population declines since the 1970s have been noted on the breeding grounds in the Northwest Territories (Gratto-Trevor et al., 1998). However, analysis of population levels at another Nearctic breeding site did not show population declines, and substantial population declines have not been noted at migration staging areas on the east coast of North America (Morrison et al., 1994). Population threats from habitat loss on the wintering grounds for this species in South America and from alteration of migratory staging habitats and pesticide exposure in the mid-western U.S. during migration are of concern (Johnson, 2003). Because this species breeds in remote and relatively undisturbed arctic regions, population declines generally are suspected to occur from increased mortality during the nonbreeding seasons. Concerns about breeding-population declines in this species are still warranted because little information is known about population trends of this species during breeding. The American Golden-Plover was listed as a species of conservation concern by two of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Lesser Yellowlegs

During the landbird and shorebird studies, Lesser Yellowlegs were recorded uncommonly both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area; they were suspected of breeding in both areas (Chapter 16, Sections 16.5 and 16.11). This species was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). Although the Lesser Yellowlegs currently is a relatively common breeder in Alaska, an analysis of Breeding Bird Survey (BBS) data shows a statistically significant decline in the continental population of this species of 9.3% per year between 1966

and 2005; population-trend data from Alaska are sparse but also show a (nonsignificant) decline of 2.1% per year over the same period (Sauer et al. 2006). Additional data from shorebird-specific surveys in eastern North America also suggest a population decline (Bart et al. 2007). Additional concerns are known threats during migration and on the wintering grounds (southern U.S., Central, and South America) from habitat loss and alteration, including pesticide exposure, hunting, and industrial development for oil production (Bird Life International, 2008). The documented population declines and the threats during the nonbreeding period are the primary reasons this species is of concern for conservation. The Lesser Yellowlegs was listed as a species of conservation concern for Alaska by four of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Whimbrel

During the landbird and shorebird studies, Whimbrels were recorded as common breeders in the mine study area but were not observed in the transportation-corridor; Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). Whimbrels are widely dispersed across tundra regions in Alaska and breed at low densities. Substantial population declines in the Hudson Bay race of Whimbrels, *Numenius phaeopus hudsonicus*, (Skeel and Mallory, 1996; Brown et al., 2001) are the primary reason this species is considered of conservation concern. An overall low population size for this species and a restricted breeding distribution in North America also are of concern (ASG, 2008). Over 80 percent of the world population of one subspecies, *N. p. rufiventris*, breeds in Alaska (ASG, 2008). Whimbrels winter along both the Pacific and Atlantic coasts of North, Central, and South America, and loss of intertidal mangrove habitat on wintering grounds on the South American Pacific Coast (Skeel and Mallory, 1996) and at migration stopover sites (ASG, 2008) also has been noted. Because this species breeds in remote and relatively undisturbed arctic regions, it is possible that population declines stem primarily from increased mortality during the nonbreeding seasons. The Whimbrel was listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Hudsonian Godwit

During the landbird and shorebird studies, Hudsonian Godwits were recorded as uncommon breeders in the mine study area and were not observed in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). The Hudsonian Godwit breeds in small, isolated populations across its range in North America, and there is substantial genetic differentiation among populations (Haig et al., 1997), indicating that individual breeding populations are important reservoirs of genetic variation for the species as a whole. Small, disjunct breeding populations also are more susceptible to local impacts. The breeding range of Hudsonian Godwit in Alaska is poorly known, but is believed to be restricted to northwestern and south-central Alaska, with a total population size in the state of only approximately 5,000 to 7,500 birds (ASG, 2008). The specific wintering area(s) of the Alaskan breeding populations are unknown. Because of the combination of small breeding populations, limited breeding and wintering areas (most winter at a few sites in southern South America), and a reliance on relatively few staging sites during migration, the species is considered of conservation concern. Habitat loss on the wintering grounds in southern South America also is of concern (NAS, 2010). The Hudsonian Godwit was listed as a species

of conservation concern for Alaska by five of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Solitary Sandpiper

Solitary Sandpipers were recorded during the landbird and shorebird studies, but only in the transportation-corridor, Bristol Bay drainages study area, where they were uncommon and suspected of breeding; they were not observed in the mine study area (Chapter 16, Sections 16.5 and 16.11). This species was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). Solitary Sandpipers are of conservation concern primarily because analyses of BBS data have indicated downward population trends, although not statistically significant, in datasets from eastern Canada (Sauer et al., 2006). Analyses of data from western Canada do not show declining population trends. In Alaska, an analysis of BBS data indicated a statistically significant population decline of 4.7 percent per year from 1966 to 2005 (Sauer et al., 2006). Although the species has a broad breeding range across boreal forests in North America from Alaska to the Atlantic coast, the global population estimate is only approximately 100,000 birds and the western race, *Tringa solitaria cinnamomea*, has a breeding population of possibly no more than 25,000 birds (ASG, 2008). It is estimated that over 75 percent of the birds of the western race breed in Alaska (ASG, 2008). Because of the downward population trend in the state and the very small breeding population size, the Solitary Sandpiper is considered of conservation concern in Alaska. The Solitary Sandpiper was listed as a species of conservation concern by four of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Surfbird

During the landbird and shorebird studies, Surfbirds were recorded as uncommon breeders in the mine study area, but were not observed in the transportation-corridor; Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). They were found to be uncommon migrants in the Iliamna Lake region by Williamson and Peyton (1962), but were suspected of breeding in the area. The Surfbird is considered a species of conservation concern because of a suspected population decline (based on Christmas Bird Count data; Senner and McCaffery, 1997), a fairly low worldwide population (approximately 70,000 birds), and a restricted breeding distribution (primarily Alaska and sparingly into the Yukon Territory; ASG; 2008). Over 75 percent of the world population of Surfbirds breeds in Alaska (ASG, 2008). Surfbirds also traditionally congregated in large numbers at spring-migration stopover sites, traditionally on Montague Island in Prince William Sound, Alaska, making them vulnerable to impacts from oil spills (Norton et al., 1990; Bishop and Green, 2001; ASG, 2008). Threats from habitat loss and marine pollution during the nonbreeding seasons also are of concern because the species migrates and overwinters in intertidal habitats, typically rocky shorelines in south-coastal Alaska and along the western coasts of North, Central, and South America. Surfbirds were listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Short-billed Dowitcher

During the landbird and shorebird studies, Short-billed Dowitchers were recorded as uncommon breeders in the mine study area, but were not observed in the transportation-corridor; Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was considered uncommon to rare as a migrant

and breeder in the Iliamna Lake region by Williamson and Peyton (1962). The Short-billed Dowitcher is considered a species of conservation concern and because significant population declines in the central Canadian subspecies (*griseus*) have been documented, and because declines also likely have occurred in the eastern Canadian subspecies (*hendersoni*) (Donaldson et al. 2000; Brown et al., 2001; Jehl et al., 2001). Data for the Alaskan subspecies (*caurinus*) are insufficient to conduct a formal population-trend analysis, but declining numbers on nonbreeding surveys have researchers concerned that populations of this subspecies also may have declined over the past decade (ASG, 2008). The world population of the *caurinus* subspecies is thought to be relatively low, estimated at approximately 75,000 birds (Morrison et al., 2006), all of which breed in Alaska. Habitat loss on the wintering grounds, which are south of Alaska on the Pacific and Atlantic Coasts of North, Central, and South America, and especially at migration stopover sites, also is of concern (Brown et al., 2001). Short-billed Dowitchers were listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered shorebirds in their conservation-status lists (Table 17-3).

Arctic Tern

Arctic Terns were found to be relatively common migrants in the Bristol Bay drainages waterbird studies, both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.4 and 16.10). This species was considered an abundant breeder near large waterbodies in the Iliamna Lake region by Williamson and Peyton (1962). Arctic Terns are of conservation concern in Alaska largely because coastal breeding populations in the Gulf of Alaska have declined dramatically (90%) and some nesting colonies have been abandoned, especially on Kodiak Island (Agler et al., 1999; Stephenson et al, 2002; Stephenson et al, 2003). These population declines have been linked to climatic shifts in the Gulf of Alaska and to subsequent changes in marine fish communities (Anderson and Piatt, 1999; Agler et al., 1999). The species also is sensitive to predation (including subsistence harvest) and disturbance during nesting, and to contaminants and climate-change effects in the marine environment (ADF&G, 2006; AKNHP, 2006c). Concerns about breeding-population declines, the fairly low world-population size, and threats during the breeding season are the primary conservation concerns for this species. Arctic Terns were listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered seabirds in their conservation-status lists (Table 17-3).

