U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Gavia adamsii*

COMMON NAME: Yellow-billed loon

LEAD REGION: 7

INFORMATION CURRENT AS OF: May 2010

STATUS/ACTION
__Initial 12-month Petition Finding:
___ not warranted
___ warranted
__X_ warranted but precluded (also complete (c) and (d) in section on petitioned candidate species- why action is precluded)
__ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
___ New candidate
_X_ Continuing candidate
___ Non-petitioned
_X_ Petitioned - Date petition received: __April 5, 2004_____
_X_ 90-day positive - FR date: __June 6, 2007
_X_ 12-month warranted but precluded - FR date: _March 25, 2009
_N_ Is the petition requesting a reclassification of a listed species?
_N_ Listing priority change
Former LP: _8__
New LP: _8
Latest Date species became a Candidate: _____
___ Candidate removal: Former LP: ___
___ A - Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F - Range is no longer a U.S. territory.
___ I - Insufficient information exists on biological vulnerability and threats to support listing.
___ M - Taxon mistakenly included in past notice of review.
___ N - Taxon may not meet the Act's definition of "species."
___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Class *Aves* (Birds); Family *Gaviidae*

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:
U.S.: Breeding: northern and northwestern Alaska; wintering: marine waters of Alaska, Washington; occasional in other states in winter
Russia: Breeding range on Arctic coast and Gulf of Anadyr; migration and wintering Chukotka, Kamchatka, Sea of Okhotsk, Barents Sea; occasional in other provinces in migration and winter
Canada: Breeding range on Arctic coast and islands, and throughout Nunavut; wintering in marine waters of British Columbia; occasional in other provinces in migration and winter
Norway: Wintering in marine waters (also in small numbers in marine waters off the British Isles)
Asian Pacific: Wintering: Marine waters of East Sea (Sea of Japan) and Yellow Sea bounded by Japan, China, North and South Korea

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Same as historical occurrence, with possible breeding range contraction in western Russian Arctic and Anadyr

LAND OWNERSHIP:
U.S.: In Alaska breeding areas: U.S. Bureau of Land Management (BLM), U.S. National Park Service (NPS), State of Alaska, possibly on Alaska Native Corporation lands. In wintering areas of Alaska and Washington: occur in State waters (0-3 nautical miles (nm) from shore), and within the U.S. Exclusive Economic Zone (3-200 nm from shore). The majority of the U.S. nesting population is on U.S. Bureau of Land Management land (National Petroleum Reserve-Alaska (NPR-A)).

Other countries: Unknown

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BIOLOGICAL INFORMATION

Species Description
A field characteristic that distinguishes yellow-billed loons from common loons is their larger yellow or ivory-colored bill. Adults weigh 4,000 to 6,000 grams (8.8 to 13.2 pounds) and are 774 to 920 millimeters (30 to 37 inches) in length. Breeding (alternate) plumage of adults of both sexes is black on top with white spots on the wings and underside, and white stripes on the neck. Non-breeding (basic) plumage is gray-brown with fewer and less distinct white spots than breeding plumage, with paler undersides and head, and a blue-gray bill. Hatchlings have dark brown and gray down, and juveniles are gray with a paler head (North 1994, p. 2). Yellow-billed

loons are specialized for aquatic foraging with a streamlined shape and legs near the rear of the body, and are unable to take flight from land.

Taxonomy

The yellow-billed loon (Order Gaviiformes, Family Gaviidae) is one of the largest of the five loon species and similar in appearance to the common loon (*Gavia immer*). There are no recognized subspecies or geographic variations (American Ornithologists' Union 1998, p. 5).

Habitat/Life History

There is no reliable scientific information on lifespan and survivorship, but as large-bodied birds with low clutch size, yellow-billed loons are probably K-selected (long-lived and dependent upon high annual adult survival to maintain populations). On average, individuals reach sexual maturity at 3 years of age, but may not acquire breeding territories until at least 4 years of age (North 1994, p. 15). The average age at first breeding for common loons is 6 years (Evers 2004, p. 18).

Yellow-billed loons forage underwater for fish and aquatic invertebrates. Limited information exists on specific prey species consumed. Marine prey species collected from loons wintering in southeast Alaska and Canada include fish such as sculpins (*Leptocottus armatus*, *Myoxocephalus* sp.), Pacific tomcod *(Microgadus proximus*), and rock cod (*Sebastodes* sp.), and invertebrates such as amphipods (*Orchomonella* sp., *Anonyx nirgax*), isopods (*Idothea* sp.), shrimps (*Pandalus danae*, *Spirontocaris ochotensis*), hermit crabs (*Pagarus* sp.), and marine worms (*Nereis* sp.) (Bailey 1922, p. 205; Cottam and Knappen 1939, p. 139; North 1994, pp. 6-7; Earnst 2004, pp. 9-10). Pacific sand dabs (*Citharichthys sordidus*) were found in a yellow-billed loon collected extralimitally (i.e., outside the limits of the species' range) in Baja California (Jehl 1970, p. 376) and sculpin (*Myoxocephalus scorpius*) in a specimen collected in Norway (Collett 1894, p. 280). Prey species taken in other wintering grounds, such as in the Yellow Sea, which supports 276 fish species and 54 crustacean species (UNDP 2002, p. 8) are unknown.

During the breeding season, foraging habitats include lakes, rivers, and the nearshore marine environment. Successfully breeding adults feed their young almost entirely from the brood-rearing lake (North 1994, p. 14). Ninespine sticklebacks (*Pungitius pungitius*) and least cisco (*Coregonus sardinella*) are thought to be the main foods of chicks in Alaska (Earnst 2004, p. 9). Other freshwater prey available in Alaska that are likely utilized include Alaska blackfish (*Dallia pectoralis*), fourhorn sculpins (*M. quadricornus*), amphipods, and isopods (Earnst 2004, p. 9), as well as aquatic plant material (Sjölander and Ågren 1976, p. 460). In arctic Russia, limited stomach content analysis indicates sticklebacks, salmon, crustaceans, beetles, and plant vegetation are consumed during the breeding season (Uspenskii 1969, p. 130).

Yellow-billed loons nest exclusively on margins of lakes in coastal and inland low-lying tundra from 62° to 74° North (N) latitude. Lakes that support breeding loons have abundant fish populations. Studies of yellow-billed loon habitat have identified several characteristics that predict loon presence. These may be indirect measures or correlates of the actual characteristics necessary or preferred by loons, such as fish availability. Predictors of yellow-billed loon

presence on a lake include water depths greater than 2 meters (m) or 6.5 feet (ft) allowing for unfrozen water under the ice during winter; large lake areas (at least 13.4 hectares (ha) or 33 acres (ac)); connections to streams that may supply fish; highly convoluted, vegetated, and low-lying shorelines; clear water; and dependable water levels (Earnst et al. 2006, pp. 230-233; Stehn et al. 2005, pp. 9-10; North 1994, p. 6). Probability of yellow-billed loon presence on a lake increases with the absence of Pacific loons (*Gavia pacifica*) (Earnst et al. 2006, p. 233; Stehn et al. 2005, p. 9). Breeding lakes may be near major rivers, but are usually not connected to them, possibly because nests along lakes with river connections are prone to flooding, or turbidity associated with fluctuating water levels compromise foraging success (North and Ryan 1989, p. 303). Falling water levels may also expose loon nests to increased risk of predation (Kertell 1996, p. 356).

Breeding territories (areas defended against other yellow-billed loons and other loon species, particularly Pacific loons) may include one or more lakes or parts of lakes. Territory size, likely dependent upon lake size and quality, ranged from 13.8 to greater than 100 ha (34 to greater than 247 ac) on the Colville River Delta, Alaska (North 1986, as cited in North 1994, p. 10). It is thought that individual loons occupy the same breeding territory throughout their reproductive life. Some breeding lakes are "known to be reoccupied over long time spans" (North 1994, p. 10), most likely by the same monogamous pair (North 1994, p. 10), as observed in common loons (Evers 2004, p. 13).

Nest sites are usually located on islands, hummocks, or peninsulas, along low shorelines, within 1 m (3 ft) of water. The nest location, which may be used in multiple years, usually provides a better view of the surrounding land and water than other available lakeshore locations. Nests are constructed of mud or peat, and are often lined with vegetation. One or two large, smooth, mottled brown eggs are laid in mid- to late June (North 1994, pp. 11-12). Egg replacement after nest predation is unusual; unless failure occurs very early in the season, the short arctic summer probably precludes the production or success of replacement clutches (Earnst 2004, p. 8). Hatching occurs after 27 to 28 days of incubation by both sexes. Although the age at which young are capable of flight is unknown, it is probably similar to common loons (8-9, possibly up to 11, weeks). The young leave the nest soon after hatching, and the family may move between natal and brood-rearing lakes. Both males and females participate in feeding and caring for young (North 1994, p. 13).

Historical and Current Range/Distribution

Yellow-billed loons have not been thoroughly surveyed, so it is difficult to identify changes in range and distribution. Most of the information available for Alaska and Canada is recent, as described below. Potential changes from historical ranges in Russia are also described.

Yellow-billed loons nest near freshwater lakes in arctic tundra of Alaska on the Arctic Coastal Plain (ACP), northwestern Alaska, and St. Lawrence Island; in Canada east of the Mackenzie Delta and west of Hudson Bay; and in Russia on a relatively narrow strip of coastal tundra from the Chukotka Peninsula in the east and on the western Taymyr Peninsula in the west, with a

break in distribution between these two areas (Earnst 2004, p. 3; North 1993, p. 42; Red Data Book of the Russian Federation 2001, p. 366; Ryabitsev 2001, p. 22; Il'ichev and Flint 1982, p. 277; Pearce et al. 1998, p. 369). Loons are sparsely distributed across their range, although, perhaps because of non-uniform quality of habitat, at a large scale breeding birds are somewhat clumped in distribution.

Yellow-billed loons use nearshore and offshore marine waters adjacent to their breeding areas for foraging in summer. Such habitats are likely used by both breeding adults and younger or non-territorial birds (Earnst 2004, p. 7). Earnst (2004, pp. 6-7) reviewed yellow-billed loon distribution information obtained from fixed-wing aerial waterfowl surveys that Fischer et al. (2002) conducted in 1999 and 2000 off the coasts of Canada's arctic islands and the ACP of Alaska between Cape Halkett and Brownlow Point. Similar surveys conducted between Barrow and Demarcation Point in 2001 also included yellow-billed loon observations in Elson Lagoon (Fischer 2001, p. 4; Fischer and Larned 2004, p. 146). While conducting fixed-wing aerial surveys for common eiders in late June of 1999 through 2007, between 23 and 99 yellow-billed loons were observed in nearshore waters and along barrier islands of the Beaufort and Chukchi Seas (Dau and Larned 2007, p. 18). Yellow-billed loons used lagoons and nearshore waters along the coast of St. Lawrence Island in summer in the 1950s (Fay and Cade 1959, pp. 92, 100). In Russia, Solovyova (coastal boat surveys; 2007, p. 6) reported densities of 0.24 yellow-billed loons/km in coastal waters near the Kyttyk Peninsula and Ayon Island at the northern end of Chaun Bay in western Chukotka, and 0.04 yellow-billed loons/km at the southern end of Chaun Bay near the Chaun River Delta in 2006. Vronskiy (1987, p. 30) observed individual yellow-billed loons and pairs in bays 100-150 m (328-492 ft) offshore of northwestern Taymyr during summer. Yellow-billed loons occurred in summer along the coast of Wrangel Island, although there were no indications of nesting on the island (Stishov et al. 1991, p. 20). In boat-based surveys in the Kara and Barents Seas, arctic (*Gavia arctica*) and red-throated (*G. stellata*) loons were abundant in the nearshore marine waters of the western Kara Sea and in the Ob' and Yenisey estuaries, especially in Baidaratskaya Bay, and occurred in smaller numbers in the Pechora Bay in the Barents Sea in August and September 1995, but no yellow-billed loons were observed (Decker et al. 1998, pp. 9, 11). In subsequent boat surveys between 1998 and 2003, only one yellow-billed loon was observed in mid-August 1998 in coastal waters northeast of Dolgy Island (west of Vaigach Island) in the Pechora Sea (M. Gavrilo, in litt. 2008).

Wintering habitats include sheltered marine waters less than 30 m (98.4 ft) deep, such as fiords and areas between islands along the inner coast in Norway (Strann and Østnes 2007, p. 2). Schmutz (2008, p. 1) found that throughout migrating and wintering seasons, yellow-billed loons marked with satellite transmitters occurred from 1 to 20 miles offshore. The wintering range includes coastal waters of southern Alaska and British Columbia from the Aleutian Islands to Puget Sound; the Pacific coast of Asia from the Sea of Okhotsk south to the Yellow Sea; the Barents Sea and the coast of the Kola Peninsula; coastal waters of Norway; and possibly Great Britain (Earnst 2004, pp. 13-14; North 1993, pp. 42-43; Ryabitsev 2001, p. 22; Schmutz in litt. 2008, p. 1; Strann and Østnes 2007, p. 2; Burn and Mather 1974, p. 278; Gibson and Byrd 2007, p. 68). Some yellow-billed loons may winter in interior lakes or reservoirs in North America (North 1994, p. 3).

Winter distribution and abundance of yellow-billed loons are not well documented, but some information is available from marine bird surveys. Earnst (2004, p. 14) summarized loon observations in boat-based marine bird population surveys of Lower Cook Inlet, Prince William Sound, and Kodiak Island. In these surveys, estimates of the number of yellow-billed loons ranged from tens to low hundreds, with wide confidence limits. In many cases, loons were not identified to species. Strann and Østnes (2007, p. 3) counted 1,160-1,605 yellow-billed loons during surveys conducted off the coast of Norway from 1986 to 1994, confirming Norway as the most important known wintering area for the species in Europe. No surveys have been conducted in Asian wintering areas. In some regularly used yellow-billed loon wintering areas, such as the Yellow Sea, the Aleutian Islands, and Great Britain, their scattered marine distribution and low abundance may have contributed to the impression that yellow-billed loons are vagrants or rare visitors (Lepage 2008, p. 1; Gibson and Byrd 2007, p. 68; Dudley et al. 2006, p. 533; Scott and Shaw 2008, pp. 241-248).

Immature loons and possibly some non-breeding adults stay in wintering areas throughout the year (North 1994, p. 4). Earnst (2004, pp. 11-12) summarized yellow-billed loon observations in summer marine boat-based surveys conducted in lower Cook Inlet and Prince William Sound in southcentral Alaska, and in Southeast Alaska. Estimates from all these surveys totaled only 339 yellow-billed loons, but many loons were not identified to species (Earnst 2004, p. 11). In boat-based surveys of murrelets conducted in July of 2002-2004 from Icy Bay to LeConte Bay in southeast Alaska, Kissling et al. (2007, Appendices 7, 8) counted 20 yellow-billed loons. Yellow-billed loons have been observed throughout summer months in the Aleutians (Gibson and Byrd 2007, p. 68). According to the Red Data Book of Kamchatka (2006, p. 92), non-breeding birds occur off the coast of Kamchatka in summer.

Yellow-billed loon migration routes are thought to be primarily marine. J. Schmutz (in litt. 2008, p. 1) found that yellow-billed loons marked with satellite transmitters generally remained between 1 and 20 miles from land during migration and winter. Yellow-billed loons migrate singly or in pairs, but gather in polynyas (areas of open water at predictable, recurrent locations in sea-ice covered regions), ice leads (more ephemeral breaks in sea ice, often along coastlines), and early-melting areas off river deltas near breeding grounds in spring along the Beaufort Sea coast of Alaska and Canada (Barry et al.1981, pp. 29-30; Barry and Barry 1982, p. 25; Woodby and Divoky 1982, p. 406; Johnson and Herter, 1989, p. 9; Barr 1997, pp. 12-13; Alexander et al. 1997, pp. 15, 17; Mallory and Fontaine 2004, pp. 52-53).

Recent observations of yellow-billed loons in the Beaufort Sea during migration establish that at least some yellow-billed loons breeding in Canada's Arctic Islands and along the adjacent Canadian coast use this migration route. J. Schmutz (USGS Alaska Science Center, pers. comm. 2010) attached satellite transmitters to two yellow-billed loons in the Canadian breeding area in 2009; both birds migrated west along the Beaufort Sea coast and south through the Bering Strait to either the Alaska Peninsula or Asian waters. North (1993, pp. 45-46) examined evidence of alternative migration routes for yellow-billed loons wintering in southeast Alaska and British Columbia, suggesting that they could migrate overland to mainland breeding areas in Canada,

particularly around Great Slave Lake. Yellow-billed loons have been observed on inland lakes in Canada and Alaska (North 1993, pp. 43, 46). The existence of this route is still hypothetical, and the number of yellow-billed loons occurring in interior mainland Canada is unknown (discussed below under Population Estimates/Status).

Yellow-billed loons breeding in Alaska are also being studied to determine their migration routes. Twenty-six yellow-billed loons captured on the ACP between 2002 and 2009 were outfitted with satellite transmitters (J. Schmutz in litt. 2008, p. 1; pers. comm. 2010). All of them migrated south to Asia, predominantly along the Russian coastline from the Chukotka Peninsula (either through the Bering Strait or across the mountains from the north side of the Chukotka Peninsula to the Gulf of Anadyr), and along the Kamchatka coast. They wintered in the Yellow Sea and Sea of Japan off the coasts of China, North Korea, Russia, and Japan (near Hokkaido). All 10 yellow-billed loons captured on the Seward Peninsula, Alaska and fitted with transmitters in 2007 and 2008 also used the Bering Strait region after leaving breeding grounds. Five of these loons migrated to Asian breeding grounds as described above for ACP breeding birds; the other 5 wintered throughout the Aleutian Islands from Shemya Island in the west to the Semidi Islands off the coast of the Alaska Peninsula (Schmutz in litt. 2008, p. 1). Most of these yellow-billed loons departed breeding areas in late September, arrived in wintering locations in mid-November, started spring migration in April, and arrived on breeding grounds in the first half of June; these dates are consistent with breeding ground arrival dates reported by North (1994, p. 5). Non-breeders or failed nesters may start their fall migration in July.

The migration routes of yellow-billed loons breeding in Russia have not been studied. Because of the proximity of the Chukotka Peninsula to the ACP in Alaska, and the fact that ACP breeding yellow-billed loons use the Chukotka Peninsula during migration (J. Schmutz in litt. 2008, p. 1), it is likely that some or all yellow-billed loons from eastern Russia migrate through the Bering Strait to Asian wintering areas.

In other parts of the range, data are sparse. The Red Data Book of the Russian Federation (2001, p. 366) stated that the species no longer nests in European Russia where it was formerly found, e.g., the Kola Peninsula, the archipelago of Novaya Zemlya, and Vaigach and Ainovy Islands in the Kara Sea. It is unclear how abundant or widespread the species was in these areas historically (However, Kalyakin (2001, p. 10) reports finding it nesting on Novaya Zemlya, although it is "extremely rare."). According to the Red Data Book of the Yamal-Nenets Autonomous District (1997) near the western end of the Russian breeding range, only a few non-breeding yellow-billed loons were recorded in the District in the previous 20 years. Strann (in litt. 2008) speculated that since the early 1990s there may have been a decline in the number of yellow-billed loons in the main Norway wintering area, which would be consistent with a western Russian breeding ground range contraction if birds nesting in western Russia migrate to Norway during winter (which seems logical). We were unable to find either the source of the Red Data Book statements or supporting evidence for this potential range contraction. In eastern Russia, yellow-billed loons apparently no longer nest along the northern coast of the Sea of Okhotsk where they occurred 30-50 years ago, nor on the Anadyr River delta (Red Data Book of the Russian Federation 2001, p. 366; Red Data Book of the Northern Far East of Russia 1998, p.

97). However, Solovyova (in litt. 2008) reported that the number of breeding yellow-billed loons may be increasing in some locations in eastern Siberia, specifically near Chaun Bay in western Chukotka, and at Belyaka Spit near Kolyuchin Bay in northeastern Chukotka. A study of yellow-billed loons near Chaun Bay is underway in 2010, and will provide more information.

In summary, we found unsubstantiated reports that the species may no longer be found in parts of its historical range in Russia, but there is somewhat contradictory information for some areas and a lack of survey data for all areas. Yellow-billed loons might also be increasing in some areas in Russia. There is insufficient information to make inferences about changes in distribution or range in other wintering grounds.

Population Estimates/Status

Arctic Coastal Plain (ACP), Alaska

Yellow-billed loon population indices on the ACP of Alaska were determined by two independent fixed-wing aerial transect surveys conducted each year by the Service's Migratory Bird Management program. Surveys were flown in early June each year from 1992 through 2008 (NSE survey, 1992-2008, an average of 1,304 km^2 (503.5 mi^2) transect area that sampled a total area of 30,465 km^2 (11,763 mi^2), for 4.3 percent coverage) and late June each year from 1986 through 2006 (ACP survey, 1986-2006, average of 1,256 km^2 (485 mi^2) transect area which sampled a total area 61,645 km^2 (23,801 mi^2), for 2.0 percent coverage of a larger area than that covered by the NSE survey). The average population index from the NSE survey is 1,119 yellow-billed loons (95 percent confidence interval (CI) = 1,012 to 1,226, Larned et al. 2009, p. 24). The confidence intervals around these 16- and 21-year means incorporate the variation due to within-year sampling error, the spatial variability among transects and within strata, and variation among years related either to detection rate (observer ability, habitat change, weather conditions) or the availability of birds to be seen (arrival or departure of population components, behavior associated with nesting chronology). One study integrated results from both the early and late surveys, incorporating covariates adjusting for detection rates (Earnst et al. 2005). The 12-year mean (1992 through 2003) resulted in an estimate of 2,221 individuals (95 percent CI = 1,209-3,233) in early June and 3,369 individuals (95 percent CI = 1,910-4,828) in late June (Earnst et al. 2005, p. 295). Another estimate of population size was determined by lake-circling, aerial searches of lakes greater than 7-ha (17.3-acre) on 7 × 7-km (4.35 × 4.35-mi) plots as part of a 2003-2004 study of yellow-billed loon habitat preferences (Stehn et al. 2005, pp. 1-37). This survey was flown from June 15 through 22 each year. Based on average density observed, the estimated total population index was 2,544 (95 percent CI = 1,780-3,308) yellow-billed loons (Stehn in litt. 2008, p. 1).

The late June survey described above, as the ACP survey, was terminated after 2006. A survey of a similar area, but flown earlier in June, about the same time as the NSE survey described above, was substituted for both the previous surveys. It is now called the ACP survey. In 2009, the index for yellow-billed loons (1,693) was the highest in the 18 years of the survey, 47 percent above the long-term mean (Larned et al. 2010, p. 8).

Western Alaska

Seward Peninsula and Cape Krusenstern fixed-wing aerial lake-circling surveys, on 12 × 12-km (7.46 × 7.46-mi) sample plots, were flown in June of 2005 and 2007, and resulted in an estimate of 431 (95 percent CI = 280-582) yellow-billed loons on these western Alaska breeding grounds (Bollinger et al. 2008, p. 1). Additional aerial transects sampling an area of 15,234 km^2 (5,882 mi^2) were flown on Selawik National Wildlife Refuge and adjacent wetlands in June in the years 1996 and 1997 (Platte 1999, p. 3), but only three yellow-billed loons were sighted, resulting in an estimated mean population index of 44 birds (95 percent CI = 0-95) (USFWS unpublished data). The NPS is conducting surveys on the Seward Peninsula in 2009 and 2011, and will produce population estimates and will evaluate trends from these surveys after 2011 (M. Flamme, NPS, pers. comm.). Yellow-billed loons were documented nesting on St. Lawrence Island in the 1950s (Fay and Cade 1959, pp. 84, 100), but there is no more recent information. Adding western Alaska population estimates to those from the ACP results in an estimated total of 3,000 to 4,000 yellow-billed loons on breeding grounds in Alaska.