Black-backed Woodpecker

During the landbird and shorebird studies, Black-backed Woodpeckers were recorded breeding only in the transportation-corridor, Bristol Bay drainages study area, where they were found to be uncommon; they were not observed in the mine study area (Chapter 16, Sections 16.5 and 16.11). This species was observed “sparingly” in the Iliamna Lake region by Williamson and Peyton (1962) and was the rarest of the woodpeckers recorded. In an analysis of BBS data, increasing population trends (not statistically significant) were found for Black-backed Woodpeckers across North America from 1966 to 1979; these increases then were followed by statistically significant declines in breeding populations of 7.4 percent per year between 1980 and 2005 (Sauer et al., 2006). Population-trend data for this species in Alaska are not available (Sauer et al., 2006). Population threats on the breeding grounds include forest-clearing, post-fire or post-insect-outbreak salvage logging, and forest-fire suppression activities (Hutto, 1995; Dixon and Saab, 2000). Black-backed Woodpeckers respond positively to natural forest disturbances, especially fires (Murphy and Lehnhausen, 1998) and insect outbreaks (Lance and Howell, 2000), which result in the

death of mature trees (their preferred habitat for foraging); populations can increase quickly in areas with abundant dead or dying trees and especially coniferous trees. Conservation concerns for Black-backed Woodpeckers in Alaska are focused on the difficulty of monitoring populations because of their nomadic movements (BPIFWG, 1999) and potential negative effects on populations from forest-clearing activities and post-fire or post-insect-outbreak salvage logging (ADF&G, 2006). Black-backed Woodpeckers are a resident species in boreal forests across North America and, in Alaska; they occur most commonly in interior areas of the state. Black-backed Woodpeckers were listed as a species of conservation concern by two of the eight U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

Olive-sided Flycatcher

During the landbird and shorebird studies, Olive-sided Flycatchers were recorded breeding only in the transportation-corridor, Bristol Bay drainages study area, where they were found to be common; they were not observed in the mine study area (Chapter 16, Sections 16.5 and 16.11). This species was not recorded in the Iliamna Lake region by Williamson and Peyton (1962). An analysis of BBS data for Olive-sided Flycatchers showed a statistically significant decline of 3.5 percent per year between 1966 and 2005 in breeding populations across the U.S. and Canada (Sauer et al., 2006), suggesting that the worldwide population may have declined by as much as 70 percent over that period. In Alaska, breeding populations declined 1.5 percent per year between 1966 and 2005, although the declines were not statistically significant (Sauer et al., 2006). Population threats on the breeding grounds include forest-clearing, forest-thinning, and forest-fire suppression activities (Altman and Sallabanks, 2000). Habitat alteration in the Cook Inlet area of Alaska, the region of the state with the greatest rate of human development, is of concern (BPIFWG, 1999). Most mortality in this species, however, is suspected to occur on the wintering grounds (BPIFWG, 1999; Altman and Sallabanks, 2000). Olive-sided flycatchers winter in Central America and most extensively in South America, where intensive tropical deforestation is suspected to be the primary factor driving the population declines. This species is considered highly vulnerable to the effects of deforestation during winter because of its preference for undisturbed tropical broadleaf forest (Petit et al., 1995). Olive-sided Flycatchers were listed as a species of conservation concern by five of the eight U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

Gray-cheeked Thrush

During the landbird and shorebird studies, Gray-cheeked Thrushes were recorded as abundant breeders in the mine study area and as common breeders in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was considered an abundant breeder in riparian habitats in the Iliamna Lake region by Williamson and Peyton (1962). The Gray-cheeked Thrush is of conservation concern because an analysis of BBS data suggests that declines in breeding populations in eastern North America occurred from 1978 to 1988 (Sauer and Droege, 1992). An analysis of BBS data over a longer time-period (for Canada only, where this species is more common) shows a statistically significant population decline of 8.8 percent per year from 1967 to 2000, although these results apply only to a small portion of the breeding range (Dunn, 2005). Similar population-trend data for Alaska are not available (Sauer et al., 2006), but an analysis of 12 years of banding data (1991 to 2003) during spring migration in Fairbanks shows a substantial decline in captures of this species (Hannah, 2003). On its tropical wintering grounds (largely South America east of the Andes), this species is considered

vulnerable to deforestation of broadleaf forests (Petit, 1993). Because Gray-cheeked Thrushes breed primarily in remote and undisturbed boreal forests and in arctic environments where population threats are minimal, it is possible that declines in breeding populations may be driven primarily by the effects of tropical deforestation on the wintering grounds. Nevertheless, there are concerns that breeding populations in Alaska should be maintained because a large percentage of the species' global breeding range is concentrated in Alaska (BPIFWG, 1999). Gray-cheeked Thrushes were listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

Varied Thrush

During the landbird and shorebird studies, Varied Thrushes were recorded breeding only in the transportation-corridor, Bristol Bay drainages study area, where they were found to be abundant; the species was not recorded in the mine study area (Chapter 16, Sections 16.5 and 16.11). The Varied Thrush was considered a common breeder in forested habitats in the Iliamna Lake region by Williamson and Peyton (1962). The Varied Thrush is considered vulnerable to forestry management practices that result in the removal of forests or alterations in forest structure because its primary habitat is mature coniferous forests on the North American west coast and in Alaska (BPIFWG, 1999; ADF&G, 2006). In analyses of BBS data, populations in western North America were found to increase between 1966 and 1979, but then showed statistically significant declines of 1.0 percent per year from 1980 to 2005 (Sauer et al., 2006). No significant population changes were detected in Alaskan populations over these same time periods (Sauer et al., 2006). The primary concern for this species in Alaska is focused on monitoring and maintaining breeding populations in the state (BPIFWG, 1999; ADF&G, 2006). A few Varied Thrushes winter in south-central Alaska coastal forests, but most winter in coastal forests in southeastern Alaska, British Columbia, and in coastal and inland forests in several western, lower 48 states, where they also are considered vulnerable to forestry management activities that result in the removal of forests or alterations in forest structure (George, 2000). Varied Thrushes were listed as a species of conservation concern by three of the eight U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

Blackpoll Warbler

During the landbird and shorebird studies, Blackpoll Warblers were recorded as common breeders both in the mine study area and in the transportation-corridor, Bristol Bay drainages study area (Chapter 16, Sections 16.5 and 16.11). This species was considered an abundant breeder in riparian habitats in the Iliamna Lake region by Williamson and Peyton (1962). An analysis of BBS data for Blackpoll Warblers shows a statistically significant decline in breeding populations across North America of 9.6 percent per year between 1980 and 2005, after increases were recorded from 1966 to 1979 (Sauer et al., 2006). An analysis of data from Alaska also indicated a statistically significant decline in breeding populations (2.9 percent per year) between 1980 and 2005 (Sauer et al., 2006). On the wintering grounds in South America, the species is considered highly vulnerable to the removal of tropical forests (Petit, 1993; Petit et al., 1995), and there are suggestions that heavy mortality can occur during transoceanic fall-migration flights because of tropical storms (Butler, 2000). Because Blackpoll Warblers in Alaska breed largely in remote and undisturbed boreal forest regions (areas with relatively few population threats), the implication is that declines in breeding populations in the state may be primarily driven by the combined effects of mortality during migration and tropical deforestation on the wintering grounds. Timber-harvest

activities in boreal forest regions in Canada have been shown to negatively affect Blackpoll Warbler breeding populations at a local scale (Darveau, 1995). The primary conservation concern in Alaska is that breeding populations should be maintained because a large percentage of the species' global breeding range is concentrated in Alaska (BPIFWG, 1999). Blackpoll Warblers were listed as a species of conservation concern by five of the eight U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