Canada

Although overall breeding population estimates for yellow-billed loons in Canada do not exist (http://www.bsc-eoc.org/clls-bw1.html, accessed May 4, 2010), and yellow-billed loons are not summarized in the Waterfowl Population Status annual reports compiled by the U.S. and Canadian governments for North American Waterfowl (USFWS 2007, pp. 1–62), several recent fixed-wing aerial waterfowl surveys included loon observations in parts of Nunavut and Northwest Territories. Loons were not the focus of the surveys, so it is possible that observer effort or identification ability varied, and no visibility correction factors or seasonal timing factors were applied. Hines (in litt. 2008) estimated there were 500-1,000 yellow-billed loons on Banks Island, based on helicopter aerial surveys conducted in 1992 and 1993. Helicopter surveys yielded estimates ranging from 659 (SE 359) to 1,784 (SE 502) on northwest Victoria Island, and from 98 (SE 70) to 258 (SE 146) birds in the southwest part of the island (Raven and Dickson 2006). In 2008, Groves, Mallek and Moser (2009, p. 28, Table 3) estimated 2,671 (SE 335) yellow-billed loons on western Victoria Island (an area roughly but not exactly comparable to the area surveyed by Raven and Dickson (2006) using fixed-winged aircraft (D. Groves, Service, pers. comm.). A fixed-winged survey included Kent Peninsula and southeastern Victoria Island in 2005, and Queen Maud Gulf, King William Island, Rasmussen Lowlands, and near Kugluktuk in 2006; all areas from both years were repeated in 2007 but with fewer transects sampled per unit area. The combined estimate for both areas from 2005-2006 fixed-winged surveys and the 2007 estimate were similar, at 2,500-3,000 birds (Conant et al. 2006, p. 7; Conant et al. 2007, p. 12; Groves, Mallek, MacDonald and Moser 2009, p. 29, Table 3). In 2009, Groves and Mallek (2010, p. X, Table 3) estimated 2,408 (SE 544) yellow-billed loons on southern and southeastern Victoria Island, King William Island, and the north coast mainland. The total area surveyed in 2009 included areas surveyed previously, but was not exactly comparable to the area surveyed in any previous year. The range of these point estimates suggests that between 3,750-6,000 birds occur on breeding grounds in the surveyed areas.

The rest of the yellow-billed loon's range on the Canadian mainland has not been surveyed. Based on the vast number of large, fish-bearing lakes north of treeline (an area of 500,000-

750,000 km^2) (193,051-289,577 mi^2) minus the surveyed areas on the mainland (46,000 km^2), (17,761 mi^2) and using opportunistic observations of yellow-billed loons by Northwest Territory and Nunavut checklist survey cooperators over the last decade, Poter (in litt. 2008, p. 2, adjusted from Hines in litt. 2008, p. 1) calculated that a density of 0.01-0.02 birds/km^2 would yield an estimate of 4,500-14,000 birds in mainland breeding areas in Canada, not including surveyed areas in the arctic described in the previous paragraph. This estimate is based on a very large land area bounded at the southern end by an area of documented yellow-billed loon breeding between Great Slave Lake and Baker Lake, particularly in or near the Thelon Game Sanctuary (North 1993, p. 42). Between this area and the arctic coast is a large area where breeding has not been documented (North 1993, Figure 2). Fair (2002, p. 30) estimated the yellow-billed loon population on interior Canadian breeding grounds to be 4,800, using a density of 0.02 loons in a 100,000 km^2 area around the Sanctuary, and a lower density of 0.007 for the wider area of 400,000 km^2. Fair's estimate of 4,800 is close to the lower end of Poter's (2008, p. 1) estimate of 4,500. We believe Fair's analysis more accurately reflects likely yellow-billed loon distribution in Canada, because it reflects a lower average density for the large area where breeding has not been documented. Combining the 4,500 to 14,000 breeding birds estimated for interior Canada, and 3,750 to 6,000 breeding birds estimated for the arctic (and rounding to thousands), we conclude that the Canadian breeding population size is 8,000 to 20,000, but that it is most likely at the lower end of this range.

Russia

Information on the breeding-ground population size of yellow-billed loons for Russia is limited. Hodges and Eldridge (2001, Appendix 2) estimated 674 yellow-billed loons (coefficient of variation 0.55 (C.V., a measure of dispersion in a probability distribution)) in a 157,611-km^2 (60,854-mi^2) fixed-wing aerial survey area of the eastern Siberia arctic coast from Kolyuchin Bay to the Lena River Delta. We know of no other loon surveys within the breeding range of the yellow-billed loon in Russia. Red Data Books for the Russian Federation (2001, pp. 366-367), Yakutia (1987, p. 33), and the Northern Far East of Russia (1998, pp. 97-98) do not offer population estimates. Kondratiev (1989, p. 37) estimated that 2,000 birds nested in Chukotka, but did not give a basis or sources for his estimate. Fair (2002, p. 31) projected, based on this estimate of 2,000 birds in Chukotka (Kondratiev 1989, p. 37), that another 2,000 nested on the Taymyr Peninsula, and that perhaps another 1,000 were scattered across the arctic coast, giving 5,000 birds on Russian breeding areas. Syroechkovsky (in litt. 2008) suggested (based on field observations but not scientific surveys) that the number of birds on breeding grounds (including non-breeding birds) is around 3,000 for Chukotka, 500 for Yakutia, and about 1,200 for Taymyr, for a total of around 4,700 birds. However, Solovyova (in. litt. 2008, p. 1; calculated from Solovyova 2007, p. 6) recently estimated the post-breeding population of the Kyttyk Peninsula on Chaun Bay in western Chukotka at 1,000, and the post-breeding population of nearby Ayon Island at 900 birds. Given Solovyova's (in. litt. 2008, p. 1) estimates for her study area in Chukotka, she estimated that the total breeding ground population in Chukotka might be as high as 5,000 birds. If the Chukotka population is 5,000, the total for Russia could be as high as 8,000 based on habitat availability. Thus, our best information suggests the Russian breeding population is between 5,000 and 8,000 birds.

In summary, the global breeding ground population size for yellow-billed loons is unknown, but probably at the lower end of the range of 16,000 to 32,000. The Alaska population estimate of 3,000 to 4,000 is derived from surveys. Less certain estimates based on the amount of available habitat (plus limited survey data) are the lower end of the range of 8,000 to 20,000 birds in Canada, and 5,000 to 8,000 in Russia.

Population Trends - Alaska

The only population trends available for yellow-billed loons breeding in Alaska are on the ACP, where the ACP and NSE waterfowl surveys are conducted. We note that because we count only the breeding component of the population, the total population could decline without being detected for a number of years. This could occur because increased mortality of breeding birds could be masked by movements of birds without territories (either sub-adult birds or adults which have not found territories) into vacated territories. With this caution, we believe the time series of at least 17 years for the surveys described below gives us a reasonably reliable data set for observing population trends, and these data represent the best information available at this time.

A population growth rate, or lambda, less than 1.00 would indicate population decline (negative "growth"), while a lambda greater than 1.00 would indicate population growth. For the ACP survey 1986-2006, the average growth rate was 0.9886 (95 percent CI = 0.9625-1.0154) (Mallek et al. 2007, p. 21), and for the NSE survey 1992-2008 (a smaller area than that covered by the ACP survey, and surveyed earlier in June), the average growth rate was 1.016 (95 percent CI = 0.995-1.036) (calculated from Larned et al. 2009, Figure 1). Thus, these surveys provide slightly conflicting perspectives, with one suggesting a stable or slightly declining population (with a point estimate of a decline of ~1.1 percent/yr.) and the other suggesting a stable or slight increasing population (with a point estimate of an increase of ~1.6 percent /yr.) on the ACP.

Earnst et al. (2005, pp. 289-304) sought to improve the estimates above by using a statistical model that takes into account possible confounding factors of survey type, spring timing, and observer experience. They used this model to analyze ACP and NSE survey data through 2003. Controlling for these confounding factors, they estimated average population growth rate to be 0.991 (95 percent CI = 0.964-1.018), also indicating a stable or slightly declining population.

We also examined a subset of the NSE data through 2008 that included only the observations of the most consistent and experienced pilot-observer, who has flown all 16 early-June NSE surveys during 1992-2008. Each survey includes observations of two observers: the pilot-observer in the left-side seat of the aircraft, and a second observer in the right-side seat. There have been numerous "right-side observers" over the course of the NSE survey. Each of these observers has a different ability to see and identify birds, and this ability often increases over successive surveys as the observer gains experience. Our analysis of the left-side pilot-observer eliminated the necessity to estimate the variable magnitudes of influence of right-side observer experience. In addition, the increased interest in yellow-billed loons in 2002 may have influenced new right-side observers to search more intensively for yellow-billed loons than earlier observers, who focused on waterfowl. Our analysis of the pilot-observer data from the NSE survey also

eliminated the need to reconcile the later timing and different survey extent of the ACP survey. The average growth rate using this subset of data was slightly lower and more precisely estimated at 0.986 (95 percent CI = 0.967-1.006) (USFWS unpublished data) than the estimate of 0.991 from Earnst et al.'s (2005, p. 298) model, and the results also indicate a relatively stable or slightly declining population.

As stated above in the population section, the late June survey described above as the ACP survey was terminated after 2006, and a survey of a similar area but flown earlier in June, about the same time as the NSE survey described above, was substituted for both the previous surveys. It is now called the ACP survey. In 2009, the index for yellow-billed loons (1,693) was the highest in the 18 years of the survey, and this new data point resulted in a significant positive trend over both the long term (growth rate 1.021, 90% CI = 1.005-1.037) and the most recent 10 year period (growth rate 1.059, 90% CI = 1.017-1.104) (Larned et al. 2010, Figure 3).

In summary, although other, earlier survey results are equivocal, as of 2009, the ACP survey indicates a positive trend in the index of yellow-billed loons on the ACP. We will continue to look for ways to improve our ability to detect trends. Surveys in western Alaska have not been conducted for a long enough period (2005 and 2007) to detect trends.

Population Trends - Russia

In Russia, recent data are fragmentary, making it difficult to determine trends. In the west, the Red Data Book of the Russian Federation (2001, p. 366) stated that the species no longer nests in European Russia where it was formerly found, such as the Kola Peninsula, the archipelago of Novaya Zemlya, and Vaigach and Ainovy Islands in the Kara Sea, although it is unclear how abundant or widespread the species was in these areas historically. (However, Kalyakin (2001, p. 10) reports finding it nesting on Novaya Zemlya, although it is "extremely rare.") Similarly, according to the Red Data Book of the Yamal-Nenets Autonomous District (1997) near the western end of the Russian breeding range, in the previous 20 years only a few non-breeding yellow-billed loons were recorded in the District. Strann (in litt. 2008) speculated that since the early 1990s there may have been a decline in the number of yellow-billed loons in the main Norway wintering area, which would be consistent with a western Russian breeding ground range contraction if birds nesting in western Russia migrate to Norway for winter (which seems logical). We were unable to find either the source of the Red Data Book statements or supporting evidence for this potential range contraction. In eastern Russia, yellow-billed loons apparently no longer nest along the northern coast of the Sea of Okhotsk where they occurred 30-50 years ago, nor on the Anadyr River delta (Red Data Book of the Russian Federation 2001, p. 366; Red Data Book of the Northern Far East of Russia 1998, p. 97). However, Solovyova (in litt. 2008) reported that the number of breeding yellow-billed loons may be increasing in some locations in eastern Siberia, specifically near Chaun Bay in western Chukotka, and at Belyaka Spit near Kolyuchin Bay in northeastern Chukotka.

In summary, we found unsubstantiated reports that the species may no longer be found in parts of its historical range in Russia, but there is somewhat contradictory information for some areas and a lack of survey data for all areas. Yellow-billed loons may also be increasing in some areas in

Russia. We conclude that we do not have reliable trend information for the Russian breeding grounds.

Population Trends - Canada
As described above for Population Estimates/Status, survey data for Canadian breeding grounds cover a small portion of the range, and have not been conducted for enough years to analyze trends. We conclude that we do not have reliable trend information for Canadian breeding grounds.

To summarize rangewide population trend information, we have reliable data indicating that the ACP breeding population is increasing. We do not have reliable evidence from other breeding areas that breeding populations are increasing or decreasing. There have been no surveys of yellow-billed loons on wintering areas, so we have no trend information from those areas.