Rusty Blackbird

During the landbird and shorebird studies, Rusty Blackbirds were recorded only in the transportation-corridor, Bristol Bay drainages study area, where they were uncommon and suspected of breeding; they were not observed in the mine study area (Chapter 16, Sections 16.5 and 16.11). This species was considered an uncommon breeder in the Iliamna Lake region by Williamson and Peyton (1962). An analysis of BBS data for Rusty Blackbirds indicated a steep and statistically significant decline of 12.5 percent per year between 1966 and 2005 in breeding populations across the U.S. and Canada (Sauer et al., 2006). Using BBS and other population data, Greenberg and Droege (1999) estimated that populations in North America had declined by 90 percent. In Alaska, breeding populations declined significantly by 5.3 percent per year between 1980 and 2005 (Sauer et al., 2006). The causes of the population declines in this species are uncertain, but effects on both the breeding and wintering grounds are suspected. Alteration of boreal forest wetlands from human activities (deforestation and peat extraction) and the drying of boreal forest wetlands, thought to be the result of global warming, both are possible effects on breeding habitats (Avery, 1995). Habitats in Alaska are believed to be largely intact (Greenberg, 2003), but permafrost degradation and drying wetlands from global warming may be altering habitats in some areas. Effects on the wintering grounds in eastern North America include the documented loss of forested wetlands in the eastern U.S. (estimated more than 80 percent reduction from presettlement records; Greenberg and Droege, 1999) and possibly more recent direct mortality from agricultural control efforts aimed at other blackbird species. Rusty Blackbirds were listed as a species of conservation concern by four of the eight of the U.S. management agencies or organizations that considered landbirds in their conservation-status lists (Table 17-3).

17.7.2.2 MAMMAL SPECIES OF CONSERVATION CONCERN

Alaska Tiny Shrew

This recently described species, the smallest mammal in North America, was discovered in the University of Alaska Museum collection by a visiting Russian mammalogist. It was first thought to be a Palearctic species, *Sorex minutissimus* (Dokuchaev, 1994), but after further study, was described as a new species (*S. yukonicus*; Dokuchaev, 1997). The AKNHP (2004b) originally classified it as unranked in the state (SNR, status not yet assessed), as well as unrankable globally (GU), presumably because so little information was available. More recently, it was classified as vulnerable in the state (S3), presumably due to its apparent rarity and uncertain conservation status (AKNHP, 2008). The latter ranking warrants further scrutiny, however, in view of the species' cryptic nature, the possibility of misidentification, the difficulty of capture, and the shrew's widespread distribution, as documented by inventory work in various parts of the state in the decade since the species was described.

The oldest specimen, captured near the upper Susitna River in 1982, was identified originally as a common shrew (*S. cinereus*). Dokuchaev (1997) listed three locations where it had been recorded.

Specimen records increased quickly, however, after Dokuchaev's work, as researchers began to look for it in field inventories elsewhere in the state. By the late 1990s, the tiny shrew had been recorded over a broad area of interior, western, and northern Alaska, including Galena (the type locality), the Nowitna National Wildlife Refuge (near Ruby), the Togiak National Wildlife Refuge (southwest of Dillingham), and south of Red Devil near the Kuskokwim River. Inventory and monitoring efforts on national parklands in 2000 through 2003 added greatly to the knowledge of the species; the total number collected statewide had increased to 37 specimens in at least 20 locations by 2003 (Cook and MacDonald, 2004a). Two specimens were captured in July 2003 at Turner Bay in Lake Clark National Park and Preserve (Cook and MacDonald, 2004a), about 32 miles northeast of the Pebble Deposit.

The species is suspected to occur in the Iliamna area (Jacobsen, 2004) and also is considered a possibility in Katmai National Park and Preserve, especially in the forested northern portion of the park (Cook and MacDonald, 2004b), although none were trapped in either location. Shrews generally are under-represented in older studies that sampled with snap-traps and are much more reliably sampled using pitfall traps. Even so, the detectability of this shrew is low due to its small size and suspected ability to escape from metal-cone pitfall traps; plastic pitfalls are more effective at capturing it (Jarrell, pers. comm., 2003). Early information on habitat affinities indicated the species occurred primarily in riparian habitats, but as trapping efforts expanded, it was captured also in scrub habitats; the Turner Bay specimens were captured in open tall-willow scrub near the shore of Lake Clark. The Alaska tiny shrew was listed as of conservation concern by one of the two state organizations that considered terrestrial small mammals in their conservation-status lists (Table 17-4).

Harbor Seal

Harbor seals typically are found in marine waters but they have been known also to enter freshwater rivers and lakes (Chapter 16, Section 16.8). Although accurate population numbers are lacking, the presence of the species in Iliamna Lake has been known since the late 19th century (Nelson and True, 1887). Harbor seals in Iliamna Lake are resident year-round, but they are not landlocked because the Kvichak River system connects the lake to Bristol Bay. The harbor seals in another freshwater population in northern Québec have been found to be distinct enough to be classified as a unique subspecies, *Phoca vitulina mellonae* (Smith et al., 1994; Smith, 1997). It is unknown if the seal population in Iliamna Lake is genetically distinct from the marine-seal population in Bristol Bay, and currently the Iliamna Lake seals are considered to be *P. v. richardii*, the same subspecies found throughout the range of the species in Alaska (Chapter 16, Section 16.8).

As with other marine mammals, harbor seals are protected under the Marine Mammal Protection Act. Although the species is not listed by the National Marine Fisheries Service under the ESA and populations in Alaska are not considered to be depleted (NMFS, 2010), the Bering Sea population is thought to have declined from the 1980s to the 1990s, with numbers remaining relatively stable since that time (Angliss and Outlaw, 2007). The Bering Sea survey data for harbor seals, however, are difficult to analyze accurately because of the presence of the closely related spotted seal (*P. largha*); harbor seals and spotted seals cannot be identified separately during aerial surveys (Angliss and Outlaw, 2007). The suspected declines in the Bering Sea stock presumably influenced the decisions to designate the harbor seal as a State of Alaska species of special concern (ADF&G, 1998) and to include it on BLM's list of sensitive species (BLM, 2005). Recent genetic research on harbor seals indicates that more population stocks exist in Alaska than the three currently designated, and the National Marine Fisheries Service

identified a need for better differentiation of stocks for management purposes (O'Corry-Crowe et al., 2003). Harbor seals were listed as of conservation concern by two of the five U.S. management agencies or organizations that considered marine mammals in their conservation-status lists (Table 17-4).

17.7.2.3 AMPHIBIAN SPECIES OF CONSERVATION CONCERN

Wood Frog

A single species of amphibian, the wood frog, occurs in Alaska north of the southeastern panhandle of the state (Hodge, 1976). Wood frogs are known to breed in freshwater ponds and lakes in the region of the Pebble Deposit (Chapter 16, Section 16.12), and the species is expected to occur in similar habitats elsewhere in the Bristol Bay drainages region. In more developed areas of eastern Cook Inlet, the wood frog recently was found to be abundant and widespread (Gotthardt, 2004). Nevertheless, the species is of conservation concern in Alaska, as are amphibians worldwide, because of widespread declines in all groups of amphibians (McCallum, 2007). The causes of these population declines are believed to be various and, in addition to habitat destruction, potentially include waterborne contaminants, increases in surface-water acidity from industrial activities, epidemic fungal infections, increases in ultraviolet radiation from ozone-layer depletion, and indirect impacts from global warming (Blaustein and Wake, 1990; Wyman, 1990; Daszak et al., 2003; Dohm et al., 2005; Bancroft et al., 2007; Whitfield et al., 2007).

In Alaska, there are concerns that many historically used breeding sites in south-central Alaska have been abandoned (AKNHP, 2005; ADF&G, 2006). Developmental abnormalities also have been reported in frogs from the Kenai National Wildlife Refuge (Trust and Tangermann, 2002). On the two conservation-status lists reviewed that specifically considered Alaskan amphibians, the wood frog is listed as a priority species for conservation by ADF&G (2006), but as secure, both globally and in the state, by the AKNHP (2008).

17.8 SUMMARY

No endangered, threatened, proposed or candidate vertebrate species listed under the ESA, and no endangered vertebrate species listed by the State of Alaska were recorded in the Bristol Bay drainages study areas.