Population Resiliency
Certain intrinsic aspects of yellow-billed loon ecology and demography, including low and variable productivity, adult survival, and low population numbers, are relevant to the species' status. Stable populations of K-selected species, such as the yellow-billed loon, are characterized by low annual productivity rates balanced with high annual survival rates, meaning that individuals must live many years to replace themselves with offspring that survive to recruit into the breeding population. Low productivity means that depleted K-selected species have lower recovery potential and slower recovery rates following population declines than r-selected species, which are characterized by high annual productivity. Factors that reduce productivity, including loss of productive breeding habitats, reduction in prey populations, and increases in nest predators, may further constrain K-selected species' recovery potential. Further, most arctic species are characterized by variable annual productivity, given the vagaries and severity of arctic weather, fluctuations in predator-prey relationships, and other aspects of arctic ecology. The population impact of threats that reduce productivity could be magnified if coincident with an infrequent year of otherwise high productivity.

Although factors that compromise productivity can cause populations to decline, adult survival is likely the more important determinant of K-selected species' population size and persistence (Smith and Smith 2001, p. 235). If enough adults are removed from the population prior to replacing themselves (i.e., adult survival is decreased), the population will decline. Perhaps most pertinent to a discussion of extinction, rare species—those with low numbers—are intrinsically closer to a threshold below which recovery is not possible (i.e., minimum viable population) (Hunter 1996, p. 137).

These intrinsic aspects of yellow-billed loon ecology and demography signal the continuing need to monitor yellow-billed loon populations, despite the fact that the species continues to be widely distributed across both its arctic breeding range, which is nearly holarctic, and in its wintering range.

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Oil and Gas Development

We considered whether yellow-billed loon habitats are threatened by oil and gas development (including disturbance, changes in freshwater chemistry and pollutant loads, and changes in freshwater hydrology), by degradation of the marine environment from pollution or overfishing, or by climate change. Potential direct impacts on loon mortality associated with development, such as increased predation and oil spills, are discussed under Factors C and E, respectively.

We expect large spatial and temporal variation in the level of oil and gas development activities on yellow-billed loon breeding habitat, but most such habitat will remain undeveloped in the foreseeable future. We do not expect terrestrial oil and gas development to occur in the Canadian breeding range, and Russian oil and gas development is likely to be confined to the western edge of the breeding range there. In Alaska's NPR-A, some areas are likely to be developed, particularly at the eastern edge of northeast NPR-A near the Alpine development. In Alaska, we believe that existing required protective measures will protect the yellow-billed loon from impacts of development. We find that degradation of breeding grounds throughout its range from oil and gas development is not a threat to the yellow-billed loon now or in the foreseeable future.

Temperate Marine Habitat: Degradation of Marine Habitats in Migration and on Wintering Grounds

The marine environment is clearly important for yellow-billed loons, as that is where they spend their first 3 years, and subsequently at least 8 months per year. Wintering areas along the coast of Alaska and British Columbia, Canada, are relatively pristine. Two important wintering areas for yellow-billed loons, the western Pacific Ocean coastal waters of the Yellow Sea and Sea of Japan, and the North and Norwegian Seas, have recently been identified among the ocean ecosystems with the greatest human impacts, and therefore degradation, of any in the world (Halpern et al. 2008, p. 949). Possible effects of human activities on yellow-billed loon marine migrating and wintering habitats include depletion of the prey base through a variety of mechanisms, including pollution-induced hypoxia and destructive fishing practices. Potential effects on loons from depletion of the winter prey base include reduced body condition, which could result in mortality or reduced breeding propensity. However, yellow-billed loon mortality from marine pollution has not been documented. The only other source of information we have to evaluate this factor is population trend information from the ACP. Yellow-billed loons breeding on the ACP migrate to Asian wintering grounds (Schmutz in litt. 2008, p. 1). If deterioration of these wintering areas were resulting in population-level effects on yellow-billed loons, we would expect to see evidence of a large population decline on the Alaska breeding grounds. Instead, the ACP population index shows a positive trend through 2009. We do not

have information indicating that the current effects to the species from the degradation of temperate marine waters will change in the future. Therefore, we find that degradation of temperate marine waters is not a threat to yellow-billed loons now or in the foreseeable future.

Climate Change

Arctic Habitats

In arctic areas, there is strong evidence that coastal erosion is occurring, and some evidence for breaching of freshwater lakes adjacent to coasts, but little or no information on whether these environmental changes have affected yellow-billed loon breeding lakes. While there is strong evidence that climate change is causing permafrost loss, no information is available on how this could affect freshwater lake morphology and the yellow-billed loon prey base in the future. Based on the best available data, we believe that important polynyas and ice-lead spring staging habitat are likely to continue to exist in the foreseeable future. While ocean acidification will likely have long-term effects on marine communities, we do not know how it will affect loons. We believe the effects of increased shipping in arctic seas will be negligible because yellow-billed loons are widely dispersed across breeding and migrating landscapes.

Our evaluation of climate-change effects on arctic yellow-billed loon habitats included documented and predicted climate-induced changes to various features of the environment, followed by hypothetical but reasonable suppositions about possible alterations to habitats important to yellow-billed loons. There are no data to suggest that climate-induced changes documented to date have resulted in breeding-habitat changes, and based on the increasing trend on the ACP, it does not appear that these changes have affected the yellow-billed loon population there. At this time, we are unable to predict potential future changes to yellow-billed loons and their habitats discussed above, because, in addition to uncertainty about the magnitude, direction, and timing of climate-induced changes to the environment, no empirical data exist regarding the effects of those potential changes on yellow-billed loons or their habitats.

Temperate Habitats

Global ocean temperatures increased (0.1 degrees C (0.2 degrees F) from 1961 to 2003, although with some cooling since 2003; Bindoff et al. 2007, p. 387), and effects on primary productivity and dissolved oxygen varied with latitude. Primary productivity in warm, low-latitude oceans declines as upper-ocean temperature increases, while warmer temperature at high latitudes increases productivity and decreases oxygen levels (Behrenfeld et al. 2006, p. 752; Bindoff et al. 2007, p. 400).

For the yellow-billed loon wintering at low latitudes in the Yellow Sea and the Japan (East) Sea, a drop in primary productivity might mean decreased prey availability. However, as already observed in northern environments (Perry et al. 2005, pp. 1,912-1,915), marine animals, including yellow-billed loons, might shift north to colder, more productive waters if winter sea ice is not a barrier. As noted for northern marine species (e.g., Perry et al. 2005, p. 1,914) the

movements of species as a result of climate change will likely be complex, so predicting the form of new species assemblages is difficult.

Potential expansion of oxygen-deficient "dead zones" in Asian coastal waters where yellow-billed loons winter depends partly on how climate change affects water-column stratification (Diaz and Rosenberg 2008, p. 929). Warming ocean temperatures could increase stratification, deepening the depletion of oxygen, but increased storminess, such as hurricanes, could increase mixing and thereby lessen stratification. Changes in rainfall patterns could change freshwater and nutrient inputs. At this time, available data on the effects of climate change on dead zones in winter marine habitats of the yellow-billed loon are uncertain.

In summary, climate change effects on the temperate-latitude wintering habitat of the yellow-billed loon include increases in ocean temperature and decreases in primary productivity and dissolved oxygen levels, which could potentially affect prey fish communities and their distribution. The magnitude and form of these effects are highly uncertain, but would most likely involve a northward shift of prey species, which could be mirrored by their predators, such as wintering yellow-billed loons. Therefore, while we conclude that the effects of climate change will be widespread and will likely have some impact on yellow-billed loons in temperate habitats, we find that climate-induced changes in the temperate marine habitat are not a threat to the yellow-billed loon now or in the foreseeable future.

There are multiple hypothetical mechanisms associated with climate change that could affect loons and their breeding and non-breeding habitats. Unlike documented and predicted declines in sea ice, an obligate habitat for other arctic species such as polar bears (*Ursus maritimus*), we lack predictive models on how climate change will affect yellow-billed loon terrestrial, freshwater, and marine habitats. Manifestations of climate-mediated changes throughout arctic and temperate yellow-billed loon habitats will emerge as models continue to be refined and effects are documented, but at this time the timing, magnitude, and net effect of the impacts are uncertain.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Subsistence harvest and bycatch of loons during commercial and subsistence fishing are discussed under Factor E.

Researchers seeking to understand the life history of yellow-billed loons have implanted 38 yellow-billed loons with satellite transmitters to date (26 birds on the ACP, ten birds on the Seward Peninsula, Alaska, and 2 birds in Canada; J. Schmutz, pers. comm. 2010). Approximately 15 eggs per year have also been taken in some years from Alaska breeding grounds to examine contaminant levels (A. Matz, Service, pers. comm. 2009). This research is permitted by the Service under the Migratory Bird Treaty Act (MBTA) and by the Alaska Department of Fish and Game (ADFG) under State law. Although it is reasonably likely that there could be heightened risks of mortality and reduced productivity in individual birds implanted with transmitters, the number of loons in this study is not sufficient to cause

population-level effects. The small number of eggs taken is likewise not sufficient to threaten the population.

C. Disease or predation.

Loons are susceptible to avian diseases, including avian cholera (from *Pasteurella multocida*), aspergillosis (from *Aspergillus fumigatus*), and avian botulism (from *Clostridium botulinum*) (Friend and Franson 1999, pp. 79, 130, 274), but we are not aware of any large disease-related die-offs in yellow-billed loons. Loons are susceptible to avian influenza, but in Alaska, none of six loons sampled, including two yellow-billed loons, tested positive for avian influenza viruses in 2006 (USFWS/USGS 2007, pp. 1-93; Y. Gillies in litt. 2008, p. 1), and worldwide the highly pathogenic H5N1 has not been detected in loons (http://www.nwhc.usgs.gov/disease_information/avian_influenza/affected_species_chart.jsp, accessed May 4, 2010).

Predation on adult yellow-billed loons is thought to be uncommon, but predation on nests on the ACP has been attributed as the primary cause of egg loss and therefore reduced productivity in some years (Earnst 2004, p. 22). Yellow-billed loon nest predators include glaucous gull (*Larus hyperboreus*), parasitic jaeger (*Stercorarius parasiticus*), and arctic fox (*Alopex lagopus*); pomarine jaeger (*Stercorarius pomarinus*), common raven (*Corvus corax*), snowy owl (*Nyctea scandiaca*), red fox (*Vulpes fulva*), and grizzly bear (*Ursus arctos horribilis*) also predate nests (North 1994, p. 11; Earnst 2004, p. 22). Many of these predators are attracted to infrastructure, which is used as nesting platforms or is associated with food sources, and so predation might be expected to increase as development in yellow-billed loon nesting habitat increases (NRC 2003, p. 6; Earnst 2004, p. 19). However, in Alaska, NPR-A required operating procedures (ROP) A-2 and A-8 require control of waste and other measures to prevent attracting wildlife to infrastructure (USDOI-BLM 2008b, Appendix A, pp. 37, 41-42), reducing the risks associated with future development. We do not know whether similar regulations would be implemented in Canada should development occur there. The extent of infrastructure increase in Russian yellow-billed loon nesting habitats, and accompanying regulation, is unknown.

D. The inadequacy of existing regulatory mechanisms.

Russia is the only nation that includes the yellow-billed loon on an endangered or sensitive species list. Some countries (Canada, Japan, Norway, Russia, and the United States) have laws that prohibit the hunting of migratory birds such as the yellow-billed loon, unless specific regulations are issued, or unless the animals are harvested for subsistence. Provisions to prevent habitat degradation for wildlife and migratory birds or to protect the environment exist, but enforcement levels are unknown and in some countries may not be effective at protecting habitats.

In the United States, the MBTA prohibits killing of yellow-billed loons, but does not provide for habitat protection. The BLM, the land management agency with authority over most of the yellow-billed loon's breeding range in Alaska, has instituted protective measures for the species

and its habitat. However, existing regulatory mechanisms have not been adequate to eliminate all threats to the yellow-billed loon throughout its range. Yellow-billed loons are not open for subsistence hunting in Alaska under migratory bird subsistence-harvest regulations (March 14, 2008, 73 FR 13788), but our analysis of harvest surveys (discussed under Factor E) indicates that harvest nevertheless occurs, at times at substantial levels. Although we have some concerns about the accuracy of reported harvest levels, as described in Factor E, we have concluded that harvest is higher than previously thought, and is likely unsustainable. The yellow-billed loon is a K-selected, long-lived species, that requires high adult survival and has low recovery potential and slow recovery rates once populations decline; consequently, significant mortality of yellow-billed loons, especially of adults, is a major concern. We believe that future take at a level consistent with these prior levels would cause a population-level decline that constitutes a threat to the species (see Factor E, below). Therefore, we conclude that existing regulatory mechanisms are inadequate to protect the species.

E. Other natural or manmade factors affecting its continued existence.

Direct Effects of Oil and Gas Development and Vessel Traffic

Yellow-billed loons face the possibility of oil spills throughout their range. The one breeding population for which we have population trend data, the ACP population, is increasing at present. We would expect a steep decline if cumulative oil spills were affecting this population, which winters in Asian waters. We do not have evidence that marine oil spills are causing population-level effects to yellow-billed loons on the ACP. The Asian wintering grounds are likely to harbor the most oil spills due to vessel accidents compared to other wintering areas, so it is reasonably likely that breeding populations that winter elsewhere are not at greater risk than the birds that winter in Asia.

In summary, at present we believe the risk to yellow-billed loons from offshore oil and gas development and shipping traffic accidents to be low. Moreover, the one breeding population for which we have population trends does not appear to be declining steeply due to this risk factor. Although the amount of oil and gas development and shipping traffic will likely increase in the future, the associated risk is reasonably likely to be partly or wholly offset by improved technologies and regulation, such as the U.S. Oil Pollution Act of 1990. Also, the species' wide distribution and extremely low densities throughout most of the year when birds are at sea reduces the risk of population-level impacts from any single event. As offshore oil and gas development and shipping traffic continue, individual yellow-billed loons will likely continue to be negatively affected as a result of collisions with vessels or structures and oil spills. However, we cannot reliably predict that the species will be affected at the population level, given the considerable uncertainty of the location of such events and the effectiveness of the design and operational spill cleanup methods that may be employed. Therefore, we find that oil and gas development and vessel traffic is not a threat to the yellow-billed loon now or in the foreseeable future.

Subsistence Harvest

Subsistence harvest of yellow-billed loons in the Bering Strait has been reported at levels that we expect would cause impacts to the species in the foreseeable future. Although we have concerns about the degree of accuracy of the reported numbers of yellow-billed loons harvested, as discussed below, we believe that the likely magnitude of actual harvest levels constitutes a threat to the species rangewide.

Subsistence hunting of wild birds, including loons, is an important component of the customs, traditions, and economies of many cultural groups in the arctic. Subsistence is defined in U.S. Federal and State law as the "customary and traditional uses" of wild resources for a variety of purposes, including food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade (Wolfe 2000. p. 1). Yellow-billed loons are generally not a preferred food in some parts of their arctic range, but their skin and feathers are used for ceremonial purposes (Paige et al. 1996, appendices; Georgette 2000, p. 19; Syreochkovskiy 2008, p. 2), and they are shot for other reasons, such as for taxidermy, to chase them from fishing nets, or out of curiosity (Syreochkovskiy 2008, p. 2). Discussions between St. Lawrence Island, Alaska hunters, and Service biologists confirmed that Bering Strait hunters target loons for harvest (Ostrand in litt. 2009, p. 1). A Service biologist working with hunters on St. Lawrence Island in the spring rarely observed hunters with harvested loons in their possession (Benter in litt. 2008, p. 1), although he has observed hunters targeting loons for harvest (Benter pers. comm. 2009).

Although it is clear that loons are harvested for subsistence, there are challenges to assessing the magnitude of harvest and biases inherent in the process. Harvest surveys have been conducted in many arctic communities, but they have varied in geographic coverage, methodology and analysis, and level of detail; thus, comparing among areas or detecting trends over time is difficult (SHSAC 2003, p. 5). Most survey data are collected through recall interviews conducted a month or more after harvest, resulting in varying and unknown levels of recall error. Sampling designs might inadequately survey rarely taken species (SHSAC 2003, p. 15), and there have been no surveys specifically targeting yellow-billed loons. As a result, most yellow-billed loon harvest estimates have a high level of variance and yield results of unknown accuracy. In some surveys, loons are not identified to species; in others misidentification of species harvested probably occurs but to an unknown degree. To consider misidentification issues, we present some data below on other loon species reported in harvest surveys.

(i). Alaska

Surveys conducted prior to migratory bird subsistence-harvest regulations established in 2003

Like many bird species, yellow-billed loons have been harvested traditionally by Alaska natives. Although the Migratory Bird Treaty Act prohibited take of loons beginning in 1918, the law has not been enforced in rural areas of Alaska. As stated in Factor D, yellow-billed loons are not

open for subsistence hunting in Alaska under Federal migratory bird subsistence-harvest regulations established for migratory bird species in 2003.

Surveys are conducted by interviewing residents of rural Alaska. Using pictures, residents identify birds they have harvested. Information on harvest surveys is available at http://alaska.fws.gov/ambcc/harvest.htm. Before 2003, subsistence harvest surveys for migratory birds in Alaska were conducted sporadically, and coverage varied considerably among surveys.

Yellow-billed loons migrate through the Chukchi and Bering Sea, making them available for harvest during spring and fall migration in northwest Alaska. In the Northwest Arctic Borough (the area around Kotzebue, Alaska) harvest surveys from 1994-1998 reported no yellow-billed, 71 common, 2 arctic, 6 red-throated, and 1 unknown loon, with identification of species noted as uncertain at times (Georgette 2000, p. 1-218). Loons comprised generally less than one percent of the total bird harvest (Georgette 2000, p. 19). A one-year survey of the two villages on St. Lawrence Island in the Bering Strait from 1995-1996 reported 40 yellow-billed loons and 290 common, 81 Pacific, and 15 unknown loons harvested (ADFG and Kawerak 1997, p. 2). Concerns about misidentification of species, particularly identification of common loons, which are rare in the Bering Strait, are discussed below.

Yellow-billed loons migrate along the coast of the Yukon/Kuskokwim Delta and Bristol Bay regions, so harvest in spring and fall is possible. Because yellow-billed loons do not breed in these regions, reports of summer and egg harvest suggest misidentification. Below we report the long-term harvest survey record for these areas. Because reports give summary results overlapping the pre- and post-2003 regulation period, we report the entire survey record here, including post-2003 results.

Yellow-billed loons have been reported in almost every annual Yukon-Kuskokwim Delta harvest survey (conducted 1985 to present, except 2003, with methodology changes in 2001 and 2002; Wentworth 2007b, p. 12). The 2001-2006 5-year average yellow-billed loon harvest was 44 ± 78 *SD* (standard deviation, a measure of the dispersion of the data around the mean) (range 0–183) for the Yukon/Kuskokwim Delta (calculated from Wentworth 2007 b, p. 36 and USFWS et al. 2008, Table 2006-17a). Yellow-billed loon eggs were reported taken in 14 of 20 years, with an annual average of 14 eggs per year estimated for 2001 through 2005 (Wentworth 2007b, pp. 37-41).

Yellow-billed loons have been reportedly taken in every Bristol Bay region survey since 1995. However, no surveys were conducted in 2000 and 2003, surveys were limited to Togiak National Wildlife Refuge in 1996, 1998, and 2006, and the methodology changed in 2001 and 2002 (Wentworth 2007a, pp. 1-2). The 2001-2005 Bristol Bay region average yellow-billed loon harvest was 78 ± 128 *SD* (range 5-269) (Wentworth 2007a, p. 22). From 1995-2005, the only eggs reported in Bristol Bay were in 1997, when 27 eggs were estimated taken (Wentworth 2007a, pp. 23-24).

Harvest surveys conducted subsequent to migratory bird subsistence-harvest regulations

In 2004, a new Alaska-wide subsistence-harvest survey, including spring, summer, and fall seasons, was initiated subsequent to the 2003 implementation of migratory bird subsistence-harvest regulations. Under the new regulations, areas of Alaska eligible for migratory bird subsistence-harvest are divided into regions that are surveyed periodically (map available at http://alaska.fws.gov/ambcc/Regulations.htm). The new survey has yet to be conducted simultaneously within a year in all villages or all regions (USFWS et al. 2008, p. 3), and the 2004-2006 summary report states that the results should be used with caution due to possible inaccuracies, unreliable data, and insufficient sample size (USFWS et al. 2008, p. 3). Within the area covered by the new survey, yellow-billed loons are most likely to occur in the North Slope, Northwest Arctic, and Bering Strait/Norton Sound regions during nesting and in Bristol Bay and Yukon/Kuskokwim regions during migration; they were reported as harvested in the Bering Strait/Norton Sound, Bristol Bay, North Slope, and Yukon/Kuskokwim Delta regions in 2004-2006 (Table 1). The largest number of yellow-billed loons and other loon species were estimated for the Bering Strait/Norton Sound region (Table 2).

Table 1. Estimated harvest of yellow-billed loons (excluding eggs) in Alaska regions reporting take of the species in the years 2004-2006. No other regions reported yellow-bill loon take. Data extracted from tables in USFWS et al. 2008.

Region	Year							TOTAL
	2004			2005			2006	
	Estimated Harvest	95% CI	Season[a]	Estimated Harvest	95% CI	Season	Estimated Harvest	
Bering Strait	317	271-530	Spring Summer Fall	45	45-123	Spring Summer	NS[b]	362
Bristol Bay	10	8-30	Fall	5	2-22	Spring	0	15
YKD	4	3-16	Spring	12	[c]	Spring Summer Fall	0	16
North Slope	NS	-	-	3	2-14	Summer	NS	3
TOTAL	331			65			0	396

CI = confidence interval

[a]Seasons that yellow-billed loons were reported as harvested.

[b]NS = region not surveyed in that year.

[c]For Yukon/Kuskokwim Delta (YKD) in 2005, 11 yellow-billed loons reported in the Kuskokwim River subregion (95 percent CI 8-53) and one reported in North Coast subregion (95 percent CI 1-23).

Table 2. Estimated harvest of loons for the Bering Strait/Norton Sound region in 2004 and 2005. Data extracted from tables in USFWS et al. 2008.

Species	Year			
	2004		2005	
	Number	95% CI	Number	95% CI
Yellow-billed loon	317	271-530	45	45-123
Common loon	405	345-889	891	871-1438
Pacific loon	498	425-772	33	18-115
Red-throated loon	26	22-89	15	10-82

For 2007, Naves (2008, pp. 1-31) reported preliminary subsistence harvest survey results by subregion rather than by region as reported previously; thus these observations are not directly comparable to data in Tables 1 and 2 and are not included therein. Naves (2008, p. 7) reported that an estimated 1,077 (95 percent CI = 808-1,347) yellow-billed loons and 2,492 (95 percent CI = 2,158-2,826) common loons were harvested for a Bering Strait/Norton Sound subregion that includes two villages on St. Lawrence Island and one on Little Diomede Island, called the St. Lawrence-Diomede Islands subregion (SL-DI subregion). This estimated SL-DI subregion yellow-billed loon harvest was allocated among seasons with 5 birds estimated harvested in spring, 362 in the summer, and 711 in the fall. Estimated harvest of common loons in the SL-DI subregion were 166 in spring, 560 in summer, and 1,766 in fall (Naves 2008, p. 7). Harvest of 76 Pacific loons (95 percent CI = 19-134) and 366 red-throated loons (95 percent CI = 221-511) was also estimated for the subregion (Naves 2008, p. 7). Yellow-billed loons were not reported for any other subregion in the Bering Strait/Norton Sound Region. The Barrow subregion of the North Slope region was the only other surveyed area that reported harvest of yellow-billed loons in 2007, with an estimated 84 (95 percent CI = 32-135) harvested (Naves 2008, p. 15).

Interpretation of the 2007 loon harvest estimates requires consideration of several factors (beyond their magnitude and potential population-level impact, which will be discussed later). First, the confidence intervals (which are mathematical estimates of the reliability of the estimate, and in this case are expressed as a percent of the estimated value) surrounding the estimates of both yellow-billed and common loons are comparatively small. The 2007 survey results for the SL-DI subregion have a 95 percent CI that is only 25 percent of the estimate for yellow-billed loons and 13 percent for common loons (Naves 2008, p. 7); these are much smaller than earlier estimates given for the entire Bering Strait/Norton Sound region. For example, the 2005 95 percent CI was 174.2 percent of the estimate for yellow-billed loons and 61.4 percent for common loons (USFWS et al. 2008, Table 2005-2a). These smaller CI values indicate increased precision in the 2007 subregional estimate compared to the earlier regional estimates, which reflects large sample size (82 of 318 households (26 percent) sampled) and low variation among households (indicating that most households reported taking fairly comparable numbers of loons).