Based on data collected as of 2006, 16 rare vascular plant taxa with the rarer state rankings (S1, S2, S1S2, or S2S3) were determined to have the potential to occur in the Bristol Bay drainages study areas. This conclusion is based on the existence of known collections of these taxa within a broad region surrounding and including the study areas and the availability of suitable habitats in the study areas. Six of these taxa are listed as critically imperiled in Alaska (S1 and S1S2 ranks) because few populations and/or few individual plants have been recorded in the state. The remaining 10 taxa are listed as imperiled in Alaska (S2 and S2S3 ranks).

Twenty-two bird species that were recorded either in the mine study area and/or in the transportation corridor, Bristol Bay drainages study area are considered to be of conservation concern for Alaska by at least two statewide or national groups that address bird conservation issues in the state.

One marine mammal species of conservation concern (harbor seal) occurs in Iliamna Lake. One species of terrestrial small mammal (Alaska tiny shrew), which currently is considered to be of conservation

concern, may occur in the Bristol Bay drainages study areas. The occurrence of this species in the study areas has not been confirmed.

A single amphibian species of conservation concern, the wood frog, has been found in the mine study area and likely occurs in the transportation corridor, Bristol Bay drainages study area as well.

17.9 REFERENCES

Ada Hayden Herbarium. 2006. *Botrichium Alaskense*. Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA. http://www.public.iastate.edu/~herbarium/botrychium/B-alaskense-1-10-05.pdf (accessed February 9, 2007).

Agler, B.A., S.J. Kendall, D.B. Irons, and S.P. Klosiewski. 1999. "Declines in Marine Bird Populations in Prince William Sound, Alaska Coincident with Climatic Regime Shift." Waterbirds. Vol. 22. Pp. 98–103.

Alaska Department of Fish and Game (ADF&G). 2006. Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources. Juneau, Alaska. http://www.sf.adfg.state.ak.us/statewide/ngplan/ (accessed May 17, 2010).

———. 1998. State of Alaska Species of Special Concern (November 27, 1998). http://www.adfg.state.ak.us/special/esa/species_concern.php (accessed May 17, 2010).

Alaska Natural Heritage Program (AKNHP). 2008. Vertebrate Species Tracking List for 2008. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/Zoology_Tracking.htm (accessed May 10, 2010).

———. 2006a. Vascular Plant Tracking List, April 2006. University of Alaska Anchorage, Anchorage, AK. http://www.uaa.alaska.edu/enri/aknhp_web/index.html (accessed February 9, 2007).

———. 2006b. Status Report: Long-tailed Duck. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/Zoology_Birds_track08.htm (accessed May 10, 2010).

———. 2006c. Status Report: Arctic Tern. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/Zoology_Birds_track08.htm (accessed May 10, 2010).

———. 2005. Status Report: Wood Frog. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/Zoology_Amphibs_track07.htm (accessed May 10, 2010).

———. 2004a. Status Report: Red-throated Loon. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/Zoology_Birds_track08.htm (accessed May 10, 2010).

———. 2004b. Mammal Tracking List, 2004. University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/zoology/mammals/Zoology_Mammals.htm (accessed June 21, 2007).

Alaska Shorebird Group (ASG). 2008. Alaska Shorebird Conservation Plan. Version II. Anchorage, AK.

Altman, B., and R. Sallabanks. 2000. "Olive-sided Flycatcher (*Contopus cooperi*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 502. Philadelphia, PA: The Birds of North America, Inc.

Anderson, D.G. 2005. *Botrychium multifidum* (Gmel.) Rupr. (Leathery Grapefern): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region, Golden, CO. http://www.fs.fed.us/r2/projects/scp/assessments/botrychiummultifidum.pdf [2006] (accessed February 9, 2007).

Anderson, P.J., and J.F. Piatt. 1999. "Community Reorganization in the Gulf of Alaska following Ocean Climate Regime Shift." Marine Ecology Progress Series. Vol. 189. Pp. 117–123.

Angliss, R.P., and R.B. Outlaw. 2007. Alaska Marine Mammal Stock Assessments, 2006. U.S. Department of Commerce, National Marine Fisheries Service, NOAA Technical Memorandum NMFS-AFSC-168.

Avery, M.L. 1995. "Rusty Blackbird (*Euphagus carolinus*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 200. Philadelphia, PA: The Birds of North America, Inc.

Bancroft, B.A., N.J. Baker, and A.R. Blaustein. 2007. "Effects of UVB radiation on marine and freshwater organisms: A synthesis through meta-analysis." Ecology Letters. Vol. 10. Pp. 332–345.

Bart, J., S. Brown, B. Harrington, and R.I.G. Morrison. 2007. "Survey Trends of North American Shorebirds: Population Declines or Shifting Distributions?" Journal of Avian Biology. Vol. 38. Pp. 73–82.

Bird Life International. 2008. Waterbird Conservation for the Americas. Bird Life International, Cambridge, UK. Country-specific reports available at http://www.birdlife.org/action/science/species/waterbirds/downloads.html (accessed May 17, 2010).

Bishop, M.A., and S.P. Green. 2001. "Predation of Pacific Herring (*Clupea pallasi*) Spawn by Birds in Prince William Sound, Alaska." Fisheries Oceanography. Vol. 10. Pp. 149–158.

Blaustein, A.R., and D.B. Wake. 1990. "Declining Amphibian Populations: A Global Phenomenon?" Trends in Ecology and Evolution. Vol. 5. Pp. 203–204.

Boreal Partners in Flight Working Group (BPIFWG). 1999. Landbird Conservation Plan for Alaska Biogeographic Regions, Version 1.0. Unpublished report. U.S. Fish and Wildlife Service, Anchorage, AK.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan. 2nd edition. Manomet Center for Conservation Sciences, Manomet, MA. http://www.fws.gov/shorebirdplan/ (accessed May 28, 2008).

Bureau of Land Management (BLM). 2005. Special Status Species List for Alaska. Instruction Memorandum No. AK 2006-03. U.S. Department of the Interior, Anchorage, AK. http://www.blm.gov/nhp/efoia/ak/2006im/im06-003.pdf (accessed November 13, 2007).

Butler, R.W. 2000. "Stormy Seas for Some North American Songbirds: Are Declines Related to Severe Storms During Migration?" Auk. Vol. 117. Pp. 518–522.

Carlson, M.L. 2006. Natural Threats to the Rare Arctic Primrose, *Primula tschuktschorum*: Goose Grazing and Reproductive Interference with its Sister Species. The Alaska Natural Heritage Program, University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/botany/pdfs/Effects_of_grazing_report_mlc_2006b.pdf (accessed February 9, 2007).

Carlson, M.L., R. Lipkin, H. Cortés-Burns, and I.V. Lapina. 2006. Stewart River Training Area — Rare Plant Survey — 2006. The Alaska Natural Heritage Program, University of Alaska Anchorage, Anchorage, AK. http://aknhp.uaa.alaska.edu/pdfs/botany/StewarRiverRarePlantSurvey_edit_9_Nov_2006.pdf (accessed February 9, 2007).

Conant, B., and D.J. Groves. 2005. Alaska-Yukon waterfowl population survey, May 15 to June 7, 2005. U.S. Fish and Wildlife Service, Juneau, AK.

Conant, B., J.I. Hodges, and D.J. Groves. 1999. Alaska-Yukon Waterfowl Breeding Population Survey: May 25 to June 20, 1999. U.S. Fish and Wildlife Service. Juneau, AK.

Cook, J.A., and S.O. MacDonald. 2004a. Mammal Inventory of Alaska's National Parks and Preserves: Lake Clark National Park and Preserve. Southwest Alaska Network Inventory and Monitoring Program Annual Report 2003. National Park Service, Anchorage, AK.

———. 2004b. Mammal Inventory of Alaska's National Parks and Preserves: Katmai National Park and Preserve. Southwest Alaska Network Inventory and Monitoring Program Annual Report 2004. National Park Service, Anchorage, AK.

Darveau, M., P. Beauchesne, L. Belanger, J. Huot, and P. LaRue. 1995. "Riparian Forest Strips as Habitat for Breeding Birds in Boreal Forest." Journal of Wildlife Management. Vol. 59. Pp. 67–78.

Daszak, P., A.A. Cunningham, and A.D. Hyatt. 2003. "Infectious disease and amphibian population declines." Diversity and Distributions. Vol. 9. No. 2. Pp. 141–150.