A second consideration in interpreting the large estimate of yellow-billed loon harvest for 2007 is possible misidentification. Large numbers of common loons are reported as harvested in the SL/DI subregion where they are a rare to uncommon visitor (Fay and Cade 1959, p. 100; Kessel 1989, p. 66; North 1994, p. 3; Armstrong 1995, p. 23; McIntyre and Barr 1997, p. 2; Lehman 2005, p. 15). The report described above of 290 common loons taken on St. Lawrence Island in 1995-1996 (ADFG and Kawerak 1997, p. 2) is considered by Lehman (2005, p. 15) to result from misidentification because only two verified records of this species from the island are known to date. Similarly, common loons reported as harvested from the Bering Strait/Norton Sound region in 2004 and 2005 (Table 2) likely also include other loon species, possibly including yellow-billed loons.

A potential source of misidentification is the probable presence in the fall of juvenile loons whose plumage resembles adult basic (ie., non-breeding or winter) plumage. It is difficult to differentiate among loon species in this plumage, and survey forms do not illustrate this plumage or highlight ways to distinguish among species. It is unknown how many common loons move through the Bering Strait, but as described above, the number is thought to be small since they have rarely been seen on St. Lawrence Island. Therefore, if misidentification is attributable to confusion between yellow-billed and common loons, the actual harvest of yellow-billed loons is likely even greater than that reported. As noted above in 2007, in the fall, estimated harvest was 711 and 1,766 of yellow-billed and common loons, respectively. It is also possible that Pacific and red-throated loons are misidentified as yellow-billed and common loons, although they are notably smaller. If so, this would result in actual harvest of yellow-billed loons being less than that reported.

We considered the possibility that a large number of households in the subregion misidentified loons due to survey deficiencies, and we considered the possibility that this problem was worse in 2007 than in earlier years, resulting in a higher estimated harvest than in previous years. The survey forms show color pictures of birds exclusively in breeding plumage, and survey respondents are asked to mark the number taken next to the pictures. The lack of depictions of winter and immature plumages in the survey form is a likely problem for harvest reported in the fall, when immature birds are likely to be harvested. There is no need for the respondent to identify the name of the bird, making it less likely that cultural differences in nomenclature would cause systemic misidentification. The surveyors were trained in a standard manner for all surveys across the state in all years, using a manual developed over many years. In the Bering Strait/Norton Sound region, the surveyors were provided with several bird identification books to assist them, although it is unknown how and how often they used the books during surveys (Ostrand in litt. 2009, p. 1). In summary, we found that misidentification could be occurring because the survey form includes only breeding plumages. We found no reason to conclude that the survey was conducted any differently in 2007 than in previous years.

Above we noted the large inter-annual variation in harvest estimates of yellow-billed loons for the Bering Strait/Norton Sound region (Table 2); this variation is increased with the addition of the large estimated harvest in the 2007 survey (Naves 2008, p. 7). Large inter-annual variation in

estimated harvest of yellow-billed loons could represent measurement error for a relatively constant rate of harvest, or it could represent actual variation in harvest among years. Schmutz (in litt. 2008, p. 1) observed that some yellow-billed loons fitted with transmitters in 2002, 2003, and 2007 on Alaskan breeding grounds moved to marine waters near St. Lawrence Island before migrating south, but others, including all eight birds fitted with transmitters in 2008, moved from Alaskan breeding grounds to Kolyuchin Bay on the north side of the Chukotka Peninsula, and crossed overland to the southwest over the peninsula and into Anadyr Bay, thereby avoiding the St. Lawrence Island area. Thus, migratory behavior may vary from year to year based on some unknown environmental factor, and loon harvest could vary with changes in the number of loons moving past hunting areas in different years.

Because the 2007 estimated harvest was substantially higher than earlier estimates, we evaluated issues specific to the 2007 survey that might help explain this difference. Other than the fact that the survey for all three seasons was conducted at the end of the fall season, survey protocols were followed, and no other factors were identified to explain the high estimate (Ostrand in litt. 2009, p. 1). Conducting the survey at the end of the year means that the respondents would have to recall what they harvested months earlier, which could reduce the accuracy of the survey, especially for the earlier seasons.

Although we examined potential flaws in the harvest survey data and concluded that some birds could have been misidentified, we believe the data are reliable enough to identify the order of magnitude of likely harvest. We conclude that on average, hundreds of yellow-billed loons are probably taken annually in the Bering Strait region. In addition, tens are likely taken in other parts of Alaska, particularly the North Slope.

To evaluate the effect of this harvest on the yellow-billed loon, we examined what we know about the number of birds that move through the Bering Strait. As described in the Species Biology section, all 29 marked Alaskan breeding birds used the Bering Strait or Chukotka Peninsula during migration. There are an estimated 3,000 to 4,000 Alaskan breeding birds. It is likely that, due to their proximity, 3,000 to 5,000 eastern Siberian breeding yellow-billed loons also migrate through the Bering Strait region. Observations of yellow-billed loons during migration on the Beaufort Sea provide evidence that at least some Canadian breeding birds use this migration route, most likely the 3,750 to 6,000 breeding birds estimated to occur on Banks and Victoria Islands and the adjacent arctic mainland coast. Thus, we believe it is likely that a large part of the rangewide population moves through the Strait and is subject to harvest there. We do not know whether the actual rangewide breeding population is closer to 16,000 or 32,000, but as discussed in the Population Estimates/Status section, we believe it is likely closer to 16,000.

We next evaluated whether hundreds of yellow-billed loons being harvested annually would be unsustainable to the rangewide population. We examined a population model developed by the U.S. Geological Survey (USGS) to test the sensitivity or response of the population to a range of possible harvest levels (Table 3; Schmutz 2009, p. 15). The model was constructed to begin with stable populations (i.e., lambda = 1.00), and then examined whether harvest caused additional

declines. The model considered a range in harvest mortality rates and population sizes to reflect our uncertainty about these parameters. We believe the model includes the entire range of possible values for the size of the affected population.

The model suggests that for all scenarios, harvest would cause an otherwise stable population to decline (i.e., lambda declines from 1.00 to values below 1.00) (Table 3). The annual average values for harvest that we believe are most likely (i.e., hundreds; best approximated in Table 3 by the column corresponding to a harvest of 317 birds) and the population size we believe is subjected to the harvest (i.e., approximately 16,000 plus 1 and 2 year old birds; best approximated in Table 3 by the row corresponding to a population size of 18,764, which includes 1 and 2 year olds) show that a hypothetical stable population that experienced added harvest of 317 birds would decline by half in 41 years, or less if the harvest is larger or varies among harvest estimates for recent years (Table 3). Even if there are 37,528 yellow-billed loons in the rangewide population subject to harvest (which we think is unlikely, as discussed above), a harvest of 317 birds would cause the population to decline by half in 83 years. We believe this harvest and associated declines would be unsustainable to the rangewide population, causing a long-term decrease in abundance that would be difficult to reverse due to the low reproductive potential of the species. It is important to note that this analysis does not take into account that additional mortality, such as harvest in other parts of Alaska, Russia, or Canada, or from other sources, could exacerbate the rate of decline from a stable population.

Table 3. Model results of the effects of various harvest scenarios on trend and population size of yellow-billed loons. The starting model predicted a stable population (trend=1.0). This model used productivity data from yellow-billed loons on the Colville Delta, and survival rates allocated among age classes similar to Mitro et al. (2008) for common loons, but with an adjustment factor to achieve hypothetical population stability so that the model could evaluate likely population response to varying levels of harvest. Thus, the starting, stable population shown in the first column represents a population without harvest. Reference population sizes used breeding population sizes of 4,000, 10,000, 16,000 and 32,000 breeding birds, and were then adjusted to include an additional population component comprised of individuals (likely 1- and 2-year olds) that remain at sea and are not counted during summer surveys of tundra habitats. The next three data columns represent three starting levels of harvest corresponding to recent harvest estimates for the Bering Straits region. The fourth data column represents population response to harvest levels that vary among years, which reflects reported variation in harvest and satellite tracking data that indicate inter-annual variation in migratory behavior through the Bering Strait. For all harvest levels, the mortality *rate*, rather than mortality number, from harvest is kept constant across the years of each population projection. In each cell, there are two numbers. The first is annual population growth rate, given the indicated harvest and the population that such harvest is allocated to. Second is the number of years from present until the population falls below half of current size. These harvest estimates and corresponding predicted population responses do not consider possible additional harvest occurring outside of the Bering Straits region in other portions of the species' life cycle. This model assumes hunting mortality is additive and not compensatory. From Schmutz 2009, p. 15.

Table 3

	Beginning harvest level to set mortality rate			
Reference Population	45	317	1,077	Annually rotate between 45, 317, and 1,077
N = 4,508	0.990070	0.929710	0.76113	0.89376
N = 10,372	0.9957162	0.969523	0.89627	0.953815
N = 18,764	0.9976295	0.983241	0.942612	0.974527
N = 37,528	0.9988601	0.991683	0.971324	0.987354

In summary, although there is uncertainty about the reported numbers of yellow-billed loons harvested in Alaska, these surveys represent the best information available to us at this time. We believe that the data are reliable enough to conclude it is likely that recent annual average harvest of yellow-billed loons in Alaska is in the hundreds. Based on this information, the large number of yellow-billed loons from Alaskan, Russian, and Canadian breeding areas that are likely to use the Bering Strait in migration, and the model results presented in Table 3, we conclude that the potential impact of the Alaska harvest on the rangewide yellow-billed loon population is significant. It is possible that recent high harvest estimates represent a new phenomenon not yet reflected in population trend information, although we do not have information on whether the harvest will increase or decrease in the future. Harvest at the present magnitude, even if occurring every few years, will cause a rangewide decline that constitutes a threat to the yellow-billed loon.

(ii). Russia

The Red Data Book of the Russian Federation (2001, p. 367) states "during the nesting period, loons are often killed/harvested by the indigenous population for food and pelts particularly in

the northeast of Russia." Other information comes from a recent review from the Russian Academy of Sciences to the Service, which reported current yellow-billed loon harvest of approximately 200 per year, including for protection of fishing nets (Syroechkovskiy 2008, p. 1-2). The review also noted that in former times yellow-billed loons were occasionally shot by indigenous peoples for ritual purposes and raw materials, and conversely, some tribes in the Yakutian arctic recognize loons as sacred species and never shoot them (Syroechkovskiy 2008, p. 1).

The basis for the Russian estimate of yellow-billed loon harvest above is unknown. Few surveys have been conducted (limited information from Yakutia and Chukotka), the species' range has not been adequately sampled, and the species has an uneven distribution across Russia (Syroechkovskiy 2008, p. 1). No subsistence harvest information is available from the Taymyr Peninsula, one of the two core areas of the breeding range in arctic Russia and the only region where Syroechkovskiy (2008, p. 1-2) reported hunting of the species as a food source.

Other harvest surveys have occurred in Russia, however. Unidentified loons were reported taken in two Providensky communities in 1997 and 1998 as part of subsistence harvest surveys for marine mammals (Ainana et al. 1999, p. 83; Ainana et al. 2000, pp. 66, 71). No loons were listed in 1999 (Ainana et al. 2001), but this report included fewer and less detailed reports of birds. Service-funded waterfowl (eider) subsistence harvest surveys in 19 of 100 northeastern Russia (Yakutia and Chukotka regions) communities within 100 km (62 mi) of the coastline by the Goose, Swan, and Duck Study Group of Northern Eurasia from 2002-2005 (Syroechkovski and Klokov 2007, p. 8) included loons. Yellow-billed loons reported (by previous year recall of hunters) varied among villages (range 0-58), with only three villages reporting harvesting 10 or more birds. Harvest was greatest in northern Chukotka, where the species nests and where one village reported egg harvest of 44 eggs in one year. The species' range was not completely surveyed because loons were not the focus of the survey (Syroechkovski and Klokov 2007, p. 1). However, based on these surveys, as well as the nationwide estimate provided by the Russian Academy of Sciences (Syroechkovskiy 2008, pp. 2), we estimate tens to possibly 200 yellow-billed loons are harvested by subsistence hunters annually in Russia, virtually all affecting the Russian breeding population (the breeding population is estimated to be 5,000 to 8,000). The effect of an annual harvest of 200 birds on a population of this size is significant, particularly if the population is subject to additional harvest in migration through the Bering Strait (as described under the Alaska section above).