Dixon, R.D., and V.A. Saab. 2000. "Black-backed Woodpecker (Picoides articus)." *In*: A. Poole and F. Gill, eds., The Birds of North America, No. 509. Philadelphia, PA: The Birds of North America, Inc.

Dohm, M.R., W.J. Mautz, J.A. Andrade, K.S. Gellert, L.J. Salas-Ferguson, N. Nicolaisen, and N. Fujie. 2005. "Effects of ozone exposure on nonspecific phagocytic capacity of pulmonary macrophages from an amphibian, *Bufo marinus*." Environmental Toxicology and Chemistry. Vol. 24. Pp. 205–210.

Dokuchaev, N.E. 1997. "A New Species of Shrew (Soricidae, Insectivora) from Alaska." Journal of Mammalogy. Vol. 78. Pp. 811–817.

———. 1994. "Siberian Shrew *Sorex minutissimus* Found in Alaska." Zoologicheskii Zhurnal. Vol. 73. Pp. 254–256. [in Russian]

Donaldson, G., C. Hyslop, G. Morrison, L. Dickson, and I. Davidson, eds. 2000. Canadian Shorebird Conservation Plan. Environment Canada, Canadian Wildlife Service, Ottawa, Ontario, Canada.

Dunn, E.H. 2005. National Action Needs for Canadian Landbird Conservation, Version 1. Canadian Wildlife Service Landbird Committee, Ottawa, Canada. http://www.cws-scf.ec.gc.ca/mgbc/action/index_e.cfm (accessed May 28, 2008).

Flora of North America (FNA). 2006. http://www.efloras.org (accessed February 9, 2007).

George, G.T. 2000. "Varied Thrush (*Ixoreus naevius*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 541. Philadelphia, PA: The Birds of North America, Inc.

Goldstein, M.I., D. Martin, and M.C. Stensvold. 2009. U.S. Forest Service 2009 Alaska Region Sensitive Species List: Assessment and Proposed Revisions to the 2002 List. Juneau, AK. http://www.fs.fed.us/r10/ro/policy-reports/documents/2009_revised_r10_ss_report.pdf (accessed October 11, 2010).

Gotthardt, T. 2004. Monitoring the Distribution of Amphibians in the Cook Inlet Watershed: 2003 Final Report. The Alaska Natural Heritage Program, University of Alaska Anchorage, Anchorage, AK.

Greenberg, R. 2003. The Troubled Blackbird of the Bog. Bird of the Month. Smithsonian Institution, National Zoological Park. http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Featured_Birds/default.cfm?bird=Rusty%20Blackbird (accessed May 28, 2008).

Greenberg, R., and S. Droege. 1999. "On the Decline of the Rusty Blackbird and the Use of Ornithological Literature to Document Long-term Population Declines." Conservation Biology. Vol. 13. Pp. 553–559.

Gratto-Trevor, C.L., V.H. Johnston, and S.T. Pepper. 1998. "Changes in Shorebird and Eider Abundance in the Rasmussen Lowlands, NWT." Wilson Bull. Vol. 110. Pp. 316–325.

Groves, D.J., B. Conant, R.J. King, J.I. Hodges, and J.G. King. 1996. "Status and Trends of Loon Populations Summering in Alaska, 1971-1993." Condor. Vol. 98. Pp. 189–195.

Haig, S.M., C.L. Gratto-Trevor, T.D. Mullins, and M.A. Colwell. 1997. "Population Identification of Western Hemisphere Shorebirds throughout the Annual Cycle." Molecular Ecology. Vol. 6. Pp. 413–427.

Hannah, K. 2003. Creamer's Field Migration Station: Spring Report, 2003. Alaska Bird Observatory, Fairbanks, AK.

Henny, C.J., D.D. Rudis, T.J. Roffe, and E. Robinson-Wilson. 1995. "Contaminants and Sea Ducks in Alaska and the Circumpolar Region." Environmental Health Perspectives. Vol. 103. Pp. 41–49.

Henson, P., and T.A. Grant. 1991. "The effects of human disturbance on Trumpeter Swan breeding behavior." Wildlife Society Bulletin. Vol. 19. Pp. 248–257.

Hodge, R.P. 1976. Amphibians and Reptiles in Alaska, the Yukon, and Northwest Territories. Anchorage, AK: Alaska Northwest Publishing Co.

Holt, D.W., and S.M. Leasure. 1993. "Short-eared Owl (*Asio flammeus*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 62. Philadelphia, PA: The Birds of North America, Inc.

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford, CA: Stanford University Press.

Hutto, R.L. 1995. "Composition of bird communities following stand-replacement fires in northern Rocky Mountain (U.S.A.) conifer forests." Conservation Biology. Vol. 9. Pp. 1041-1058.

Jacobsen, B. 2004. Mammal Inventory of BLM Lands: Vicinity of Iliamna Lake, Kvichak River and Nushagak River Valleys, with Reports of Opportunistically Collected Amphibians. Annual Report 2003. University of Alaska Museum, Fairbanks, for U.S. Department of the Interior, Bureau of Land Management, Anchorage, AK.

Jarrell, G. 2003. University of Alaska Museum of the North, Fairbanks, AK. Personal communication—e-mail message to Brian Lawhead, ABR, Inc.—Environmental Research & Services. March 10.

Jehl, J.R., Jr., J. Klima, and R.E. Harris. 2001. "Short-billed Dowitcher (*Limnodromus griseus*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 564. Philadelphia, PA: The Birds of North America, Inc.

Johnson, O.W. 2003. "Pacific and American Golden-Plovers: Reflections on Conservation Needs." Wader Study Group Bulletin. Vol. 100. Pp. 10–13.

Kirchhoff, M., and V. Padula. 2010. The Audubon Alaska WatchList 2010. Audubon Alaska, Anchorage, AK. http://ak.audubon.org/birds-science-education/alaska-watchlist (accessed November 26, 2010).

Kochert, M.N., K. Steenhof, C.L. McIntyre, and E.H. Craig. 2002. "Golden Eagle (*Aquila chrysaetos*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 684. Philadelphia, PA: The Birds of North America, Inc.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp., M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Conservation for the Americas: the North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC.

Lance, E.W., and S. Howell. 2000. "A survey of songbirds during a spruce beetle (Dendroctonus rufipennis) outbreak on the Kenai Peninsula, Alaska." Northwestern Naturalist. Vol. 81. Pp. 1-10.

———. 2006. Conservation Status Assessment Factor Scores and Categories of Concern for Solitary-Nesting Waterbird Species. Addendum to Waterbird Conservation for the Americas: North American Waterbird Conservation Plan, Version 1, April 17, 2006. Waterbird Conservation for the Americas, Washington, DC.

Lipkin, R., and D.F. Murray 1997. Alaska Rare Plant Field Guide. U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Alaska Natural Heritage Program, and U.S. Forest Service, Anchorage, AK.

Mallek, E.J., and D.J. Groves. 2009. Alaska-Yukon Waterfowl Breeding Population sSurvey, May 16 to June 7, 2009. U.S. Fish and Wildlife Service, Fairbanks and Juneau, AK.

MacDonald, S.O., and J.A. Cook. 2009. Recent Mammals of Alaska. Fairbanks, AK: University of Alaska Press.

McCallum, M.L. 2007. "Amphibian decline or extinction? Current declines dwarf background extinction rate." Journal of Herpetology. Vol. 41. No. 3. Pp. 483–491.

Mitchell, C.D., and M.W. Eichholz. 2010. "Trumpeter Swan (*Cygnus buccinator*)." *In:* A. Poole, ed., The Birds of North America Online, No. 105. Ithaca, NY: Cornell Lab of Ornithology. http://bna.birds.cornell.edu/bna/species/105 (accessed November 26, 2010).

Morrison, R.I.G., C. Downes, and B. Collins. 1994. "Population Trends of Shorebirds on Fall Migration in Eastern Canada, 1974-1991." Wilson Bull. Vol. 106. Pp. 431–447.

Morrison, R.I.G., B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. "Population Estimates of North American Shorebirds, 2006." Wader Study Group Bulletin. Vol. 111. Pp. 67–85.

Murphy, E.C., and W.A. Lehnhausen. 1998. "Denisty and foraging ecology of woodpeckers following a stand-replacement fire." Journal of Wildlife Management. Vol. 62. Pp. 1359-1372.

National Marine Fisheries Service (NMFS). 2010. Marine Mammals [conservation status]. Office of Protected Resources, Silver Spring, MD. http://www.nmfs.noaa.gov/pr/species/mammals/ (accessed October 29, 2010).

National Audubon Society (NAS). 2010. WatchList 2007 Species. http://birds.audubon.org/species-by-program/watchlist (accessed November 26, 2010).

Nelson, E.W., and F.W. True. 1887. "Mammals of Northern Alaska." *In* E. W. Nelson, ed., Report upon Natural History Collections in Alaska Between the Years 1877 and 1881. Arctic Series Publication, No. 3. Pp. 227–294. U.S. Army Signal Service, Washington, DC.

Norton, D.W., S.E. Senner, R.E. Gill, Jr., P.D. Martin, J.M. Wright, and A.K. Fukuyama. 1990. "Shorebirds and Herring Roe in Prince William Sound, Alaska." American Birds. Vol. 44. Pp. 367–371, 508.

O'Corry-Crowe, G.M., K.K. Martien, and B.L. Taylor. 2003. The Analysis of Population Genetic Structure in Alaska Harbor Seals, *Phoca vitulina*, as a Framework for the Identification of Management Stocks. Administrative Report LJ-03-08. Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, CA.

Petit, D.R. 1993. "Management and Conservation of Migratory Landbirds Overwintering in the Neotropics." *In:* D.M. Finch and P.W. Stangel, eds., Status and Management of Neotropical Migratory Birds. U.S. Department of Agriculture, U.S. Forest Service General Technical Report RM-229. Fort Collins, CO. Pp. 70–92.

Petit, D.R., J.F. Lynch, R.L. Hutto, J.G. Blake, and R.B. Waide. 1995. "Habitat Use and Conservation in the Neotropics." *In:* T. E. Martin and D. M. Finch, eds., Ecology and Management of Neotropical Migratory Birds: A Synthesis and Review of Critical Issues. New York, NY: Oxford University Press. Pp. 145–197.

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, and T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Version: March 2005.Cornell Lab of Ornithology, Ithaca, NY. http://www.partnersinflight.org/cont_plan/ (accessed May 28, 2008).

Ritchie, R.J. 2006. ABR, Inc.—Environmental Research & Services, Fairbanks, AK. Personal communication—conversation with Terry Schick, ABR, Inc.—Environmental Research & Services. November.

Robertson, G.J., and R.I. Goudie. 1999. "Harlequin Duck (*Histrionicus histrionicus*)." *In:* A. Poole and F. Gill, eds. The Birds of North America, No. 466. Philadelphia, PA: The Birds of North America, Inc.

Sauer, J.R., and S. Droege. 1992. "Geographic Patterns in Population Trends of Neotropical Migrants in North America." *In:* J.E. Hagan III and D.W. Johnston, eds., Ecology and Conservation of Neotropical Migrant Landbirds. Washington, DC: Smithsonian Institution Press. Pp. 26–41.

Sauer, J.R., J.E. Hines, and J. Fallon. 2006. The North American Breeding Bird Survey, Results and Analysis 1966–2005, Version 6.2.2006. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD. http://www.mbr-pwrc.usgs.gov/bbs/bbs2005.html (accessed May 10, 2010).

Senner, S.E., and B.J. McCaffery. 1997. "Surfbird (*Aphriza virgata*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 266. Philadelphia, PA: The Birds of North America, Inc.

Skeel, M.A., and E.P. Mallory. 1996. "Whimbrel (*Numenius phaeopus*)." *In:* A. Poole and F. Gill, eds., The Birds of North America, No. 219. Philadelphia, PA: The Birds of North America, Inc.

Small, R.J., G.W. Pendleton, and K.W. Pitcher. 2003. "Trends in Abundance of Alaska Harbor Seals, 1983-2001." Marine Mammal Science. Vol. 19. Pp. 344–362.

Smith, R.J. 1997. "Status of the Lacs des Loups Marins Harbour Seal, *Phoca vitulina mellonae*, in Canada." Canadian Field-Naturalist. Vol. 111. Pp. 270–276.

Smith, R.J., D.M. Lavigne, and W.R. Leonard. 1994. "Subspecific Status of the Freshwater Harbor Seal (*Phoca vitulina mellonae*): A Re-assessment." Marine Mammal Science. Vol. 10. Pp. 105–110.

Stephenson, B. 2008. Lynx. Alaska Department of Fish and Game Wildlife Notebook Series. Alaska Department of Fish and Game, Anchorage, AK. http://www.adfg.state.ak.us/pubs/notebook/notehome.php (accessed January 14, 2011).

Stephenson, S.W., D.C. Zwiefelhofer, and R.J. Howard. 2002. Seabird Colony Survey of South and East Kodiak Island, Alaska, June 2001. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK.

Stephenson, S.W., D.C. Zwiefelhofer, and L. Slater. 2003. Seabird Colony Survey of North and West Kodiak Island, Alaska, June 2002. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK.

Swem, T., C. McIntyre, R.J. Ritchie, B.J. Bente, and D.G. Roseneau. 1994. "Distribution, Abundance, and Notes on the Breeding Biology of Gyrfalcons (*Falco rusticolus*) in Alaska." *In:* B.U. Meyburg and R.D. Chancellor, eds., Raptor Conservation Today. Robertsbridge, East Sussex, England: Pica Press, Helm Information. Pp. 437–444.

Trust, K.A., and H. Tangermann. 2002. National Malformed Amphibian Study. FY 2000: Kenai National Wildlife Refuge. Annual Progress Report. U.S. Fish and Wildlife Service, Anchorage, AK.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA, NRCS). 2008. The PLANTS Database. National Plant Data Center, Baton Rouge, LA. http://plants.usda.gov (accessed May 28, 2008).

U.S. Fish and Wildlife Service (USFWS). 2010. Endangered, Threatened, Proposed, Candidate, and Delisted Species in Alaska (Updated January 6, 2010). Anchorage Fish and Wildlife Field Office, Anchorage, AK.

———. 2008. Birds of Conservation Concern 2008. Division of Migratory Bird Management, Arlington, VA.

———. 1999. Population Status and Trends of Seaducks in Alaska. Division of Migratory Bird Management, Anchorage, AK.

Washington Natural Heritage Program (WANHP). 2006. *Draba lonchocarpa* Rydb. var. *vestita* Schulz. Washington Dept. of Natural Resources, Olympia, WA. http://www.dnr.wa.gov/nhp/refdesk/fguide/pdf/dralonves.pdf (accessed February 9, 2007).

Welsh, S.L. 1974. Anderson's Flora of Alaska and Adjacent Parts of Canada. Provo, UT: Brigham Young University Press.

Whitfield, S.M., K.E. Bell, T. Philippi, M. Sasa, F. Bolaños, G. Chaves, J.M. Savage, and M.A. Donnelly. 2007. "Amphibian and reptile declines over 35 years at La Selva, Costa Rica." Proceedings of the National Academy of Sciences USA. Vol. 104. No. 20. Pp. 8352–8356.

Williamson, F.S.L., and L.J. Peyton. 1962. Faunal Relationships of Birds in the Iliamna Lake Area, Alaska. Biological Papers of the University of Alaska, No. 5.

Wyman, R.L. 1990. "What's Happening to the Amphibians?" Conservation Biology. Vol. 4. Pp. 350–352.

TABLES

TABLE 17-1
Definitions of Vascular Plant Rarity Rankings Used by the Alaska Natural Heritage Program[a]

Rarity Ranking	Definition
Global Ranks[b]	
G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals) or because of biological and /or ecological factors making it especially vulnerable to extinction.
G2	Imperiled globally because of rarity (6 to 20 occurrences) or because of biological and/or ecological factors making it vulnerable to extinction throughout its range.
G3	Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (21 to 100 occurrences).
G4	Widespread and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5	Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
T#	Global rank of the described subspecies or variety.
G#G#	Global rank of species uncertain, best described as a range between the two ranks.
G#Q	Indicates some uncertainty about taxonomic status that might affect global rank.
State Ranks[c]	
S1	Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals) or because of biological and/or ecological factors making it especially vulnerable to extirpation from the state.
S2	Imperiled in state because of rarity (6 to 20 occurrences) or because of biological and/or ecological factors making it vulnerable to extirpation from the state.
S3	Rare or uncommon in the state (21 to 100 occurrences).
S4	Widespread and apparently secure in state, though it may be quite rare in parts of its range, especially at the periphery.
S5	Demonstrably secure in state, though it may be quite rare in parts of its range, especially at the periphery.
S#S#	State rank of species uncertain, best described as a range between the two ranks.
S#Q	Indicates some uncertainty about taxonomic status that might affect state rank.

Notes:

a. From Lipkin and Murray (1997).

b. Global ranks based on the worldwide status of the taxon assigned by The Nature Conservancy and an international network of natural heritage programs and conservation data centers.

c. State ranks based on the status of the taxon within Alaska assigned by the Alaska Natural Heritage Program.

TABLE 17-2
Rare Vascular Plant Taxa Listed by the Alaska Natural Heritage Program as Imperiled or Critically Imperiled as of 2006[a] for which Collection Localities Occur within a 161-kilometer Radius of the Midpoint between the Pebble Deposit and Iniskin Bay at Cook Inlet

Scientific Name	Range Overlap	Habitats	Global Rarity Ranking	State Rarity Ranking
Arabis lemmonii	Range and search area overlap	Alpine meadows and talus at ~2,000 meters elevation (Welsh, 1974; Hultén, 1968)	G5	S1
Catabrosa aquatica[b]	Range and search area may overlap but no known collections from Hultén (1968) occur within the search area	Wet places, marshes, shallow ponds and lakes (Welsh, 1974; Hultén, 1968)	G5	S1
Ceratophyllum demersum	Search area at the edge of known range	Springs, streams, and ponds where water is not stagnant (FNA, 2006)	G5	S1
Eleocharis quinqueflora	Range and search area overlap	Swamps, fens, wet meadows, hot springs, muskegs (FNA, 2006; Welsh, 1974; Hultén 1968)	G5	S1
Myriophyllum farwellii	Range and search area overlap	Ponds and small lakes (USDA, NRCS, 2008)	G5	S1
Geum aleppicum var. strictum	Range and search area overlap	Meadows, open woods and thickets (Hultén, 1968)	G5T5	S1S2
Botrycium virginianum	Range and search area overlap	Open woods and meadows, with preference for calcareous soils (Hultén, 1968)	G5	S2
Draba lonchocarpa var. vestita	Range and search area overlap	Arctic and alpine tundra and heathlands (Welsh, 1974)	G5T3	S2?[c]
Eriophorum viridicarinatum	Range and search area overlap	Marshes, meadows, bogs, fens, wet woods (FNA, 2006; Welsh, 1974; Hultén, 1968)	G5	S2
Potentilla drummondii	Range and search area overlap	Forest openings, meadows, and high ridges, middle to high elevations in the mountains (USDA, NRCS, 2008)	G5	S2
Smelowskia pyriformis[b]	Collections restricted to Alaska Range and the Kuskokwim mountains (Lipkin and Murray, 1997)	Steep, unstable alpine screes from ~600 to 1,700 meters elevation (Lipkin and Murray, 1997)	G2	S2
Botrychium alaskense	Range and search area overlap	Naturally and artificially disturbed meadows, roadsides, and riverbars. At higher elevations, in riverine meadows, sandy fields, and lightly vegetated scree slopes (Ada Hayden Herbarium, 2006)	G2G3	S2S3
Botrychium multifidum	Range and search area overlap	Moist to wet sandy meadows and woods (Anderson, 2005)	G5	S2S3
Carex heleonastes	Range and search area	Peat bogs, swamps, muskegs,	G4	S2S3

Scientific Name	Range Overlap	Habitats	Global Rarity Ranking	State Rarity Ranking
	overlap	bogs, and seeps (Welsh, 1974; Hultén, 1968)		
Eleocharis kamtschatica	Range and search area overlap	Brackish marshes, meadows, ponds, tidal flats, and saline meadows in coastal habitats (FNA, 2006; Welsh, 1974; Hultén, 1968)	G4	S2S3
Primula tschuktschorum	Range and search area overlap	Saturated to moist soils and open microsites such as frost boils (Carlson et al., 2006).	G2G3	S2S3
Saxifraga adscendens ssp. oregonensis	Range and search area overlap	Rock crevices, sandy places, glacial moraines (Welsh, 1974; Hultén, 1968)	G5T4T5	S2S3

Notes:

a. Listings from AKNHP (2006a).

b. These species have collection localities close to the edge of 100-mile-radius search area, but without direct overlap.

c. Question mark indicates the rarity ranking is unclear because insufficient data were available to support firm conclusions.

TABLE 17-3
Bird Species of Conservation Concern[a] Recorded in the Bristol Bay Drainages Study Areas, 2004–2006, and Listing Status by Agency or Conservation Organization

Species	USFWS[b]	BLM[c]	USFS[d]	ADF&G[e]	Audubon Alaska[f]	AKNHP[g]	NAWCP[h]	ASG[i]	BPIF[j]
Trumpeter Swan (*Cygnus buccinator*)	—[k]	Sensitive species	—	—	—	Vulnerable species	—	—	—
Surf Scoter (*Melanitta perspicillata)*	—	Sensitive species	—	Featured species for conservation	—	—	—		—
Black Scoter (*Melanitta americana*)	—	Sensitive species	—	Featured species for conservation	Declining or depressed population	Vulnerable species	—	—	—
Long-tailed Duck (*Clangula hyemalis*)	—	Sensitive species	—	Featured species for conservation	—	—	—	—	—
Red-throated Loon (*Gavia stellata*)	Species of conservation concern	Sensitive species	—	Featured species for conservation	Declining or depressed population	—	Species of high concern	—	—
Golden Eagle (*Aquila chrysaetos*)	—	—	—	Featured species for conservation	—	Vulnerable species	—	—	—
Gyfalcon (*Falco rusticolus*)	—	—	—	Featured species for conservation	—	—	—	—	Priority species for conservation
Peregrine Falcon (*Falco pereginus* ssp. *anatum*)	Species of conservation concern	—	—	Featured species for conservation	—	Imperiled/ vulnerable species	—	—	—
American Golden-Plover (*Pluvialis dominica*)	—	—	—	—	Declining or depressed population	—	—	Species of high concern	—
Lesser Yellowlegs (*Tringa flavipes*)	Species of conservation concern	—	—	Featured species for conservation	Declining or depressed population	—	—	Species of high concern	—
Whimbrel (*Numenius phaeopus*)	Species of conservation concern	—	—	—	Vulnerable population	—	—	Species of high concern	—

Species	USFWS[b]	BLM[c]	USFS[d]	ADF&G[e]	Audubon Alaska[f]	AKNHP[g]	NAWCP[h]	ASG[i]	BPIF[j]
Hudsonian Godwit (*Limosa haemastica*)	Species of conservation concern	Sensitive species	—	—	Vulnerable population	Imperiled/ vulnerable species	—	Species of high concern	—
Solitary Sandpiper (*Tringa solitaria*)	Species of conservation concern	—	—	Featured species for conservation	Declining or depressed population	—	—	Species of high concern	—
Surfbird (*Aphriza virgata*)	—	—	—	—	Declining or depressed population	Imperiled/ vulnerable species	—	Species of high concern	—
Short-billed Dowitcher (*Limnodromus griseus* ssp. *caurinus*)	Species of conservation concern	—	—	—	Vulnerable population	—	—	Species of high concern	—
Arctic Tern (*Sterna paradisaea*)	Species of conservation concern	—	—	Featured species for conservation	—	—	Species of high concern	—	—
Black-backed Woodpecker (Picoides arcticus)	—	—	—	Featured species for conservation	—	—	—	—	Priority species for conservation
Olive-sided Flycatcher (*Contopus cooperi*)	—	Sensitive species	—	Species of special concern and featured species for conservation	Declining or depressed population	—	—	—	Priority species for conservation
Gray-cheeked Thrush (*Catharus minimus*)	—	Sensitive species	—	Species of special concern	—	—	—	—	Priority species for conservation
Varied Thrush (*Ixoreus naevius*)	—	—	—	Featured species for conservation	Declining or depressed population	—	—	—	Priority species for conservation

Species	USFWS[b]	BLM[c]	USFS[d]	ADF&G[e]	Audubon Alaska[f]	AKNHP[g]	NAWCP[h]	ASG[i]	BPIF[j]
Blackpoll Warbler (*Dendroica striata*)	—	Sensitive species	—	Species of special concern and featured species for conservation	Declining or depressed population	—	—	—	Priority species for conservation
Rusty Blackbird (*Euphagus carolinus*)	Species of conservation concern	—	—	Featured species for conservation	Declining or depressed population	—	—	—	Priority species for conservation

Notes:

a. See Methods (Section 17.6.2) for definition of species of conservation concern.

b. U.S. Fish and Wildlife Service (USFWS): Birds of Conservation Concern (USFWS, 2008). Species are listed for one or two Bird Conservation Regions (BCRs) (western Alaska and/or northwestern interior forest) because the Bristol Bay drainages study areas are near the border between the two BCRs.

c. Bureau of Land Management (BLM): Alaska Threatened, Endangered, and Sensitive Species List (BLM, 2005).

d. U.S. Forest Service (USFS): Alaska Region Sensitive Species List (Goldstein et al., 2009).

e. Alaska Department of Fish and Game (ADF&G): Species of Special Concern (ADF&G, 1998) and Comprehensive Wildlife Conservation Strategy (ADF&G, 2006).

f. The Audubon Alaska Watchlist 2010 (Kirchhoff and Padula, 2010).

g. Alaska Natural Heritage Program (AKNHP): Vertebrate Species Tracking List for 2008 (AKNHP, 2008); state listings only; the highest conservation ranking for either the breeding or nonbreeding season is shown; secure and apparently secure rankings (roughly equivalent to low and moderate conservation-concern classes) are not shown.

h. North American Waterbird Conservation Plan (NAWCP) (Kushlan et al. 2002 and 2006); species in the higher concern classes only; species of low to moderate concern are not shown.

i. Alaska Shorebird Group (ASG): Alaska Shorebird Conservation Plan Version II (ASG, 2008); species of high concern only; species of low to moderate concern are not shown.

j. Boreal Partners in Flight Working Group (BPIFWG): Landbird Conservation Plan for Alaska Biogeographic Region (BPIFWG, 1999).

k. Dash indicates the species is not listed or its conservation ranking is below the threshold for inclusion in this study (see Section 45.6.2 and notes g, h, and i above).

TABLE 17-4
Mammal Species of Conservation Concern[a] Recorded or Expected to Occur in the Bristol Bay Drainages Study Areas, 2004–2006, and Listing Status by Agency or Conservation Organization

Species	National Marine Fisheries Service[b]	Bureau of Land Management[c]	Alaska Department of Fish and Game[d]	Alaska Natural Heritage Program[e]
Alaska tiny shrew[f] (*Sorex yukonicus*)	—[g]	—	—	Vulnerable species
Harbor seal (*Phoca vitulina*)	—	Sensitive species	Species of special concern	—

Notes:

a. See Methods (Section 17.6.2) for definition of species of conservation concern.

b. NMFS Marine Mammals [conservation status] (NMFS, 2010).

c. BLM Alaska Threatened, Endangered, and Sensitive Species List (BLM, 2005).

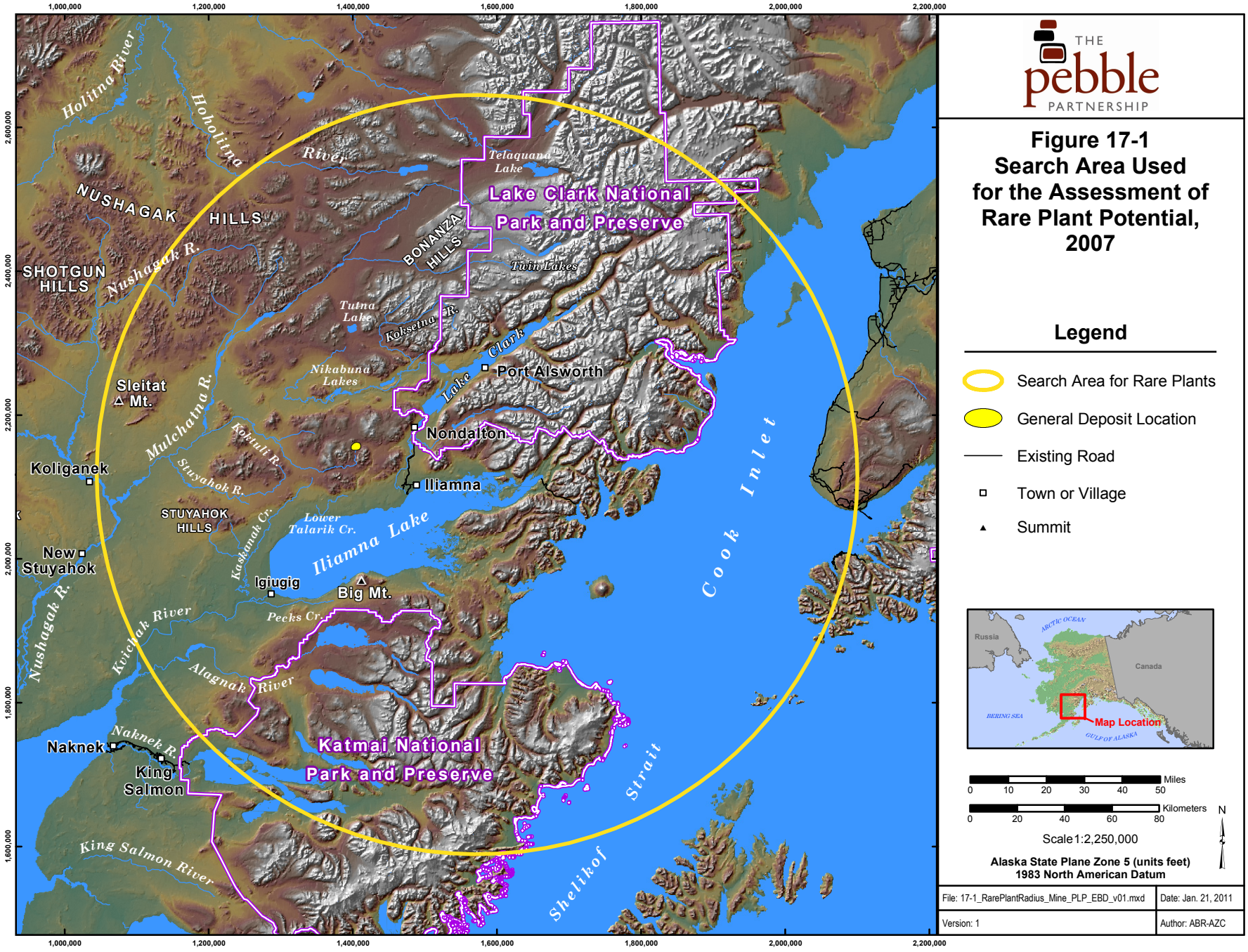
d. ADF&G Species of Special Concern (ADF&G, 1998) and Comprehensive Wildlife Conservation Strategy (ADF&G, 2006).

e. AKNHP Vertebrate Species Tracking List for 2008 (AKNHP, 2008); state listings only; the highest conservation ranking is shown; secure and apparently secure rankings (roughly equivalent to low and moderate conservation-concern classes) are not shown.

f. The Alaska tiny shrew has not been recorded in the Bristol Bay drainages study areas (small mammals studies have not been conducted), but the area is within the species range and suitable habitats are available.

g. Dash indicates the species is not listed or its conservation ranking is below the threshold for inclusion in this study (see Section 17.6.2 and note e above).

FIGURE



THE pebble PARTNERSHIP

Figure 17-1
Search Area Used for the Assessment of Rare Plant Potential, 2007

Legend

- Search Area for Rare Plants
- General Deposit Location
- Existing Road
- Town or Village
- Summit

Miles
0 10 20 30 40 50

Kilometers
0 20 40 60 80

N

Scale 1:2,250,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: 17-1_RarePlantRadius_Mine_PLP_EBD_v01.mxd	Date: Jan. 21, 2011
Version: 1	Author: ABR-AZC