(iii). Canada

Yellow-billed loons are thought to breed in several of the Native Land Claims in northern Canada, but primarily in Inuvialuit and Nunavut. The land claims are in different phases of settlement, and harvest data are only available for those areas where claims have been settled and Renewable Resource Boards (RRBs) are in operation to jointly manage wildlife resources (http://www.mb.ec.gc.ca/nature/ecb/da02s11.en.html, accessed October 2008). The RRBs all use similar methodology to determine wildlife harvest levels for their areas of jurisdiction. Reported possible sources of error in these harvest estimates include enumeration, coverage and non-

response, measurement and questionnaire design, recall failure, and strategic response bias (Priest and Usher 2004, pp. 35-42).

Harvest survey data are available from the Nunavut, Inuvialuit, and Sahtu regions, which encompass the vast majority of the yellow-billed loon's breeding range in Canada (see map at http://www.mb.ec.gc.ca/nature/ecb/da02s11.en.html, accessed November 25, 2008), from 1988 to 2003. Nunavut harvest surveys (Priest and Usher 2004) were conducted from 1996 through 2001. Five communities reported harvesting yellow-billed loons from May through October, while twenty-two communities did not report harvest of yellow-billed (or unidentified) loons. The estimated yearly harvest (reported as a range) was 2.6-8.2 yellow-billed and 1.4-5.8 unidentified loons (Priest and Usher 2004; tables). Inuvialuit harvest surveys were conducted from 1988 to 1997 (Inuvialuit Harvest Study 2003). Loons, including yellow-billed loons, were reported harvested from May through July in three of six communities surveyed. Estimated mean annual harvest of yellow-billed loons for the region was 10 ± 8 *SD*, and 1 ± 2 *SD* additional unidentified loons per year (Inuvialuit Harvest Study 2003; tables). Sahtu Region surveys were conducted from 1998 to 2003 (Bayha and Snortland 2002, 2003, 2004). (Yellow-billed loons occur only in the northern Sahtu region.) No yellow-billed loons were reported harvested, but a total of 5 unidentified loons were harvested over the 6 survey years (less than 1 per year) from May to August (Bayha and Snortland 2002, 2003, 2004; tables), with no extrapolation to the entire Sahtu region. Based on these data, we estimate low tens of yellow-billed loons are harvested by subsistence hunters annually in Canada.

(iv). Conclusion for Subsistence

Our ability to accurately estimate the magnitude of subsistence harvest of yellow-billed loons rangewide is compromised by incomplete harvest survey coverage of the species' range, possible misidentification among species, sampling shortcomings, and our limited ability to allocate harvest during migration to source breeding populations. Correctly assessing subsistence harvest of a rare species, such as the yellow-billed loon, requires intensive surveys to adequately sample villages within the species' range to increase precision in the harvest estimate. The data do tell us that yellow-billed loons have been harvested, probably averaging in the hundreds annually, which we believe would be unsustainable relative to the overall yellow-billed loon population.

Despite the limitations described above, the best available information indicates that, throughout its range, on average, hundreds of yellow-billed loons from multiple breeding areas are harvested annually by subsistence hunters. Population modeling suggests that the number of yellow-billed loons being harvested in the Bering Strait area of Alaska alone is likely unsustainable. In addition, up to several hundred yellow-billed loons could be taken annually on Russian breeding grounds, and small amounts of harvest are reported for other areas in Alaska and Canada. The lack of precision of the population trend information for Alaska could be preventing us from detecting the impact of this harvest on the population, or the high harvest estimates could represent a new phenomenon not yet manifested in our population trend estimates. The harvest is also likely having an impact on breeding populations that are not being monitored; population trends for Canada and Russia are not known. We have no reason to believe that the current level

of subsistence harvest of yellow-billed loons will change in the future. Because we believe that the rangewide population of yellow-billed loons is subject to unsustainable levels of harvest, we find that subsistence harvest is a threat to the species rangewide.

Commercial Fishing Bycatch

Loon bycatch has been documented in commercial drift-net, gill-net, trap-net, and longline fisheries. Compared to other fisheries, gill-net fisheries have the greatest potential to affect loons. For example, a 1998 study of bycatch in winter gill-net fisheries on the U.S. mid-Atlantic coast found that loons (red-throated and common) accounted for 89 percent of all avian bycatch (Forsell 1999, p. 23). While loon species have been recorded as bycatch in several longline fisheries (Brothers et al. 1999), in general, longlines attract surface-feeding seabirds rather than species that dive to feed.

Yellow-billed loon bycatch in commercial fisheries has been documented anecdotally or by observer programs in Washington State, Russia, and Norway. No data exist from large portions of the species' wintering range (Yellow Sea, Sea of Japan, and coastal Japan), but bycatch is likely to occur in extensive gill net fisheries that overlap with wintering yellow-billed loons. We lack information to explain the difference in catch rates reported from various observer programs. We do not have enough information to extrapolate bycatch estimates to areas lacking data, or to determine the number of birds taken as bycatch over time.

Subsistence-Fishing Bycatch

Subsistence fishing is an important component of the customs, traditions, and economies of many indigenous groups in the arctic. Across the breeding range of the yellow-billed loon, rural residents fish primarily using gill nets, although some angling and ice jigging occurs (Craig 1987, p. 17). Gill-net use is localized near villages and fish camps, in marine inlets and lagoons, lakes, and rivers, depending on season and target fish species (Craig 1987, p.17; Bacon in litt. 2008). During the breeding season, yellow-billed loons will forage in large lakes close to their nests (Earnst 2004, p. 4), as well as other nearby lakes, rivers, and marine areas (Earnst 2004, pp. 6-7), where the potential for bycatch in subsistence fisheries exists. Because yellow-billed loons are widely dispersed across their nesting grounds, however, a large proportion of the breeding population is likely not exposed to localized subsistence fishing.

Limited observations confirm that yellow-billed loons have been inadvertently caught in subsistence gill nets in Canada, Russia, and the United States, although the level of bycatch is not extensively documented. In Canada, researchers on Victoria Island documented yellow-billed loon entanglement in nets on several occasions, including one instance where seven birds were found dead in nets in a single day (Sutton 1963 p.1; Parmelee et. al. 1967). In Russia, Syroechkovski (2008, p. 2) reported that two reasons for subsistence mortality were accidental entanglement in fishing nests and deliberate shooting to scare loons from fishing areas. The Red Data Book of the Russian Federation states that yellow-billed loon mortality in fishing nets is the main threat to the species (Red Data Book 2001, pp. 366-367), with bycatch rates described as

"catastrophic" in the Chukchi Peninsula region (Red Data Book 2001, pp. 366-367). We could not locate data or a source for that assessment.

In Alaska, information on loon bycatch from subsistence fishing is available only for the ACP, where Inupiat Eskimos use yellow-billed loon parts for subsistence and ceremonial purposes (Hepa and Bacon 2008, p. 1). In 2005, an exception for the North Slope region was incorporated into the regulations allowing possession for subsistence use of up to 20 (total for the region each year) yellow-billed loons inadvertently caught in subsistence nets (50 CFR Part 92). As a result of this provision, the North Slope Borough Department of Wildlife Management compiles data on incidental bycatch from a variety of sources. Two to nine yellow-billed loons (and some red-throated and Pacific loons) were reported as found dead in nets in each of three years (2005 to 2007) (Acker and Suydam 2006, p. 1; Acker and Suydam 2007, p. 1; Hepa and Bacon 2008, p. 10). Small numbers of loons, including yellow-billed loons, were also reported as found alive and released. All yellow-billed loons collected in 2007 were reportedly utilized for subsistence, including ceremonial purposes (Hepa and Bacon 2008, p. 2). These numbers are likely a minimum estimate of yellow-billed loon subsistence bycatch because not all fishers were contacted (Hepa and Bacon 2008, p. 2).

For subsistence fisheries, yellow-billed loon bycatch has been documented either anecdotally or in reporting programs on the breeding grounds in Alaska, Canada, and Russia. Data are limited or non-existent for large parts of the species' range. Because yellow-billed loons are widely dispersed across the landscape on the nesting grounds, while subsistence fishing is localized, we suspect a large proportion of the breeding population is not exposed to subsistence fishing. We do not have enough information to extrapolate subsistence bycatch accounts to areas lacking data or to evaluate likely population-level effects.

Yellow-billed loon bycatch data are primarily anecdotal and cannot be extrapolated to estimate total bycatch levels or rates. Although yellow-billed loon mortality from commercial and subsistence gill-net fisheries currently affects yellow-billed loons at the individual level, we do not have enough evidence of bycatch to show population-level impacts. The ACP breeding population is the only one for which we have trend information. That trend is increasing, and so we do not have evidence that bycatch is currently affecting the species at the population level. In addition, there is no available information that suggests take levels will change in the future. Therefore, we find that bycatch is not a threat to yellow-billed loons now or in the foreseeable future.

Direct Effects of Contaminants Not Associated with Oil and Gas

Although contaminants can affect species through a variety of mechanisms, below we discuss direct effects on individuals or reproduction, such as mortality or embryo viability, from contaminants other than those associated with oil and gas (discussed under Factor A and earlier in Factor E). Indirect effects of contaminants or pollution, such as alterations in prey abundance, were also discussed under Factor A.

Ecological characteristics can be used to estimate the relative risk of contaminants to a species. These include trophic status (species higher in a food chain are more likely to accumulate persistent pollutants), pollution point sources, location (including migratory pathways), and lifespan (long-lived individuals have more time to accumulate persistent compounds). Yellow-billed loons are relatively long-lived birds, and being piscivorous are also trophically elevated. Both arctic breeding areas and temperate wintering areas have documented pollution. It is therefore appropriate to examine potential risk to yellow-billed loons from contaminant exposure.

Yellow-billed loons spend the majority of the year in southern wintering areas, which are primarily coastal and are more likely to have elevated environmental concentrations of persistent organic pollutants (POPs), such as organochlorine pesticides and polychlorinated biphenyls (PCBs), compared to northern breeding areas. Twenty-four out of 29 yellow-billed loons fitted with transmitters on Alaska breeding grounds wintered in Asian waters (Schmutz 2008, p. 1) that have been demonstrably affected by pollution. For example, Ma et al. (2001, pp. 133-134) reported high levels of persistent organic pollutants (DDT and PCBs) and petroleum-derived contaminants in the intertidal zone of the Bohai and Yellow Seas off China. In Korea, PCBs were greater in fish and birds from industrially contaminated areas of the Nakdong estuary than non-industrial areas (Choi et al. 1999, p. 233). Other studies document contamination of Asian sea sediments and biota, including fish and birds, that support potential exposure for wintering migratory birds such as yellow-billed loons (e.g., Nie et al. 2005, pp. 537-546; Oh et al. 2005, pp. 217-222; Daoji and Daler 2004, pp. 107-113; Guruge et al. 1997, pp. 186-193). In a test of exposure to persistent contaminants in Asian wintering areas compared to northern breeding areas, Kunisue et al. (2002, p. 1,397) found that herring gulls (*Larus argentatus*) and other migratory birds nesting on Lake Baikal in Russia had higher levels of organochlorine contaminants on arrival from Asian wintering areas than at the end of the breeding season.

Further, sympatrically nesting red-throated loons from the ACP had PCB concentrations and formulations (containing the most toxic PCB congeners) great enough, when compared to thresholds developed for other species, to postulate teratogenic (causing abnormal development) or other reproductive effects (Schmutz et al. in review, p. 19). Preliminary satellite telemetry data indicate that these red-throated loons winter in Asian marine waters (Schmutz et al. in review, p. 1), similar to yellow-billed loons. These data compelled us to examine PCBs in yellow-billed loon eggs from the ACP. We found that although PCBs were present in yellow-billed loon eggs (n = 45, collected over 3 years), preliminary data show the most toxic individual PCB congeners (PCBs 77 and 81) present in red-throated loon eggs were generally not present in yellow-billed loon eggs, and therefore the PCB toxicity in yellow-billed loon eggs (TEQ (toxic equivalency quotient , a measure of toxicity) range = 0.176 - 10.39 picograms/gram (pg/g); A. Matz, U.S. Fish and Wildlife Service, unpubl. data) was much lower than in red-throated loon eggs (TEQ mean $\pm$ SE = 237 $\pm$ 129 pg/g), and lower than published thresholds for embryonic toxicity in other avian species, such as 227 pg/g in great blue heron (*Ardea herodias*) eggs (Hoffman et al. 1996, pp. 191). We are currently evaluating other contaminants in yellow-billed loon eggs and blood from the coastal plain and the Seward Peninsula of Alaska, but based on the

red-throated loon data (presented in Schmutz et al. in review), we were most concerned about the PCBs.

In conclusion, we have few data on most of the contaminants that could directly affect yellow-billed loons throughout their range. Additional range-wide data on productivity, population trends, and concentrations of persistent contaminants will allow us to more fully evaluate this risk factor. However, data from an ongoing multi-agency study in Alaska show that yellow-billed loon eggs do not have concentrations of toxic PCBs thought to affect reproduction. Because yellow-billed loons nesting in Canada, and some proportion of those nesting in Russia, likely winter in Asian seas or on the Pacific coast of North America, we assume that PCB and other persistent contaminant concentrations in their eggs would be equal to or less than those from the ACP, which are known to winter in Asia. The contaminant loading for yellow-billed loons wintering in the North Sea is unknown, but those loons represent a small proportion of the total population. In the future, yellow-billed loons could continue to be exposed to the contaminants they are exposed to now, as well as emerging persistent contaminants such as polybrominated compounds. However, the Service and its partners plan to monitor contaminant exposure, mortality, and productivity in Alaska. Future contaminant risks will be identified and efforts made to address them before they cause population-level declines that threaten the continued existence of the species. Therefore, we find that contaminants other than those associated with oil and gas are not a threat to the yellow-billed loon now or in the foreseeable future.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED:

The *Conservation Agreement for the Yellow-billed Loon (Gavia adamsii)* was signed by five Federal, State and local agencies in 2006 to address research and management needs for yellow-billed loons in Alaska. The Service and its partners agreed to: (1) implement specific actions to protect yellow-billed loons and their breeding habitats in Alaska from potential impacts of land uses and management activities, including oil and gas development; (2) inventory and monitor yellow-billed loon breeding populations in Alaska; (3) reduce the impact of subsistence activities (including fishing and hunting) on yellow-billed loons in Alaska; and (4) conduct biological research on yellow-billed loons, including response to management actions.

In April 2009, the Service organized a workshop for yellow-billed loon biologists to prioritize information needs to conserve the species. This was followed in May 2009 with a conservation planning meeting for agency managers, biologists and other stakeholders to strengthen or expand the Conservation Agreement and identify partnerships and funding sources to implement high priority projects. The Service recently completed the Spotlight Species Action Plan for this species, which identifies the actions we will pursue in cooperation with our partners over the next 5 years, to further its conservation. We expect that further cooperation among agencies and stakeholders will continue, and eventually expand to colleagues in Russia, Canada and other nations hosting yellow-billed loons in their marine waters, as described below.

We believe that the strategies outlined in the agreement demonstrate the partners' commitment to

prioritize yellow-billed loon conservation in Alaska. To fulfill the first strategy, we will continue to work with partners to maintain their commitment to actions protecting loons. In particular, we will work closely with the BLM to monitor and maintain protection of loons on NPR-A, as expressed in their recent memorandum on the yellow-billed loon (Galterio, in litt. 2008, pp. 1-3). For the second strategy, we will continue to inventory yellow-billed loons through waterfowl surveys on the ACP; the NPS will continue loon-specific surveys currently in operation on the Seward Peninsula, and we will investigate the potential for initiating yellow-billed loon-specific surveys. For the third strategy, the Service Endangered Species and Migratory Bird Management programs are working closely with the Alaska Migratory Bird Co-management Council (AMBCC), the native corporation of Kawerak Inc., local communities in the Bering Strait region, the North Slope Borough and the State of Alaska to acquire reliable, verifiable information on subsistence harvest and fishing bycatch levels in Alaska, and to substantially increase education and law enforcement efforts to reduce levels of this threat. Finally, we support the ongoing research by the USGS and others on yellow-billed loons in Alaska, and will continue to advocate for further research where it will inform management of yellow-billed loons, such as understanding effects of disturbance on nesting loons to ensure that buffers separating loons from human activity are adequate.

Research and management of yellow-billed loons have also begun outside Alaska. In particular, we need to understand population sizes and trends for Russian and Canadian breeding populations, migration corridors, and where breeding populations winter. A study by USGS biologists in the northern Canada breeding area began in 2009, and will continue in 2010. In Russia, a survey of yellow-billed loons breeding near the Chaun Bay began in 2009 by Dr. Diana Solovyova; yellow-billed loon studies will continue there in 2010 and 2011 with support from the Service, the Biodiversity Research Institute, and USGS. We encourage managers in both countries to take an active role conserving loons where substantial industrial development occurs, or where other threats such as subsistence harvest or fishing bycatch occur.

Habitat conditions in wintering grounds, especially in Asia, need to be understood and managed so that they continue to support loons. In particular, it will be critical to increase awareness of pollution impacts in marine habitats in Asia, and to develop regulations to reduce pollution levels, so that these wintering areas continue to support yellow-billed loons.

SUMMARY OF THREATS:

We considered whether the existing level of threats causes us to conclude that the species is in danger of extinction now or in the foreseeable future. If population size were to decline or the range were to contract, recovery or re-colonization would likely occur slowly. During most of the year, individuals in the population are so widespread that high adult mortality is unlikely. However, during migration, yellow-billed loons are subject to subsistence harvest that appears to be unsustainable based on the best available information. The total population is uncertain, but based on the best available information, the population, estimated at 16,000 to 32,000 birds on breeding grounds, could decline substantially if unsustainable harvest continues. Future subsistence harvest in Alaska is enough in itself to constitute a threat to the species rangewide.

In addition, up to several hundred yellow-billed loons could be taken annually on Russian breeding grounds, and small amounts of harvest are reported for other areas in Alaska and Canada. Other stressors discussed below may not rise to the level of a threat individually, but when taken collectively with the effects of subsistence hunting in other areas, may reduce the rangewide population even further. Given the small population and the existence of subsistence harvest and inadequate regulatory mechanisms as threats, we believe the species is likely to become in danger of extinction within the foreseeable future.

The present or threatened destruction, modification, or curtailment of its habitat or range:
In our analysis of Factor A, we identified and evaluated the risks to the yellow-billed loon's habitats, including: Oil and gas development (i.e., disturbance, changes in freshwater chemistry and pollutant loads, and changes in freshwater hydrology); pollution; overfishing; and climate change. Based on our review of the best available information, we find that the present or threatened destruction, modification, or curtailment of the yellow-billed loon's habitat or range is not a threat to the species now or in the foreseeable future.

Overutilization for commercial, recreational, scientific, or educational purposes:
We do not have any evidence of risks to yellow-billed loons from overutilization for commercial, recreational, scientific, or educational purposes, and we have no reason to believe this factor will become a threat to the species in the future. Although a small number of birds is taken for scientific research, we find that overutilization for commercial, recreational, scientific or educational purposes is not a threat to the yellow-billed loon now or in the foreseeable future.

Disease or predation:
No large disease-related mortality events have been documented for yellow-billed loons. Indeed, yellow-billed loons might be relatively protected from avian disease mass mortality events that are more common in other water birds because of the loon's dispersed distribution and relatively solitary habits. We have no reason to believe that disease outbreaks will increase or will have more severe effects on yellow-billed loons in the future. Nest predation might affect current productivity, but population-level effects are more likely to result from decreases in adult survival (see Population Resiliency, above). Moreover, due to regulations associated with infrastructure development that also target increasing human safety, we believe that nest predation is unlikely to cause population-level effects in the future, at least in Alaska and Canada; no information is available that would indicate future effects of such development in Russia. Therefore, we find that neither disease nor predation is a threat to the yellow-billed loon now or in the foreseeable future.

The inadequacy of existing regulatory mechanisms:
Existing regulatory mechanisms have not been adequate to eliminate the threat of harvest to the yellow-billed loon throughout its range. In particular, despite the fact that the species is closed to subsistence hunting in Alaska, harvest surveys have recorded a substantial level of harvest. We believe that future take at a level consistent with these prior levels would cause a population-level decline that constitutes a threat to the species (see Factor E). Therefore, we conclude that existing regulatory mechanisms are inadequate to protect the species.

Other natural or manmade factors affecting its continued existence:
In our analysis of Factor E, we identified and evaluated other risk factors, including: oil and gas development and vessel traffic; subsistence harvest; commercial- and subsistence-fishery bycatch; and contaminants other than those associated with oil and gas. Based on our review of the best available information, we find that subsistence harvest is a threat to the yellow-billed loon now and in the foreseeable future.

For species that are being removed from candidate status:
__Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES:
See discussion under "Conservation Measures Planned or Implemented," above.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8*
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for Listing Priority Number

Magnitude—The magnitude of threat to this species is moderate. The primary threat to the species that caused us to conclude listing is warranted is subsistence harvest, despite the species being closed to hunting under the Migratory Bird Treaty Act. Although subsistence harvest is ongoing, the numbers reported taken have varied substantially between years. We also have concerns about the precision of the numbers reported. If changes in management are

implemented in the near future, we believe there is time to reduce this threat before it causes further population-level impacts. Other potential threats, including oil and gas development, climate change, pollution, fishing bycatch and contaminants might also have impacts on yellow-billed loons, but we did not find evidence of these factors affecting populations.

Imminence—The threat of subsistence harvest is imminent. Recent harvest surveys indicate sufficient numbers taken to cause a decline in an otherwise stable population.

__Y__Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?
Emergency listing of the yellow-billed loon is not warranted. The only trend information is for Alaska, where the population is increasing. The current global breeding ground population is of sufficient size (at least 16,000) that extirpation of a significant proportion of the population is not likely to occur before a routine listing process for this species could be completed.

DESCRIPTION OF MONITORING:

We will continue to monitor the status of this species as new information becomes available, and information on the species' distribution, status, and threats will be evaluated every year. The Service continues to inventory yellow-billed loons through our waterfowl surveys on the ACP in Alaska and in parts of the breeding range in Canada. The NPS surveys breeding yellow-billed loons annually on the Seward Peninsula, Alaska. We are working closely with the Alaska Migratory Bird Co-management Council (AMBCC), the Alaska Native corporation of Kawerak, Inc., local communities in the Bering Strait region, the North Slope Borough and the State of Alaska Department of Fish and Game to develop reliable annual surveys on subsistence harvest and fishing bycatch levels in Alaska, and to substantially increase education and law enforcement efforts to reduce levels of subsistence harvest and bycatch.

COORDINATION WITH STATES:

See discussions under "Conservation Measures Planned or Implemented" and "Description of Monitoring." In particular, we work with the AMBCC and the State of Alaska to improve the reliability of subsistence harvest data, and to substantially increase education and law enforcement efforts to reduce levels of this threat. We also coordinated with the State of Alaska on the development of the Spotlight Species Action Plan for the yellow-billed loon.

LITERATURE CITED

See attached Literature Cited List (dated 23 March 2009), and add:

Groves, D.J., E.J. Mallek, R. MacDonald, and T.J. Moser. 2009. Migratory bird surveys in the

Canadian Arctic, 2007. U.S. Fish and Wildlife Service, Juneau, Alaska. 31 pp.

Groves, D.J., E.J. Mallek and T.J. Moser. 2009. Migratory bird surveys in the Canadian Arctic, 2008. Unpubl. report, U.S. Fish and Wildlife Service, Juneau, Alaska. 30 pp.

Groves, D.J. and E.J. Mallek. 2010, in prep. Migratory bird surveys in the Canadian Arctic, 2009. Unpubl. report, U.S. Fish and Wildlife Service, Juneau, Alaska. pp.

Larned, W., R. Stehn and R. Platte. 2010. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska, 2009. U.S. Fish and Wildlife Service, Division of Migratory Bird Migratory Management, Anchorage, Alaska. 45 pp.

Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approved: _____ 24 May 2010
Regional Director, Fish and Wildlife Service Date

Concur: _____ Date: October 22, 2010
ACTING
Director, Fish and Wildlife Service

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review:
Conducted by: