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# A Process for Evaluating the Risk to Persistence of Birds and Mammals in South-central Alaska

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**Cover photo: Landsat Thematic Mapper composite image of the Chugach National Forest in south-central Alaska.**

## Contents

# A PROCESS FOR EVALUATING THE RISK TO PERSISTENCE OF BIRDS AND MAMMALS IN SOUTH-CENTRAL ALASKA

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*Abstract*—Sub-specific variation and unique distribution patterns of wildlife are characteristic of the Chugach National Forest on the Kenai Peninsula, the mainland and islands of Prince William Sound, and the Copper River Delta in south-central Alaska. Maintaining sustainable, well-distributed populations of wildlife across this >2 million-ha landscape is required by the 1976 National Forest Management Act and offered a significant challenge to the USDA Forest Service during revision of the Chugach National Forest Land and Resource Management Plan. In this paper we describe a process, based on the principles of conservation biology that was designed to assist in meeting this challenge. Wildlife species were evaluated to identify those that may be most sensitive to reasonably foreseeable land management actions. Nine of the 267 wildlife species and endemic subspecies that occur on the Chugach National Forest were identified as having a potential risk to their persistence or distribution (i.e., Montague Island hoary marmot (*Marmota caligata sheldoni*), dusky Canada goose (*Branta canadensis occidentalis*), wolverine (*Gulo gulo katschemakensis*), brown bear (*Ursus arctos*), black oystercatcher (*Haematopus bachmani*), gray wolf (*Canis lupus pambasileus*), northern red-backed vole (*Clethrionomys rutilus insularis*), and Montague Island tundra vole (*Microtus oeconomus elymocetes*)). Conservation assessments were completed for five of the species for which there was a high level of concern and helped to guide planning for management activities.

Keywords: biological diversity, conservation, land management, south-central Alaska, species at risk.

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A high degree of sub-specific variation and the discontinuous distribution of wildlife in south-central Alaska are a result of the island nature of habitat in this area. Many of the subspecies endemic to the Chugach National Forest (Forest) are found in only a few locations (e.g., Hall 1981). The complexity of habitats and frequency of subspecies with limited distribution provide a significant challenge to the USDA Forest Service to maintain biological diversity within the context of ongoing land management activities under a multiple-use mandate.

Regulations were developed to implement the National Forest Management Act of 1976 on National Forests in the United States (USDA Forest Service 1982). Those regulations directed the USDA Forest Service to provide wildlife habitats capable of maintaining sustainable populations of existing native and desired non-native vertebrate species across the National Forests. A sustainable (i.e., viable) population has been

defined as "...one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed..." throughout a National Forest (USDA Forest Service 1982:43048). "Well distributed" has been defined "throughout the existing range of the subspecies" (USDA Forest Service 1984). The regulations further state that "...habitat must be well distributed so that...individuals can interact with others..." on National Forests (USDA Forest Service 1982:43048). "Well distributed" was more specifically defined for the purposes of the process we developed to mean that habitats are maintained so that a species has a high likelihood of occurring within each 4,000+ ha watershed within its current range.

Because most of the landscape has not been modified, land managers in south-central Alaska have an opportunity to maintain biological diversity through application of the principles of conservation biology (e.g., Meffe and Carroll 1994) on a large geographic scale. However, if actions are not taken to ensure the maintenance of biological diversity, future management options may be foreclosed. Conservation of biological diversity includes, among other management considerations, specific actions to ensure that sustainable populations of all wildlife are maintained and are well distributed over the landscape (Keystone Center 1991). This paper presents the process used to identify species on the Chugach National Forest in south-central Alaska that were potentially at risk. The results of this process were used as supporting information for the revision of the Chugach Land and Resource Management Plan (USDA Forest Service 2002).

## STUDY AREA

The 2.22-million-hectare landscape on the Forest contains glaciers and ice fields; glacial-fed rivers and outwash plains; steep, rugged mountain side slopes; rolling hills; temperate rainforests; and >7,500 kilometers of shoreline. These features are located throughout three distinct geographical areas on the Forest: the Kenai Peninsula, Prince William Sound, and the Copper River Delta; all have integral roles in ecosystem processes in south-central Alaska.

The Kenai Peninsula is characterized by alpine and subalpine areas covered with ice, snow, barren ground, shrubs, and herbaceous vegetation. Almost 16% of the Peninsula is covered by closed needleleaf and broadleaf forests. Since the mid-1970s >20,000 hectares of forest on the Chugach National Forest portion of the Kenai Peninsula have experienced >70% spruce mortality due to the activities of the spruce beetle (*Dendroctonus rufipennis*) (DeLapp et al. 2000). Most of this mortality occurred to trees in the mature to old age classes. The Kenai Peninsula has historically had the highest levels of disturbance on the Forest, both natural and human-caused. A relatively long fire cycle is present on the Kenai Peninsula with a recurrence interval of >500 years. While fire is not historically frequent on the Kenai Peninsula, it is much more infrequent in Prince William Sound and on the Copper River Delta. In the past 30 years, the Kenai Peninsula has received the greatest amounts of active management, wildfire, and spruce beetle-induced spruce mortality. Prince William Sound is characterized by large expanses of ice and snow and needleleaf forests, with almost 20% of the area supporting conifer stands, most of which are in the mature to old age classes. The Copper River

Delta is dominated by shrubs, graminoids, and barren ground. Forested cover types make up only 10% of the area.

# METHODS

## Selection of species for review

Distributions of mammals (Hall 1981), and birds (American Ornithologists' Union 1957, 1983) were reviewed to determine species and endemic subspecies that occurred on the Forest. Each species presence on the Forest was verified, when possible, with specimens collected on, or near, the Forest and maintained at the University of Alaska Museum, University of Alaska Fairbanks. Species that occurred only accidentally or casually (i.e., primarily birds) (Isleib and Kessel 1973, Armstrong 1990) were not considered in this analysis. Species taxonomy and naming conventions follow those of Banks et al. (1987).

## Evaluation criteria

Numerous rating systems have been developed to evaluate the concern for and direct management attention to wildlife species (e.g., Sparrowe and Wight 1975; Niemi 1982; Thompson 1984). Several of these were summarized and discussed by Millsap et al. (1990). We were specifically interested in an analysis of the vulnerability to extinction or extirpation of populations of wildlife in south-central Alaska. A process necessary to achieve this required information on:

- The physical and biotic environment of the individual and the population,
- The species' life history and habitat requirements, and
- The structure of the population (Gilpin and Soule 1986).

We modified the approach developed by Millsap et al. (1990) for setting wildlife conservation priorities to address the situation in south-central Alaska and our specific objectives.

Twelve criteria were developed to describe aspects of vulnerability for wildlife species in south-central Alaska (Table 1). A numerical level of concern, ranging from 0 (no concern) to 3 (high concern) was associated with each criterion for each species. This was based on information available on the species in the published literature and unpublished technical reports. A concern level of 2 was assigned in those situations when available information was not adequate to establish a rating.

1. Seasonal occurrence in south-central Alaska.

This criterion primarily functioned as a screen to determine the residence status of a species in south-central Alaska. Management practices in south-central Alaska may have a limited effect on species that migrate through this area. Potential effects of land management practices will be much greater on those species that breed in south-central Alaska or are year-round residents. Species status was determined from published accounts of species distribution and natural history (e.g., Isleib and Kessel 1973).

Table 1. Criteria used to evaluate species for viability and distribution concerns in south-central Alaska.

| Criteria | Ranking factor | Score |
|---|---|---|
| 1. Seasonal occurrence in south-central Alaska | | |
| a. | Transient | 0 |
| b. | Resident during winter or nonbreeding season | 1 |
| c. | Resident during breeding season | 2 |
| d. | Permanent resident | 3 |
| e. | Information not available | 2 |
| 2. Geographic distribution within south-central Alaska | | |
| a. | Species occurs in 7+ ecological subsections | 0 |
| b. | Species occurs in 4-6 ecological subsections | 1 |
| c. | Species occurs in 2-3 ecological subsections | 2 |
| d. | Species occurs in 1 ecological subsection | 3 |
| e. | Information not available | 2 |
| 3. Geographic distribution outside Chugach National Forest | | |
| a. | Species distribution > 200% of the size of Chugach National Forest | 0 |
| b. | Species distribution 100–200% of the size of Chugach National Forest | 1 |
| c. | Species distribution 50–100% of the size of Chugach National Forest | 2 |
| d. | Species distribution 0–50% of the size of Chugach National Forest | 3 |
| e. | Information not available | 2 |
| 4. Estimated size of the population in south-central Alaska | | |
| a. | >10,000 individuals throughout its range | 0 |
| b. | 2,500-10,000 individuals throughout its range | 1 |
| c. | 250-2,500 individuals throughout its range | 2 |
| d. | <250 individuals throughout its range | 3 |
| e. | Information not available | 2 |

Table 1. Criteria used to evaluate species for viability and distribution concerns in south-central Alaska.

| Criteria | Ranking factor | Score |
|---|---|---|
| 5. Population trend throughout the species' range | | |
| a. | Population known or suspected to be stable or increasing | 0 |
| b. | Population formerly experienced a downward trend but presently is stable or increasing | 1 |
| c. | Population suspected to be decreasing over a 10 year period | 2 |
| d. | Population known to be decreasing over a 10 year period | 3 |
| e. | Information not available | 2 |
| 6. Population trend of the species in south-central Alaska | | |
| a. | Population known or suspected to be stable or increasing | 0 |
| b. | Population formerly experienced a downward trend but presently is stable or increasing | 1 |
| c. | Population suspected to be decreasing over a 10 year period | 2 |
| d. | Population known to be decreasing over a 10 year period | 3 |
| e. | Information not available | 2 |
| 7. Vulnerability of habitats in south-central Alaska | | |
| a. | Species' habitat is unlikely to be affected by land management activities, species is not negatively affected by habitat fragmentation, and species is a ecological generalist | 0 |
| b. | Species' habitat is likely to be affected by land management activities, species is not negatively affected by habitat fragmentation, and species is a ecological generalist | 1 |
| c. | Species' habitat is likely to be affected by land management activities, species is negatively affected by habitat fragmentation, or species is a ecological specialist | 2 |
| d. | Species' habitat is likely to be affected by land management activities, species is negatively affected by habitat fragmentation, and species is a ecological specialist | 3 |
| e. | Information not available | 2 |

Table 1. Criteria used to evaluate species for viability and distribution concerns in south-central Alaska.

| Criteria | Ranking factor | Score |
|---|---|---|
| 8. Vulnerability to road construction and increased access | | |
| a. | Species unlikely to be affected by increased access | 0 |
| b. | Species harvest likely to increase but will not affect population levels; species not susceptible to increased disturbance | 1 |
| c. | Species not harvested but susceptible to increased disturbance | 2 |
| d. | Species vulnerable to over harvest or other increased mortality as a result of increased access | 3 |
| e. | Information not available | 2 |
| 9. Capability of a species to disperse | | |
| a. | Species are mobile and dispersal is not limited | 0 |
| d. | Dispersal is limited | 3 |
| e. | Information not available | 2 |
| 10. Demographic characteristics of the species | | |
| | Average number of eggs or live young produced/adult female/year | |
| a. | <1 | 3 |
| b. | 1-2 | 2 |
| c. | 3-5 | 1 |
| d. | >5 | 0 |
| e. | Information not available | 2 |
| 11. Demographic characteristics of the species | | |
| | Minimum age of first reproduction in females | |
| a. | >5 yr | 3 |
| b. | 3-4 yr | 2 |
| c. | 2 yr | 1 |
| d. | <2 yr | 0 |
| e. | Information not available | 2 |

Table 1. Criteria used to evaluate species for viability and distribution concerns in south-central Alaska.

| Criteria | Ranking factor | Score |
|---|---|---|
| 12. Knowledge about the species in south-central Alaska | | |
| a. | Limited knowledge concerning a species beyond documentation of their occurrence in south-central Alaska | 3 |
| b. | Species are monitored locally without statistical validity and habitat associations are extrapolated from other areas | 2 |
| c. | Species are monitored throughout south-central Alaska with statistical validity and habitat associations are established in south-central Alaska | 1 |
| d. | Species whose distribution and habitat relationships are well documented in south-central Alaska and throughout their range | 0 |
| e. | Information not available | 2 |

2. Geographic distribution within south-central Alaska.

Species that are present in only a few locations in south-central Alaska have a high risk of extirpation. Interchange of individuals between subpopulations is limited and subpopulations are more vulnerable to local events (e.g., disease, storms) that may cause extinction. The USDA Forest Service has developed a National hierarchical framework of ecological units (McNab and Avers 1994) that has been further developed for the Forest (Davidson 1997). Under this framework, 13 ecological subsections occur on the Forest. Distribution of wildlife species by subsection was used as a basis for evaluation of this criterion. Local and regional accounts of species distributions (e.g., Isleib and Kessel 1973, Manville and Young 1965) and general habitat associations by subsection were used to assign species to ecological subsections.

3. Geographic distribution outside of south-central Alaska.

Species (or subspecies) which occurred only in south-central Alaska, or had limited distribution outside of south-central Alaska warranted a high level of concern. A species (or subspecies) that was mostly restricted to the Forest with a distribution outside of this area limited to an area 50-100% as large as the Forest would have a moderate level of concern. This is because the risk of extinction associated with activities on the Forest is moderated by the limited populations adjacent to the Forest. A species whose range included the Forest and adjacent areas up to double the size of the Forest would

have had a low level of concern. A species with a wide distribution outside of south-central Alaska would generally have had limited risk as a result of activities on the Forest and would be assigned a rating of no concern. Species and subspecies distribution off of the Forest were evaluated from range maps published for each species, generally from accounts of the species' natural history (e.g., Johnsgard 1981).

4. Estimated size of the population in south-central Alaska.

Population density or abundance is the primary factor in determining whether a species will persist following habitat loss (Lehmkuhl and Ruggiero 1991). The lower the abundance or density, the greater the risk of extinction (Pimm et al. 1988, Terborgh and Winter 1980). The definitions developed by Mace and Lande (1991) were used to describe a level of concern in terms of a species' population size. Estimates of population sizes were taken from inventory and monitoring reports (e.g., Hicks 1996*a*), quantitative population estimates (e.g., Isleib and Kessel 1973), and qualitative population estimates (e.g., Armstrong 1990).

5. Population trend throughout the species' range.

The best indication that sustainability of a species may be at risk is a persistent downward trend in population size. Declining populations were an indication of concern even if current population size was large. If a species population trend was unknown, trends in the availability and condition of the species' habitat were considered to be indicative of a population trend. Results of National monitoring programs were often used to assign values for this criterion (e.g., Sauer et al. 1996, The Nature Conservancy 1996).

6. Population trend of the species in south-central Alaska.

Although similar to criterion 5, this criterion provided an evaluation of population trends within south-central Alaska which may be different than the species' range-wide trend and which may be related to specific land management activities on the Forest. Local or regional monitoring efforts provided information for this criterion (e.g., Hodges et al. 1996).

7. Vulnerability of habitats in south-central Alaska to modification as a result of land management activities currently implemented or proposed for implementation.

The primary causes of habitat modification in south-central Alaska has been urban and rural development, timber harvest, and associated road construction. The primary effects of these activities were loss and fragmentation of habitat which reduced the availability and heterogeneity of original habitats (Lehmkuhl and Ruggiero 1991). Human developments and timber harvests tended to be concentrated in those areas that also had high habitat values (e.g., low elevation, high timber volume). This criterion evaluated the potential effects of habitat modification on wildlife species. Information upon which values for this criterion were based generally came from accounts of species' habitat use patterns (e.g., Kuletz et al. 1995, Matsuoka et al. 1997).

8. Vulnerability of the species to road construction and increased access.

Land management activities in south-central Alaska were usually accompanied by road construction. Roads can contribute to increased fragmentation of habitats. However, the most significant impact associated with roads may be the potential for increased access for humans which results in increased disturbance and/or mortality for many wildlife species. Improved access to Prince William Sound and increased densities of water craft may also increase disturbance and harvest of species in this area. Published assessments of the effects of human disturbance or increased mortality were used to evaluate this criterion (e.g., Brody and Pelton 1989, Henson and Grant 1991).

9. Capability of the species to disperse.

Dispersal of individuals from a population may be limited because a species has low vagility or because barriers to dispersal exist. Barriers may be induced through management practices resulting in areas unsuitable as habitat between residual tracts of preferred habitat. Barriers to dispersal may also occur naturally such as water bodies, mountain ranges, or ice fields. Species that are mobile and for which dispersal is not limited by unsuitable habitats generally did not have a concern assigned under this criterion (e.g., Divoky and Horton 1995). Species for which dispersal is limited by behavioral patterns, capability, or unsuitable habitat were assigned a high level of concern (e.g., West 1982).

10-11. Demographic characteristics of the species.

Life history factors, such as low reproductive rates, that result in slow rates of increase in a species' numbers have a significant influence on a species' ability to recover from population declines. A species with a slow rate of increase carries a high risk because it may not be able to rebound from natural– or management–induced population reductions. Two characteristics that significantly affect rate of increase were evaluated: (1) average number of eggs or live young produced per breeding female per year, and (2) minimum age of first reproduction in females (Henny et al. 1970).

12. Knowledge about the species in south-central Alaska.

When knowledge of a species' distribution, life history, demographics, and habitat requirements is limited, the risks to that species associated with management actions are increased.

The level of concern scores for each criterion for each species were summed to provide an overall evaluation value for each species. The highest total score possible for species evaluated using these criteria was 36. The individual species sums were divided by 36 to obtain a percentage of total possible points. The species were ranked in descending order based on this percentage. Species that were assigned a total score > 60% of the maximum score were considered to have a high concern for continued sustainability (after King and Sanger 1979). This standard was verified by comparing it to the mean score of species designated as Threatened or Endangered under the Endangered Species Act, Sensitive by the USDA Forest Service (USDA Forest Service 1994), or as Species of Concern by the US Fish and Wildlife Service (US Fish and

Wildlife Service 1996) or by the Alaska Department of Fish and Game (Alaska Department of Fish and Game 1996).

**Evaluation of the ranking procedure**

*Interrelationships among variables*.–A correlation analysis was conducted using the level-of-concern scores assigned to all species of birds and mammals. This was done to evaluate the degree of association (or independence) among evaluation criteria. It was desirable for all criteria to be independent to assure their contribution to the overall ranking was meaningful.

*Accuracy of level-of-concern scores*.–Determining the accuracy of this ranking process was problematic, but comparing the results with taxa already characterized provided a relative assessment. Species designated as Threatened or Endangered under the Endangered Species Act, Sensitive by the USDA Forest Service (USDA Forest Service 1994), or as Species of Concern by the US Fish and Wildlife Service (US Fish and Wildlife Service 1996) or by the Alaska Department of Fish and Game (Alaska Department of Fish and Game 1996) presumably would have higher values under this process as a result of identified risks to sustainability than species without these designations. All of these designations imply that there is some concern for the sustainability of species within these categories. A t test with an alpha level of 0.05 was used to determine if the mean level-of-concern scores assigned to these species was significantly higher than the mean values of the remaining species.

An effort to establish conservation priorities for land birds in South-coastal Alaska provided a means to compare the work reported here with an independent assessment of a limited number of species (Handel 1996). Correlation coefficients were calculated among level-of-concern scores from the process reported here and the ranks assigned to land bird species as reported by Handel (1996). Positive correlations indicated similar results from the two processes and provided some assurance that the process used in this analysis was relatively accurate.

**Development of conservation assessments**

Conservation assessments were intended be developed for species identified with having high concern for sustainability. The objective of the assessments was to develop a synthesis of the best available, comprehensive, scientific and technical information describing life history, habitat associations, and conservation status. They provided a basis for developing subsequent management conclusions and recommendations for a course of action to conserve the species. Results of the assessments also provided supporting documentation for analysis and review of management actions designed to conserve these species.

Conservation assessment components included:

- Current management situation. A discussion of the history of the species population status.
- Review of technical knowledge. A summary of current scientific knowledge concerning the species including the technical strength of that knowledge.

- Conservation status. A synthesis of the scientific knowledge to project the demographic condition of the species as it relates to the likelihood of long-term persistence. This also included discussion of habitat relationships, present and potential future habitat conditions, and other ecological relationships that would lead to identification of limiting factors.
- Information needs. A systematic examination of available knowledge to assess the need for additional information.

# RESULTS

## Species on the Chugach National Forest

The Chugach National Forest in south-central Alaska provided habitat for 189 bird species, 78 mammal species and endemic subspecies (Tables 2 and 3). This represented 15 orders and 37 families of birds. The range of one subspecies (i.e., Kenai song sparrow) was restricted primarily to the Forest. Six orders and 13 families of mammals occurred on the Forest. The ranges of seven subspecies of mammals were restricted to the Kenai Peninsula (one of these seven is extinct—gray wolf); one subspecies occurred primarily on the Kenai Peninsula but its range extended to Palmer, Alaska. Three subspecies of small mammals were restricted to the islands and mainland of Prince William Sound.

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| **Gaviiformes** | |
| Gaviidae | |
| Yellow-billed loon | *Gavia adamsii* [1] |
| Arctic loon | *G. arctica* |
| Common loon | *G. immer* |
| Pacific loon | *G. pacifica* |
| Red-throated loon | *G. stellata* |
| Total species in family: | 5 |
| **Podicipediformes** | |
| Podicipedidae | |
| Horned grebe | *Podiceps auritus* |
| Red-necked grebe | *Podiceps grisegena* |
| Total species in family: | 2 |
| **Procellariiformes** | |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order** Family Common name | Scientific name |
|---|---|
| Diomedeidae | |
| Laysan albatross | *Diomedea immutabilis* |
| Black-footed albatross | *D. nigripes* |
| Total species in family: | 2 |
| Procellariidae | |
| Northern fulmar | *Fulmarus glacialis* |
| Mottled petrel | *Pterodroma inexpectata* |
| Pink-footed shearwater | *Puffinus creatopus* |
| Sooty shearwater | *P. griseus* |
| Short-tailed shearwater | *P. tenuirostris* [1] |
| Total species in family: | 5 |
| Hydrobatidae | |
| Fork-tailed storm-petrel | *Oceanodroma furcata* [1] |
| Leach's storm-petrel | *O. leucorhoa* [1] |
| Total species in family: | 2 |
| **Pelecaniformes** | |
| Phalacrocoracidae | |
| Double-crested cormorant [2] | *Phalacrocorax auritus cininatus* [1] |
| Pelagic cormorant | *P. pelagicus pelagicus* [1] |
| Brandt's cormorant | *P. penicillatus* |
| Red-faced cormorant | *P. urile* |
| Total species in family: | 4 |
| **Ciconiformes** | |
| Ardeidae | |
| Great-blue heron | *Ardea herodias fannini* |
| Total species in family: | 1 |
| **Anseriformes** | |
| Anatidae | |
| Northern pintail | *Anas acuta* [1] |
| American wigeon | *A. americana* |
| Northern shoveler | *A. clypeata* |
| Green-winged teal | *A. crecca* |
| Blue-winged teal | *A. discors* [1] |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| Mallard | *A. platyrhynchos* [1] |
| Gadwall | *A. strepera* |
| G. white-fronted goose | *Anser albifrons* [1] |
| Greater scaup | *Aythya marila* [1] |
| Canvasback | *A. valisineria* |
| Brant | *Branta bernicla nigricans* |
| Vancouver Canada goose | *B. canadensis fulva* |
| Dusky Canada goose | *B. canadensis occidentalis* [1] |
| Lesser Canada goose | *B. canadensis parvipes* |
| Cackling Canada goose | *B. canadensis minima* |
| Bufflehead | *Bucephala albeola* |
| Common goldeneye | *B. clangula* |
| Barrow's goldeneye | *B. islandica* [1] |
| Snow goose | *Chen caerulescens* |
| Oldsquaw | *Clangula hyemalis* |
| Trumpeter swan | *Cygnus buccinator* [1] |
| Tundra swan | *C. columbianus* [1] |
| Harlequin duck | *Histrionicus histrionicus* |
| White-winged scoter | *Melanitta fusca* [1] |
| Black scoter | *M. nigra* |
| Surf scoter | *M. perspicillata* |
| Common merganser | *Mergus merganser* |
| Red-breasted merganser | *M. serrator* |
| Total species in family: | 28 |
| **Falconiformes**<br>Accipitridae | |
| Osprey | *Pandion haliaetus* |
| Northern goshawk | *Accipiter gentilis* |
| Sharp-shinned hawk | *A. striatus* |
| Golden eagle | *Aquila chrysaetos* |
| Red-tailed hawk | *Buteo jamaicensis* [1] |
| Rough-legged hawk | *B. lagopus* [1] |
| Northern harrier | *Circus cyaneus* |
| Bald eagle | *Haliaeetus leucocephalus* [1] |
| Total species in family: | 8 |
| Falconidae | |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| Merlin | *Falco columbarius* |
| Peregrine falcon | *F. peregrinus pealei* |
| Gyrfalcon | *F. rusticolus* |
| American kestrel | *F. sparverius* |
| Total species in family: | 4 |
| **Galliformes** | |
| Phasianidae | |
| Spruce grouse [3] | *Dendragapus canadensis atratus* |
| Willow ptarmigan | *Lagopus lagopus* [1] |
| White-tailed ptarmigan | *L. leucurus* [1] |
| Rock ptarmigan | *L. mutus* |
| Total species in family: | 4 |
| **Gruiformes** | |
| Gruidae | |
| Sandhill crane | *Grus canadensis* [1] |
| Total species in family: | 1 |
| **Charadriiformes** | |
| Charadriidae | |
| Semi-palmated plover | *Charadrius semipalmatus* [1] |
| Lesser golden plover | *Pluvialis dominica* |
| Black-bellied plover | *P. squatarola* |
| Total species in family: | 3 |
| Haematopodidae | |
| Black oystercatcher | *Haematopus bachmani* |
| Total species in family: | 1 |
| Scolopacidae | |
| Spotted sandpiper | *Actitis macularia* [1] |
| Surfbird | *Aphriza virgata* [1] |
| Ruddy turnstone | *Arenaria interpres* |
| Black turnstone | *A. melanocephala* |
| Sanderling | *Calidris alba* |
| Dunlin | *C. alpina* |
| Baird's sandpiper | *C. bairdii* [1] |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| Red knot | *C. canutus* |
| Western sandpiper | *C. mauri* [1] |
| Pectoral sandpiper | *C. melanotos* [1] |
| Least sandpiper | *C. minutila* [1] |
| Rock sandpiper | *C. ptilocnemis* [1] |
| Semipalmated sandpiper | *C. pusilla* |
| Common snipe | *Gallinago gallinago* [1] |
| Wandering tattler | *Heteroscelus incanus* [1] |
| Short-billed dowitcher | *Limnodromus griseus* [1] |
| Long-billed dowitcher | *L. scolopaceus* |
| Hudsonian godwit | *Limosa haemastica* [1] |
| Whimbrel | *Numenius phaeopus* |
| Lesser yellowlegs | *Tringa flavipes* [1] |
| Greater yellowlegs | *T. melanoleuca* [1] |
| Solitary sandpiper | *T. solitaria* |
| Red phalarope | *Phalaropus fulicarius* [1] |
| Red-necked phalarope | *P. lobatus* [1] |
| Total species in family: | 24 |
| Laridae | |
| Long-tailed jaeger | *Stercorarius longicaudus* [1] |
| Parasitic jaeger | *S. parasiticus* |
| Pomarine jaeger | *S. pomarinus* |
| Herring gull | *Larus argentatus* |
| Mew gull | *L. canus* [1] |
| Glaucous-winged gull | *L. glaucescens* [1] |
| Glaucous gull | *L. huperboreus* |
| Bonaparte's gull | *L. philadelphia* |
| Thayer's gull | *L. thayeri* |
| Black-legged kittiwake | *Rissa tridactyla* [1] |
| Aleutian tern | *Sterna aleutica* |
| Caspian tern | *S. caspia* [1] |
| Arctic tern | *S. paradisaea* [1] |
| Total species in family: | 13 |
| Alcidae | |
| Kittlitz's murrelet | *Brachyramphus brevirostris* |
| Marbled murrelet | *B. marmoratus* [1] |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| Order<br>Family<br>Common name | Scientific name |
|---|---|
| Pigeon guillemot | *Cepphus columba* [1] |
| Rhinoceros auklet | *Cerorhinca monocerata* |
| Parakeet auklet | *Cyclorrhynchus psittacula* |
| Tufted puffin | *Fratercula cirrhata* |
| Horned puffin | *F. corniculata* |
| Ancient murrelet | *Synthliboramphus antiquus* |
| Common murre | *Uria aalge* [1] |
| Thick-billed murre | *U. lomvia* [1] |
| Total species in family: | 10 |
| **Strigiformes** | |
| Strigidae | |
| Northern saw-whet owl | *Aegolius acadicus* [1] |
| Boreal owl | *A. funereus* |
| Short-eared owl | *Asio flammeus* |
| Great-horned owl | *Bubo virginianus* |
| Snowy owl | *Nyctea scandiaca* |
| Great gray owl | *Strix nebulosa* |
| Northern hawk owl | *Surnia ulula* |
| Total species in family: | 7 |
| **Apodiformes** | |
| Trochilidae | |
| Rufus hummingbird | *Selasphorus rufus* [1] |
| Total species in family: | 1 |
| **Coraciiformes** | |
| Alcedinidae | |
| Belted kingfisher | *Ceryle alcyon* [1] |
| Total species in family: | 1 |
| **Piciformes** | |
| Picidae | |
| Downy woodpecker [4] | *P. pubescens glacialis* [1] |
| Three-toed woodpecker | *P. tridactylus* [1] |
| Hairy woodpecker | *P. villosus* |
| Total species in family: | 3 |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| **Passeriformes** | |
| Tyrannidae | |
| Olive-sided flycatcher | *Contopus borealis* |
| Western wood-pewee | *C. sordidulus* |
| Alder flycatcher | *Empidonax alnorum* [1] |
| Say's phoebe | *Sayornis saya* [1] |
| Total species in family: | 4 |
| Alaudidae | |
| Horned lark | *Eremophila alpestris* [1] |
| Total species in family: | 1 |
| Hirundinidae | |
| Cliff swallow | *Hirundo pyrrhonota* |
| Barn swallow | *H. rustica* |
| Bank swallow | *Riparia riparia* |
| Tree swallow | *Tachycineta bicolor* [1] |
| Violet-green swallow | *T. thalassina* [1] |
| Total species in family: | 5 |
| Corvidae | |
| Northwestern crow | *Corvus caurinus* [1] |
| Common raven | *C. corax* |
| Steller's jay | *Cyanocitta stelleri* [1] |
| Gray jay | *Perisoreus canadensis* [1] |
| Black-billed magpie | *Pica pica* [1] |
| Total species in family: | 5 |
| Paridae | |
| Black-capped chickadee | *Parus atricapillus* [1] |
| Boreal chickadee | *P. hudsonicus* |
| Chestnut-backed chickadee | *P. rufescens* [1] |
| Total species in family: | 3 |
| Sittidae | |
| Red-breasted nuthatch | *Sitta canadensis* [1] |
| Total species in family: | 1 |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order** Family Common name | Scientific name |
|---|---|
| Certhiidae | |
| Brown creeper | *Certhia americana* [1] |
| Total species in family: | 1 |
| Troglodytidae | |
| Winter wren | *Troglodytes troglodytes* [1] |
| Total species in family: | 1 |
| Cinclidae | |
| American dipper | *Cinclus mexicanus* |
| Total species in family: | 1 |
| Muscicapidae | |
| Ruby-crowned kinglet [5] | *Regulus calendula grinnelli* [1] |
| Golden-crowned kinglet | *R. satrapa* [1] |
| Total species in family: | 2 |
| Turdinae | |
| Hermit thrush | *Catharus guttatus* [1] |
| Gray-cheeked thrush | *C. minimus* [1] |
| Swainson's thrush | *C. ustulatus* [1] |
| Varied thrush | *Ixoreus naevius* [1] |
| Townsend's solitaire | *Myadestes townsendi* [1] |
| Northern wheatear | *Oenanthe oenanthe* [1] |
| American robin | *Turdus migratorius* [1] |
| Total species in family: | 7 |
| Motacillidae | |
| Red-throated pipit | *Anthus cervinus* [1] |
| American pipit | *Anthus rubrscens* [1] |
| Total species in family: | 2 |
| Bombycillidae | |
| Bohemian waxwing | *Bombycilla garrulus* [1] |
| Total species in family: | 1 |
| Laniidae | |
| Northern shrike | *Lanius excubitor* [1] |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| Total species in family: | 1 |
| Emberizidae | |
| Yellow-rumped warbler | *Dendroica coronata* [1] |
| Yellow warbler | *D. petechia* [1] |
| Blackpoll warbler | *D. striata* [1] |
| Townsend's warbler | *D. townsendi* [1] |
| Northern waterthrush | *Seiurus noveboracensis* [1] |
| Orange-crowned warbler | *Vermivora celata* [1] |
| Wilson's warbler | *Wilsonia pusilla* [1] |
| Lapland longspur | *Calcarius lapponicus* [1] |
| Dark-eyed junco | *Junco hyemalis* [1] |
| Lincoln's sparrow | *Melospiza lincolnii* [1] |
| Song sparrow [6] | *M. melodia kenaiensis* [1] |
| Savannah sparrow | *Passerculus sandwichensis* [1] |
| Fox sparrow | *Passerella iliaca* [1] |
| Snow bunting | *Plectrophenax nivalis* [1] |
| American tree sparrow | *Spizella arborea* [1] |
| Golden-crowned sparrow | *Zonotrichia atripcapilla* [1] |
| White-crowned sparrow | *Z. leucophrys* [1] |
| Red-winged blackbird | *Agelaius phoeniceus* [1] |
| Rusty blackbird | *Euphagus carolinus* [1] |
| Total species in family: | 19 |
| Fringillidae | |
| Common redpoll | *Carduelis flammea* [1] |
| Pine siskin | *C. pinus* [1] |
| Rosy finch | *Leucosticte arctoa* [1] |
| Red crossbill | *Loxia curvirostra* [1] |
| White-winged crossbill | *L. leucoptera* [1] |
| Pine grosbeak [7] | *Pinicola enucleator flammula* [1] |
| Total species in family: | 6 |
| Occurrence: Orders | 15 |
| Families | 37 |
| Species | 189 |

Table 2. Occurrence of birds on the Chugach National Forest, south-central Alaska.

| **Order** Family Common name | Scientific name |
|---|---|

[1] Occurrence on the Chugach National Forest was verified with collected specimens at the University of Alaska Museum (University of Alaska Fairbanks).
[2] The range of this subspecies included Carlisle Island, Alaska Peninsula, Kodiak Island, and the Kenai Peninsula. It was resident in portions of this range.
[3] Range included Bristol Bay to Cook Inlet, Prince William Sound, and Kodiak Island. The type locality was Cedar Bay, Hawkins Island, Prince William Sound.
[4] Range included the Kenai Peninsula to the Taku River. The type locality was Valdez Narrows, Prince William Sound.
[5] Range included Prince William Sound to Skagway to southern British Columbia. The type locality was Sitka.
[6] Range included Seldovia to Hope to the Copper River Delta. The type locality was Port Graham, Kenai Peninsula.
[7] Range included Kodiak Island, Kenai Peninsula, Sitka, Dall Island, to Northwest British Columbia. The type locality was Alaska.

Table 3. Occurrence of mammals on the Chugach National Forest, south-central Alaska.

| **Order** Family Common name | Scientific name |
|---|---|
| **Insectivora** | |
| Soricidae | |
| Masked shrew | *Sorex cinereus* [1] |
| Pygmy shrew | *Sorex hoyi* |
| Montane shrew | *Sorex monticolus* [1] |
| Northern water shrew | *Sorex palustris* [1] |
| Total species and subspecies in family: | 4 |
| **Chiroptera** | |
| Vespertilionidae | |
| Silver-haired bat (E. PWS) | *Lasionycteris noctivagans* |
| Little brown myotis | *Myotis lucifugus* [1] |
| Total species and subspecies in family: | 2 |
| **Carnivora** | |
| Canidae | |
| Coyote | *Canis latrans* [1] |
| Gray wolf [2] | *Canis lupus pambasileus* [1] |
| Gray wolf [3] (extinct) | *C. l. alces* |
| Red fox | *Vulpes vulpes alascensis* |
| Red fox [4] | *Vulpes vulpes kenaiensis* |

Table 3. Occurrence of mammals on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|
| Total species and subspecies in family: | 5 |
| Ursidae | |
| Black bear [5] | *Ursus americanus perniger* [1] |
| Black bear [6] | *U. a. emmonsii* |
| Brown bear | *Ursus arctos* [1] |
| Total species and subspecies in family: | 3 |
| Mustelidae | |
| Wolverine [7] | *Gulo gulo luscus* [1] |
| Wolverine [8] | *G. g. katschemakensis* |
| Marten | *Martes americana* [1] |
| Marten [9] | *M. a. kenaiensis* |
| Ermine | *Mustela erminea* [1] |
| Least weasel | *Mustela nivalis* |
| Mink [10] | *Mustela vison melampeplus* [1] |
| Sea otter | *Enhydra lutris* [1] |
| River otter | *Lutra canadensis* |
| Total species and subspecies in family: | 9 |
| Felidae | |
| Lynx | *Lynx canadensis* [1] |
| Total species and subspecies in family: | 1 |
| Otariidae | |
| Northern fur seal | *Callorhinus ursinus* |
| Steller sea lion | *Eumetopias jubatus* [1] |
| Total species and subspecies in family: | 2 |
| Phocidae | |
| Harbor seal | *Phoca vitulina richardsi* [1] |
| Total species and subspecies in family: | 1 |
| **Artiodactyla** | |
| Cervidae | |
| Moose | *Alces alces* [1] |
| Sitka black-tailed deer | *Odocoileus hemionus* |
| Caribou | *Rangifer tarandus* |
| Total species and subspecies in family: | 3 |

Table 3. Occurrence of mammals on the Chugach National Forest, south-central Alaska.

| Common name | Scientific name |
|---|---|
| **Order** | |
| Family | |
| Bovidae | |
| Mountain goat [11] | *Oreamnos americanus kennedyi* |
| Dall sheep [12] | *Ovis dalli kenaiensis* [1] |
| Total species and subspecies in family: | 2 |
| **Rodentia** | |
| Sciurdae | |
| Northern flying squirrel | *Glaucomys sabrinus* |
| Hoary marmot | *Marmota caligata* [1] |
| Montague Island hoary marmot | *M. c. sheldoni* |
| Arctic ground squirrel | *Spermophilus parryii* [1] |
| Red squirrel | *Tamiasciurus hudsonicus* [1] |
| Red squirrel [13] | *T. h. kenaiensis* |
| Beaver | *Castor canadensis* [1] |
| Northern red-backed vole [14] | *Clethrionomys rutilus dawsoni* [1] |
| Northern red-backed vole [15] | *C. r. insularis* |
| Northern red-backed vole [16] | *C. r. orca* |
| Singing vole [17] | *Microtus miurus miurus* [1] |
| Singing vole [18] | *M. m. cantator* |
| Tundra vole | *M. oeconomus* [1] |
| Montague Island tundra vole | *M. o. elymocetes* |
| Meadow vole | *M. pennsylvanicus* [1] |
| Muskrat | *Ondatra zibethicus* |
| Northern bog lemming | *Synaptomys borealis* [1] |
| Meadow jumping mouse | *Zapus hudsonius* [1] |
| Porcupine | *Erethizon dorsatum* |
| Total species and subspecies in family: | 19 |
| **Lagomorpha** | |
| Ochotonidae | |
| Collard pika | *Ochotona collaris* [1] |
| Total species and subspecies in family: | 1 |
| Leporidae | |
| Snowshoe hare | *Lepus americanus* [1] |
| Total species and subspecies in family: | 1 |
| Occurrence: Orders | 6 |
| Families | 13 |
| Species and subspecies | 53 |

Table 3. Occurrence of mammals on the Chugach National Forest, south-central Alaska.

| **Order**<br>Family<br>Common name | Scientific name |
|---|---|

[1] Occurrence on the Chugach National Forest was verified with collected specimens at the University of Alaska Museum (University of Alaska Fairbanks).
[2] Type locality was the Susitna River south of Denali.
[3] Type locality was Kachemak Bay, Alaska.
[4] Known only from the Kenai Peninsula.
[5] Known only from the Kenai Peninsula. Type locality was Homer.
[6] Range extended from Prince William Sound to Yakutat. Type locality was Yakutat Bay.
[7] Range included Alaska, Canada, and the northern lower 48 States.
[8] Known only from the Kenai Peninsula. Type locality was Kachemak Bay, Alaska.
[9] Extent of range was unknown. Type locality was the Kenai Peninsula.
[10] Range extended from the Alaska Peninsula through the Kenai Peninsula to Prince William Sound. Type locality was the Kenai Peninsula.
[11] Range included Cook Inlet to Thompson Pass. Type locality was the mouth of the Copper River opposite Kayak Island.
[12] Known only from the Kenai Peninsula. Type locality was Skilak Lake.
[13] Known only from the Kenai Peninsula. Type locality was Hope.
[14] Range included Alaska other than Prince William Sound and most of Canada.
[15] Known only from Hawkins and Hinchinbrook islands. Type locality was the west side of Canoe Passage, Hawkins Island.
[16] Range included Valdez Narrows, Cordova, LaTouche Island, and the head of Port Nellie Juan. Type locality was Orca, Prince William Sound.
[17] Range included the Kenai Peninsula to Palmer. Type locality was Hope.
[18] Range included much of south-central Alaska from Prince William Sound and east ward. Type locality was Tepee Lake, St. Elias mountain range.

## Ranking of species

Nine species or subspecies occurring on the Chugach National Forest received ratings >60% of the total possible score for the evaluation criteria (Tables 4 and 5). These species generally had restricted distribution, experienced a documented population decline or had a high likelihood for a population decline, and were sensitive to land management activities. Five of these were subspecies endemic to the Forest with limited distribution.

Table 4. Results of risk screening of birds found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total | % | |
| Dusky Canada goose | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 25 | 69 | 39,61,63,87,128 |
| Black oystercatcher | 3 | 2 | 0 | 2 | 1 | 3 | 2 | 2 | 0 | 2 | 3 | 3 | 23 | 64 | 3,55,61,64,70,116 |
| Ancient murrelet | 3 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 3 | 21 | 58 | 43,61,70 |
| Thick-billed murre | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 3 | 21 | 58 | 4,61,70 |
| Three-toed woodpecker | 3 | 2 | 0 | 2 | 2 | 2 | 2 | 0 | 3 | 1 | 2 | 2 | 21 | 58 | 32,61,70,104 |
| Yellow-billed loon | 3 | 1 | 0 | 2 | 2 | 2 | 0 | 2 | 0 | 3 | 2 | 3 | 20 | 56 | 61,88 |
| Northern goshawk | 3 | 1 | 0 | 2 | 3 | 2 | 3 | 2 | 0 | 1 | 1 | 2 | 20 | 56 | 61,90,100,101,102,104,112,126 |
| Marbled murrelet | 3 | 1 | 0 | 0 | 3 | 3 | 3 | 2 | 0 | 2 | 2 | 1 | 20 | 56 | 31,34,61,70,72,84,93,94,98 |
| Pigeon guillemot | 2 | 2 | 0 | 0 | 2 | 3 | 2 | 2 | 0 | 2 | 2 | 3 | 20 | 56 | 40,41,61,70 |
| Rhinoceros auklet | 2 | 2 | 0 | 2 | 1 | 2 | 2 | 2 | 0 | 2 | 2 | 3 | 20 | 56 | 44,61,70 |
| Northern saw-whet owl | 3 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 2 | 3 | 20 | 56 | 24,61,66,70,82 |
| Great gray owl | 3 | 1 | 0 | 3 | 2 | 2 | 2 | 2 | 0 | 1 | 1 | 3 | 20 | 56 | 19,36,61,66,70 |
| Northwestern crow | 3 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 20 | 56 | 61,46,104 |
| Arctic loon | 3 | 1 | 0 | 1 | 2 | 2 | 1 | 2 | 0 | 2 | 2 | 3 | 19 | 53 | 55,61,88 |
| Pacific loon | 3 | 1 | 0 | 1 | 2 | 2 | 1 | 2 | 0 | 2 | 2 | 3 | 19 | 53 | 55,61,88 |
| Laysan albatross | 1 | 3 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 19 | 53 | 61,88,124 |
| Brandt's cormorant | 3 | 3 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 19 | 53 | 61,88 |
| Golden eagle | 2 | 1 | 0 | 3 | 0 | 2 | 2 | 2 | 0 | 2 | 3 | 2 | 19 | 53 | 4,17,91,104,118 |
| Spruce grouse | 3 | 1 | 0 | 1 | 2 | 2 | 2 | 3 | 3 | 0 | 0 | 2 | 19 | 53 | 11,61,70,118 |
| Chestnut-backed chickadee | 3 | 2 | 0 | 1 | 2 | 2 | 2 | 0 | 3 | 0 | 2 | 2 | 19 | 53 | 61,70,104,118 |
| Red-throated loon | 3 | 1 | 0 | 1 | 2 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 18 | 50 | 55,61,88 |
| Black-footed albatross | 1 | 3 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 18 | 50 | 61,88,125 |
| Pink-footed shearwater | 0 | 3 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 18 | 50 | 61,88 |
| Leach's storm-petrel | 1 | 3 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 18 | 50 | 58,61,88 |
| Red-faced cormorant | 3 | 3 | 0 | 1 | 2 | 2 | 0 | 2 | 0 | 1 | 1 | 3 | 18 | 50 | 61,88 |
| Peregrine falcon | 3 | 1 | 0 | 3 | 1 | 2 | 2 | 2 | 0 | 1 | 1 | 2 | 18 | 50 | 61,91,104,118 |
| Semi-palmated plover | 2 | 1 | 0 | 2 | 1 | 2 | 2 | 2 | 0 | 1 | 2 | 3 | 18 | 50 | 61,64,70,77 |
| Lesser yellowlegs | 2 | 2 | 0 | 2 | 3 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 18 | 50 | 61,64,70,104 |
| Caspian tern | 2 | 3 | 0 | 3 | 0 | 0 | 1 | 2 | 0 | 2 | 2 | 3 | 18 | 50 | 4,70,104 |
| Common murre | 2 | 1 | 0 | 0 | 2 | 3 | 2 | 2 | 0 | 2 | 3 | 1 | 18 | 50 | 41,61,70 |
| Western wood-pewee | 2 | 1 | 0 | 3 | 3 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 18 | 50 | 96,104,118 |
| Blackpoll warbler | 2 | 2 | 0 | 3 | 3 | 3 | 1 | 0 | 0 | 1 | 0 | 3 | 18 | 50 | 29,61,96,104 |
| Northern fulmar | 1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 17 | 47 | 61,88 |
| Mottled petrel | 0 | 3 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 17 | 47 | 61,88 |
| Short-tailed shearwater | 0 | 3 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 3 | 3 | 3 | 17 | 47 | 61,88 |
| Pelagic cormorant | 3 | 3 | 0 | 0 | 2 | 2 | 0 | 2 | 0 | 1 | 1 | 3 | 17 | 47 | 53,61,88 |
| Parasitic jaeger | 2 | 2 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 17 | 47 | 61,70 |
| Black-legged kittiwake | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 0 | 2 | 2 | 3 | 17 | 47 | 6,61,70 |
| Aleutian tern | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 2 | 3 | 17 | 47 | 61,70,85 |
| Steller's jay | 3 | 2 | 0 | 1 | 0 | 2 | 1 | 0 | 3 | 1 | 2 | 2 | 17 | 47 | 61,46,70,104 |
| Boreal chickadee | 3 | 1 | 0 | 2 | 2 | 2 | 2 | 0 | 3 | 0 | 0 | 2 | 17 | 47 | 32,42,61,70,104 |
| Common loon | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | 0 | 2 | 1 | 2 | 16 | 44 | 55,61,88,104 |
| Fork-tailed storm-petrel | 1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 16 | 44 | 61,88 |
| Harlequin duck | 3 | 1 | 0 | 0 | 2 | 2 | 2 | 3 | 0 | 1 | 1 | 1 | 16 | 44 | 61,63,89 |
| White-tailed ptarmigan | 3 | 2 | 0 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 0 | 2 | 16 | 44 | 14,61,62,121 |
| Long-tailed jaeger | 2 | 2 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 16 | 44 | 61,70 |
| Tufted puffin | 2 | 2 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 2 | 2 | 3 | 16 | 44 | 61,70 |
| Horned puffin | 2 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 2 | 2 | 3 | 16 | 44 | 61,70 |
| Boreal owl | 3 | 1 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 16 | 44 | 49,50,51,61,66 |
| Great-horned owl | 3 | 0 | 0 | 1 | 3 | 2 | 1 | 0 | 0 | 2 | 2 | 2 | 16 | 44 | 4,33,61,66,82,104,118 |
| Rufus hummingbird | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 0 | 0 | 2 | 0 | 3 | 16 | 44 | 23,61,65,96,104,118 |
| Belted kingfisher | 2 | 1 | 0 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 16 | 44 | 33,47,61,70,104 |
| Hairy woodpecker | 3 | 1 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 1 | 0 | 2 | 16 | 44 | 32,61,70,104 |
| Olive-sided flycatcher | 2 | 1 | 0 | 3 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 16 | 44 | 4,32,61,96,104,118 |
| Horned lark | 2 | 2 | 0 | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 16 | 44 | 4,7,32,61,70,104 |

Table 4. Results of risk screening of birds found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total | % | |
| Pine grosbeak | 3 | 0 | 0 | 1 | 2 | 2 | 1 | 0 | 3 | 1 | 0 | 3 | 16 | 44 | 32,61,70,118 |
| Sooty shearwater | 0 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 3 | 2 | 3 | 15 | 42 | 61,88 |
| Great-blue heron | 3 | 0 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 1 | 1 | 3 | 15 | 42 | 20,61,88,104 |
| Greater scaup | 3 | 2 | 0 | 1 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 1 | 15 | 42 | 55,61,63,89,117 |
| Osprey | 2 | 1 | 0 | 3 | 0 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | 15 | 42 | 61,90,104,118 |
| Semipalmated sandpiper | 0 | 2 | 0 | 2 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 15 | 42 | 61,64,70,77,104 |
| Common snipe | 2 | 0 | 0 | 1 | 3 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 15 | 42 | 61,64,70,104 |
| Wandering tattler | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 15 | 42 | 61,64,70 |
| Hudsonian godwit | 2 | 2 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 15 | 42 | 4,64,70 |
| Mew gull | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 1 | 2 | 3 | 15 | 42 | 61,70 |
| Glaucous-winged gull | 3 | 1 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 1 | 2 | 3 | 15 | 42 | 61,70,104,119 |
| Bonaparte's gull | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 1 | 2 | 3 | 15 | 42 | 61,70 |
| Parakeet auklet | 2 | 2 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 15 | 42 | 61,70 |
| Northern hawk owl | 3 | 2 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 15 | 42 | 61,66,118 |
| Downy woodpecker | 3 | 0 | 0 | 2 | 3 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 15 | 42 | 4,32,61,70,104,105 |
| Bank swallow | 2 | 1 | 0 | 2 | 3 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 15 | 42 | 32,61,70,104 |
| Common raven | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 1 | 2 | 2 | 15 | 42 | 57,61,46,70,104 |
| Gray jay | 3 | 2 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 15 | 42 | 61,70,104,113,118 |
| Brown creeper | 3 | 1 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 15 | 42 | 61,96,104,118 |
| Winter wren | 3 | 2 | 0 | 1 | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 15 | 42 | 32,61,70,104 |
| American dipper | 3 | 0 | 0 | 1 | 3 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 15 | 42 | 61,70,71,104,118 |
| Townsend's solitaire | 2 | 1 | 0 | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 15 | 42 | 4,13,96,118 |
| Northern wheatear | 2 | 2 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 3 | 15 | 42 | 61,70,118 |
| Red-winged blackbird | 2 | 1 | 0 | 2 | 3 | 2 | 1 | 0 | 0 | 1 | 0 | 3 | 15 | 42 | 4,32,61,70,104,118,127 |
| Double-crested cormorant | 2 | 1 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 1 | 2 | 3 | 14 | 39 | 61,88,104 |
| Vancouver Canada goose | 3 | 2 | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 2 | 14 | 39 | 54,55,61,63,73,80,99 |
| White-winged scoter | 3 | 1 | 0 | 0 | 2 | 2 | 1 | 2 | 0 | 0 | 1 | 2 | 14 | 39 | 18,55,61,63,89,104 |
| Sharp-shinned hawk | 2 | 1 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 14 | 39 | 61,67,90,104,118 |
| Rough-legged hawk | 0 | 1 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 91,118 |
| Bald eagle | 3 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 2 | 2 | 1 | 14 | 39 | 41,61,67,79,90,104,118 |
| Merlin | 3 | 1 | 0 | 3 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 3 | 14 | 39 | 61,91,104,110,118 |
| Gyrfalcon | 1 | 1 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | 14 | 39 | 4,91,118 |
| Spotted sandpiper | 2 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 55,61,64,70,86 |
| Short-billed dowitcher | 2 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 61,64,70,77 |
| Red-necked phalarope | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 61,64,70 |
| Arctic tern | 2 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 14 | 39 | 61,70 |
| Snowy owl | 0 | 2 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | 14 | 39 | 92,118 |
| Say's phoebe | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 4,61,70,104 |
| Golden-crowned kinglet | 2 | 2 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 14 | 39 | 32,60,61,70,104,118 |
| Gray-cheeked thrush | 2 | 1 | 0 | 2 | 3 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 14 | 39 | 61,96,118 |
| Bohemian waxwing | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 3 | 14 | 39 | 61,70,118 |
| American tree sparrow | 2 | 1 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 14 | 39 | 21,61,83,118 |
| Pine siskin | 2 | 1 | 0 | 1 | 3 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 14 | 39 | 30,61,96,104,118 |
| Rosy finch | 2 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 39 | 61,70,118 |
| Red-necked grebe | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 1 | 1 | 3 | 13 | 36 | 61,88,104 |
| Northern pintail | 2 | 1 | 0 | 1 | 3 | 3 | 0 | 1 | 0 | 0 | 0 | 2 | 13 | 36 | 55,61,63,89,117 |
| Brant | 0 | 1 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 55,61,63,89 |
| Common goldeneye | 1 | 2 | 0 | 0 | 2 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 13 | 36 | 37,55,61,63,89,104 |
| Trumpeter swan | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 1 | 13 | 36 | 22,27,48,52,61,81,89 |
| Red-tailed hawk | 2 | 0 | 0 | 3 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 2 | 13 | 36 | 91,97,104,118 |
| Northern harrier | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 2 | 13 | 36 | 4,76,90,104,118 |
| Willow ptarmigan | 3 | 1 | 0 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 2 | 2 | 13 | 36 | 9,10,61,62,121 |
| Sanderling | 0 | 2 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,64,70,77,104 |
| Baird's sandpiper | 0 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,64,70 |
| Whimbrel | 0 | 1 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,70,77,108 |
| Greater yellowlegs | 2 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,64,70,104 |
| Glaucous gull | 1 | 1 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,70 |

Table 4. Results of risk screening of birds found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total | % | |
| Thayer's gull | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 13 | 36 | 4,70 |
| Violet-green swallow | 2 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 16,61,104,118 |
| Red-breasted nuthatch | 3 | 1 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 32,61,70,104,118 |
| Swainson's thrush | 2 | 1 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 61,96,104 |
| Dark-eyed junco | 2 | 1 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 4,21,61,70,104,118 |
| Snow bunting | 2 | 1 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 4,21,61,75 |
| Rusty blackbird | 2 | 1 | 0 | 2 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 4,5,32,61,70,104,118 |
| Common redpoll | 2 | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 13 | 36 | 61,70,118 |
| Red crossbill | 3 | 2 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 13 | 36 | 1,32,61,70,104,118 |
| White-winged crossbill | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 13 | 36 | 4,8,104,118 |
| Horned grebe | 1 | 1 | 0 | 1 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 12 | 33 | 61,88,104 |
| Barrow's goldeneye | 3 | 1 | 0 | 0 | 0 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 12 | 33 | 55,61,63,89,104 |
| Black scoter | 1 | 1 | 0 | 0 | 2 | 2 | 1 | 2 | 0 | 0 | 1 | 2 | 12 | 33 | 12,55,61,63,89,104 |
| Surf scoter | 3 | 1 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 0 | 1 | 2 | 12 | 33 | 55,61,63,89,104 |
| Red knot | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 12 | 33 | 61,64,70,77 |
| Pectoral sandpiper | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 12 | 33 | 61,64,70 |
| Rock sandpiper | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 12 | 33 | 61,64,70 |
| Herring gull | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 12 | 33 | 61,70,95,104 |
| Kittlitz's murrelet | 3 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 12 | 33 | 61,70,41 |
| Barn swallow | 2 | 0 | 0 | 2 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 12 | 33 | 32,61,70,104 |
| Varied thrush | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 2 | 12 | 33 | 61,70,104,118 |
| American pipit | 2 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 3 | 12 | 33 | 61,70,120 |
| Northern shrike | 2 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 3 | 12 | 33 | 61,70,118 |
| Townsend's warbler | 2 | 1 | 0 | 2 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 2 | 12 | 33 | 29,61,78,96,104,118 |
| Northern waterthrush | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 12 | 33 | 29,38,71,70,104,118 |
| Wilson's warbler | 2 | 1 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 12 | 33 | 29,61,96,104,118 |
| Lapland longspur | 2 | 1 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 12 | 33 | 4,21,61,70 |
| Song sparrow | 2 | 0 | 0 | 1 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 12 | 33 | 21,104,118 |
| American wigeon | 2 | 2 | 0 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 11 | 31 | 55,61,63,117 |
| Northern shoveler | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 11 | 31 | 35,55,61,63,89,117 |
| Gadwall | 3 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 3 | 11 | 31 | 55,61,63,74,117 |
| Canvasback | 2 | 2 | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 11 | 31 | 55,61,63,89,117 |
| Snow goose | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 11 | 31 | 61,63,89 |
| Common merganser | 3 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 1 | 2 | 11 | 31 | 55,61,63,89,104 |
| Red-breasted merganser | 3 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 1 | 2 | 11 | 31 | 55,61,63,89,104 |
| Rock ptarmigan | 3 | 1 | 0 | 0 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 11 | 31 | 61,62,121,122 |
| Lesser golden plover | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 11 | 31 | 61,64,70,77 |
| Black-bellied plover | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | 11 | 31 | 61,64,70,77 |
| Black turnstone | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 11 | 31 | 61,64,70 |
| Solitary sandpiper | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 11 | 31 | 61,70 |
| Pomarine jaeger | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 11 | 31 | 61,70 |
| Short-eared owl | 2 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 11 | 31 | 26,56,61,66,82,104 |
| Cliff swallow | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 11 | 31 | 15,32,61,70,104 |
| Black-capped chickadee | 3 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 11 | 31 | 4,61,104,106,109,118 |
| Yellow-rumped warbler | 2 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 11 | 31 | 29,61,70,104,118 |
| White-crowned sparrow | 2 | 1 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 11 | 31 | 25,61,104 |
| Mallard | 3 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 10 | 28 | 55,61,63,89,117 |
| Bufflehead | 1 | 1 | 0 | 0 | 0 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 10 | 28 | 45,55,61,63,104 |
| American kestral | 0 | 1 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 10 | 28 | 91,118 |
| Dunlin | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | 10 | 28 | 61,64,70,77,104 |
| Western sandpiper | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 10 | 28 | 61,64,70,104 |
| Least sandpiper | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 3 | 10 | 28 | 28,61,64,70,104 |
| Long-billed dowitcher | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 10 | 28 | 61,64,70,104 |
| Alder flycatcher | 2 | 1 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 10 | 28 | 96,104 |
| Tree swallow | 2 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 10 | 28 | 61,103 |
| Fox sparrow | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 10 | 28 | 21,61,118,104 |
| Blue-winged teal | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 3 | 9 | 25 | 61,63,89,117 |

Table 4. Results of risk screening of birds found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total | % | |
| G. white-fronted goose | 0 | 2 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 9 | 25 | 55,61,89 |
| Tundra swan | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 1 | 1 | 2 | 9 | 25 | 55,61,89 |
| Ruddy turnstone | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 9 | 25 | 61,64,70,104 |
| Red phalarope | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 9 | 25 | 61,64,70 |
| Black-billed magpie | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 9 | 25 | 46,61,70,104 |
| Ruby-crowned kinglet | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 9 | 25 | 59,61,96,104,118 |
| Hermit thrush | 2 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 9 | 25 | 61,69,96,104,118 |
| Yellow warbler | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 9 | 25 | 29,61,70,104,118 |
| Lincoln's sparrow | 2 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 9 | 25 | 2,21,61,104 |
| Golden-crowned sparrow | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 9 | 25 | 21,61,118 |
| Green-winged teal | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 8 | 22 | 55,61,63,68,89,117 |
| Oldsquaw | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 8 | 22 | 55,61,63,89,104 |
| Sandhill crane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 8 | 22 | 55,61,104,114,115 |
| Surfbird | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 2 | 8 | 22 | 61,70,104,107 |
| American robin | 2 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 8 | 22 | 32,61,70,104,118 |
| Orange-crowned warbler | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 8 | 22 | 29,33,61,104,111 |
| Savannah sparrow | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 7 | 19 | 21,33,61,70,104,123 |
| Lesser Canada goose | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 6 | 17 | 55,61,63,89 |
| Cackling Canada goose | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 6 | 17 | 55,61,63,89 |

2 : Adequate information was not available to assign a value to these criteria.

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Table 5. Results of risk screening of mammals found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | Total | % | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| Mont. Is. hoary marmot | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 27 | 75 | 40,43,54,63,113 |
| Wolverine [1] | 3 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 2 | 24 | 67 | 2,26,40,91,105,120 |
| Brown bear | 3 | 0 | 0 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 23 | 64 | 21,40,45,74,105,110 |
| Steller sea lion | 3 | 2 | 0 | 2 | 3 | 3 | 2 | 2 | 0 | 2 | 3 | 1 | 23 | 64 | 33,40,52,77,105 |
| Gray wolf | 3 | 0 | 0 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 22 | 61 | 18,40,44,70,71,84,87,106,107 |
| N. red-backed vole [2] | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 22 | 61 | 12,23,40,55,115,116 |
| Mont. Is. tundra vole [3] | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 0 | 3 | 0 | 0 | 2 | 22 | 61 | 40,61,83,117,118 |
| Mountain goat | 3 | 1 | 1 | 1 | 0 | 0 | 3 | 3 | 3 | 2 | 2 | 2 | 21 | 58 | 19,40,50,97,105,119 |
| Dall sheep | 3 | 2 | 3 | 2 | 0 | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 21 | 58 | 32,40,49,62,105 |
| Red squirrel [4] | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 0 | 3 | 1 | 0 | 3 | 21 | 58 | 28,30,40,73 |
| Northern red-backed vole [5] | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 21 | 58 | 12,23,40,55,115,116 |
| American marten [6] | 3 | 0 | 1 | 2 | 1 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 20 | 56 | 2,40,68,100,105 |
| Black bear [7] | 3 | 1 | 2 | 1 | 0 | 2 | 2 | 3 | 0 | 2 | 2 | 2 | 20 | 56 | 1,16,40,58,85,94,105 |
| Red fox [8] | 3 | 1 | 3 | 2 | 1 | 1 | 0 | 1 | 3 | 1 | 0 | 3 | 19 | 53 | 2,3,40,95,99 |
| Northern fur seal | 2 | 1 | 0 | 2 | 3 | 2 | 2 | 2 | 0 | 2 | 2 | 1 | 19 | 53 | 5,17,29,40,92,105 |
| Northern flying squirrel | 3 | 2 | 0 | 2 | 0 | 2 | 3 | 0 | 3 | 1 | 0 | 3 | 19 | 53 | 23,40,68,76,101,105,112 |
| Wolverine [9] | 3 | 0 | 0 | 2 | 2 | 1 | 2 | 3 | 0 | 2 | 1 | 2 | 18 | 50 | 2,26,40,79,91,105,120 |
| River otter | 3 | 0 | 0 | 2 | 1 | 2 | 2 | 3 | 0 | 2 | 1 | 2 | 18 | 50 | 2,13,22,40,56,103,104,105,109 |
| Black bear [10] | 3 | 1 | 0 | 2 | 0 | 0 | 2 | 3 | 0 | 2 | 2 | 2 | 17 | 47 | 1,16,40,58,85,94,105 |
| Sea otter | 3 | 2 | 0 | 2 | 1 | 3 | 0 | 0 | 0 | 3 | 2 | 1 | 17 | 47 | 40,59,93,105 |
| Caribou | 3 | 2 | 0 | 2 | 0 | 1 | 0 | 3 | 0 | 2 | 2 | 2 | 17 | 47 | 46,72,98,105 |
| Arctic ground squirrel | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 0 | 2 | 3 | 17 | 47 | 40,105,108 |
| Singing vole [11] | 3 | 1 | 1 | 2 | 2 | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 17 | 47 | 6,40 |
| Northern bog lemming | 3 | 0 | 0 | 2 | 2 | 2 | 2 | 0 | 3 | 0 | 0 | 3 | 17 | 47 | 6,23,40,105 |
| Lynx | 3 | 0 | 0 | 2 | 1 | 1 | 2 | 3 | 0 | 1 | 1 | 2 | 16 | 44 | 2,4,10,40,69,78 |
| Harbor seal | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 2 | 3 | 1 | 16 | 44 | 40,53,89,105 |
| Red squirrel [12] | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 1 | 0 | 3 | 16 | 44 | 28,30,40,73,105 |
| Singing vole [13] | 3 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 16 | 44 | 6,40,105 |
| Northern water shrew | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 3 | 15 | 42 | 6,40,105 |
| Little brown myotis | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 3 | 0 | 3 | 15 | 42 | 6,27,38,40,96,105 |
| Sitka black-tailed deer | 3 | 2 | 0 | 1 | 1 | 1 | 3 | 1 | 0 | 2 | 0 | 1 | 15 | 42 | 40,47,60,67,75,81,111 |
| Hoary marmot | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 1 | 1 | 3 | 15 | 42 | 40,54,63,105 |
| Tundra vole [14] | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 3 | 15 | 42 | 40,57,105,114,116,117,118 |
| Muskrat | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 3 | 15 | 42 | 40,66,86,105 |
| Porcupine | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 2 | 0 | 3 | 15 | 42 | 23,24,25,40,105 |
| Collard pika | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 15 | 42 | 6,40,68,105 |
| Masked shrew | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 1 | 0 | 3 | 14 | 39 | 6,40,105 |
| Silver-haired bat | 2 | 1 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 3 | 14 | 39 | 6,7,40,105 |
| Least weasel | 3 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 14 | 39 | 40,102,105 |
| Mink | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 1 | 0 | 1 | 0 | 3 | 14 | 39 | 40,64,105 |
| Montane shrew | 3 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 3 | 13 | 36 | 6,40,80,105 |
| Ermine | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 3 | 13 | 36 | 40,102,105 |
| Moose | 3 | 1 | 0 | 2 | 0 | 0 | 1 | 3 | 0 | 2 | 0 | 1 | 13 | 36 | 20,31,40,48,105 |
| Beaver | 3 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 0 | 1 | 2 | 2 | 13 | 36 | 2,14,39,40,51,68,105 |
| Northern red-backed vole[15] | 3 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 1 | 13 | 36 | 12,23,40,55,105,115,116 |
| Meadow vole | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 13 | 36 | 34,35,40,41,57,105 |
| Meadow jumping mouse | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 13 | 36 | 11,23,40,90,105 |
| Snowshoe hare | 3 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 2 | 13 | 36 | 15,40,82,105 |
| Pygmy shrew | 3 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 12 | 33 | 40,65 |
| Red fox [16] | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 3 | 12 | 33 | 2,3,40,88,95,99,105 |
| Coyote | 3 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 10 | 28 | 8,9,36,40,105 |

Table 5. Results of risk screening of mammals found on the Chugach National Forest, south-central Alaska.

| Species | Scores by evaluation criteria | | | | | | | | | | | | Total | % | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |

2 : Adequate information was not available to assign a value to this criterion.

[1] *Gulo gulo katschemakensis*
[2] *Clethrionomys rutilus insularis*
[3] *Microtus oeconomus elymocetes*
[4] *Tamiasciurus hudsonicus kenaiensis*
[5] *Clethrionomys rutilus orca*
[6] *Martes americana kenaiensis*
[7] *Ursus americanus perniger*
[8] *Vulpes vulpes kenaiensis*
[9] *Gulo gulo luscus*
[10] *Ursus americanus emmonsii*
[11] *Microtus miurus cantator*
[12] *Tamiasciurus hudsonicus*
[13] *Microtus miurus miurus*
[14] *Microtus oeconomus*
[15] *Clethrionomys rutilus dawsoni*
[16] *Vulpes vulpes alascensis*

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1-Abbott 1993*a*, 2-Abbott 1993*b*, 3-Ables 1974, 4-Bailey et al. 1986, 5-Baker et al. 1970, 6-Banfield 1974, 7-Barbour and Davis 1989, 8-Bekoff 1982, 9-Berg and Chesness 1978, 10-Berrie 1973, 11-Blair 1940, 12-Blair 1941, 13-Bowyer et al. 1995, 14-Boyce 1974, 15-Brocke 1975, 16-Brody and Pelton 1989, 17-Burt and Grossenheider 1964, 18-Carnes et al. 1996, 19-Chadwick 1983, 20-Coady 1982, 21-Craighead and Mitchell 1982, 22-Deems and Pursely 1978, 23-DeGraaf and Rudis 1986, 24-Dodge 1982, 25-Dodge and Barnes 1975, 26-Ewer 1973, 27-Fenton 1969, 28-Ferron and Prescott 1977, 29-Fiscus 1978, 30-Flyger and Gates 1982, 31-Franzmann 1978, 32-Geist 1971, 33-Gentry 1970, 34-Getz 1961*a*, 35-Getz 1961*b*, 36-Gier 1968, 37-Dunson and Hayes 1995, 38-Guthrie 1933, 39-Hakala 1952, 40-Hall 1981, 41-Hamilton 1941, 42-Hawes 1977, 43-Heller 1910, 44-Hicks 1994, 45-Hicks 1995*a*, 46-Hicks 1995*b*, 47-Hicks 1995*c*, 48-Hicks 1995*d*, 49-Hicks 1996*a*, 50-Hicks 1996*b*, 51-Hill 1982, 52-Hoover 1988*a*, 53-Hoover 1988*b*, 54-Howell 1915, 55-Iverson and Turner 1972, 56-Jenkins 1983, 57-Johnson and Johnson, 58-Jonkel and Cowan 1971, 59-Kenyon 1982, 60-Kirchhoff 1994, 61-Lance and Cook 1995, 62-Lawson and Johnson 1982, 63-Lee and Funderburg, 64-Linscombe et al. 1982, 65-Long 1972, 66-MacArthur 1978, 67-Kackie et al 1982, 68-Manville and Young 1965, 69-McCord and Cardoza 1982, 70-Mech 1970, 71-Mech et al. 1988, 72-Miller 1982, 73-Miller 1970, 74-Miller 1993, 75-Morgan 1989, 76-Mowrey and Zasada 1985, 77-National Oceanic and Atmospheric Administration 1993, 78-Nava 1970, 79-Newby and McDougal 1964, 80-Nowak 1991, 81-Nyberg 1990, 82-O'Farrell 1965, 83-Osgood 1906, 84-Paradiso and Nowak 1982, 85-Pelton 1982, 86-Perry 1982, 87-Peterson et al. 1984, 88-Pils and Martin 1978, 89-Pitcher 1984, 90-Quimby 1951, 91-Rausch and Person, 92-Ronald et al. 1982, 93-Rotterman and Simon-Jackson 1988, 94-Rudis and Tansey 1995, 95-Samuel and Nelson 1982, 96-Schowalter 1979, 97-Smith and Raedeke 1982, 98-Spraker 1992, 99-Storm et al. 1976, 100-Strickland et al. 1982, 101-Suring 1993, 102-Svendsen 1982, 103-Tabor and Wight 1977, 104-Testa et al. 1994, 105-The Nature Conservancy 1996, 106-Thiel 1985, 107-Thiel and Ream 1995, 108-Tomich 1982, 109-Toweill and Tabor 1982, 110-U. S. Fish and Wildlife Service, 111-Wallmo 1981, 112-Wells-Gosling and Heaney 1984, 113-West 1993, 114-West 1979, 115-West 1982, 116-Whitney 1973, 117-Whitney 1973, 118-Whitney 1977, 119-Wigal and Goggins 1982, 120-Wilson 1982.

**Evaluation of the process**

Examination of the independence of the evaluation criteria showed only a single strong correlation (i.e., $r^2 > 0.50$) (Table 6). This relationship ($r^2 = 0.52$) was between the criteria describing the demographic characteristics of species (i.e., criteria 10 and 11). This relationship has a biological basis and is intuitively correct (i.e., long-lived species that mature late tend to have small litter/clutch sizes). Despite this relationship each criterion provided information important to the evaluation process and each was retained.

Table 6. Analysis of correlation among scores assigned to evaluation criteria for assessment of viability of wildlife species on the Chugach National Forest, south-central Alaska.

| Evaluation criteria[1] | $r^2$ Values by evaluation criteria | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 1.00 | | | | | | | | | | | |
| 2 | -0.19 | 1.00 | | | | | | | | | | |
| 3 | 0.16 | 0.19 | 1.00 | | | | | | | | | |
| 4 | 0.24 | 0.00 | 0.08 | 1.00 | | | | | | | | |
| 5 | -0.15 | 0.20 | 0.06 | -0.04 | 1.00 | | | | | | | |
| 6 | -0.01 | 0.10 | -0.04 | -0.01 | 0.25 | 1.00 | | | | | | |
| 7 | 0.48 | -0.15 | 0.17 | 0.10 | -0.04 | 0.01 | 1.00 | | | | | |
| 8 | 0.32 | -0.02 | 0.13 | -0.10 | -0.09 | -0.21 | 0.39 | 1.00 | | | | |
| 9 | 0.39 | -0.09 | 0.42 | 0.14 | -0.15 | -0.03 | 0.21 | -0.04 | 1.00 | | | |
| 10 | -0.15 | 0.25 | -0.02 | 0.01 | 0.09 | -0.04 | -0.01 | 0.23 | -0.23 | 1.00 | | |
| 11 | -0.32 | 0.30 | -0.10 | -0.20 | 0.08 | 0.01 | -0.15 | 0.24 | -0.23 | 0.52 | 1.00 | |
| 12 | -0.23 | 0.07 | -0.04 | 0.12 | 0.05 | 0.07 | -0.35 | -0.34 | 0.03 | 0.05 | 0.09 | 1.00 |

[1] See Table 1 for a description of the evaluation criteria.

Mean level-of-concern scores assigned during this process for species on State or Federal lists of species of concern were significantly higher (i.e., 50) than the mean score for all other species (i.e., 40) ($p < 0.05$). Positive correlations resulted from comparisons between rankings in this analysis for selected land birds and rankings in a separate process (Table 7). These analyses indicate that our process ranked the relative status of species consistently across an array of species' circumstances.

Table 7. Analysis of correlation among ranks assigned by two separate processes to selected land birds on the Chugach National Forest, south-central Alaska[1].

| Taxa | n | $r^2$ | Statistical significance of relationship[2] |
|---|---|---|---|
| Falconiformes | 12 | 0.72 | ** |
| Accipitridae | 8 | 0.76 | * |
| Falconidae | 4 | 0.82 | n.s. |
| Galliformes | 4 | 0.91 | * |
| Strigiformes | 7 | 0.29 | n.s. |
| Piciformes | 3 | 0.99 | ** |
| Passeriformes | 58 | 0.44 | ** |
| Tyrannidae | 4 | 0.84 | n.s. |
| Hirundinidae | 5 | 0.23 | n.s. |
| Corvidae | 5 | 0.60 | n.s. |
| Paridae | 3 | 0.97 | * |
| Turdinae | 7 | 0.22 | n.s. |
| Emberizidae | 19 | 0.43 | n.s. |
| Fringillidae | 6 | 0.20 | n.s. |
| All species | 84 | 0.41 | ** |

[1] The two processes are the one described in this paper and that of Handel (1996).

[2] ** = highly significant ($p$ <0.01)
* = significant ($p$ <0.05)
n.s.= not significant

## DISCUSSION

Conservation assessments were completed for five of the top-ranked species recognized as having sustainability or distribution concerns (i.e., Montague Island hoary marmot, dusky Canada goose, brown bear, black oystercatcher, Montague Island tundra vole) (Table 8). Initial emphasis was placed on dusky Canada goose and brown bear (on

the Kenai Peninsula) to respond to immediate management issues that required attention in revision of the Chugach National Forest Land and Resource Management Plan (e.g., see Pacific Flyway Council 1997 and Suring et al. 1998). Recovery of threatened Steller sea lion populations is being managed by the National Marine Fisheries Service; additional efforts by the Forest for assessment and conservation planning are not anticipated. Consideration should be given to completing a conservation assessment for the remaining four species on the list. All species should be monitored closely to evaluate their populations' status.

Table 8. Wildlife species identified as having potential concerns for sustainability or distribution on the Chugach National Forest.

| Species | Scientific name | Evaluation score | Conservation assessment |
|---|---|---|---|
| Montague Island hoary marmot | *Marmota caligata sheldoni* | 75 | Lance 2002*a* |
| Dusky Canada goose | *Branta canadensis occidentalis* | 69 | Bromley and Rothe 2003 |
| Wolverine | *Gulo gulo katschemakensis* | 67 | -- |
| Brown bear | *Ursus arctos* | 64 | IBBST 2001 |
| Steller sea lion | *Eumetopias jubatus* | 64 | -- |
| Black oystercatcher | *Haematopus bachmani* | 64 | Poe and Murphy 1999 |
| Gray wolf | *Canis lupus pambasileus* | 61 | -- |
| Northern red-backed vole | *Clethrionomys rutilus insularis* | 61 | -- |
| Montague Island tundra vole | *Microtus oeconomus elymocetes* | 61 | Lance 2002*b* |

**Conservation assessments**

Montague Island hoary marmot (from Lance 2002*a*)

This marmot, from Montague Island, south-central Alaska, was classified as a distinct subspecies based on smaller size and skull characteristics relative to other island and mainland populations. The taxonomic validity of the Montague Island hoary marmot is questionable, as conclusions were based on the analysis of no more than eight specimens. With the exception of one relatively recent sight record, Montague Island hoary marmots have not been reported or collected since the early 1900s. A conservation concern exists, particularly owing to the unknown population status and questionable taxonomy of this island endemic subspecies that may be negatively affected by land management practices.

Dusky Canada goose (from Bromley and Rothe 2003)

Dusky Canada geese compose one of the smallest populations of geese in North America and have exhibited a marked decline in the past 30 years. A comprehensive synthesis of past and current biological information on the subspecies has been compiled to provide insights into the ecology and demography of the population, as well as explore management efforts to promote long-term conservation. Duskys occupy a discrete range, which has allowed the development of focused, long-standing management programs. The 1964 Alaska earthquake set in motion significant ecological changes in wetlands, plant communities, and the suite of predators on the dusky Canada goose breeding grounds. A subsequent decline in goose productivity has become the primary challenge to this population. Concurrently, habitats on the western Washington and Oregon wintering grounds became more favorable for geese, but >250,000 Canada geese of five other subspecies now occupy the region where formerly duskys were the majority. In the 1960s, the harvest of dusky Canada geese was recognized as a primary management concern and regulation was effectively implemented. At present, protection of diminished duskys amid 10 times as many other Canada geese has created great complications for both management of hunting and attention to increasing complaints of crop depredation by wintering flocks. Important information needs are suggested to improve population monitoring, evaluate specific causes of lost productivity, and assess the direction and effects of succession of breeding ground habitats and conversion of winter habitats.

Brown bear (from IBBST 2001)

Alaska brown bears are large omnivores that commonly live in coastal areas and require unfettered access to productive salmon streams. These bears may live for > 20 years in the wild, but the stability of brown bear populations can be threatened by human-caused mortality and from fragmentation of habitat. The Kenai Peninsula has a population of brown bears that may be insular and highly vulnerable to human impacts; thus, the State of Alaska has formally declared the population to be one of special concern and one whose management needs close investigation. The current population estimate (i.e., 250-300 brown bears) is not adequate for current conservation needs. A statistically rigorous population estimate is needed. Kenai Peninsula brown bears likely are not distinct from mainland Alaska bears when comparing mtDNA, but they may be genetically distinct when nuclear DNA frequencies and sequences are contrasted. Recently collected data indicate that 90% of the total recruitment into the population has been accomplished by only 51% of the adult females. This may be due to differences in habitat quality or other aspects of the ecological relationships of individual female brown bears. Human-caused mortality of brown bears as a result of defense of life or property kills poses a significant hazard to the Kenai Peninsula brown bear population. As the human population and associated developments on the Kenai Peninsula increase, brown bear mortalities are also expected to increase.

Black oystercatcher (from Poe and Murphy 1999)

Perhaps the greatest current threat to black oystercatchers in Prince William Sound is increasing recreational use of the area's shores and islands during the breeding

season. The magnitude of disturbance required to disrupt activity on the mating grounds has been poorly documented but this species is routinely reported as being extremely sensitive to human disturbance (Warheit et al. 1984, Nysewander 1977, Andres and Falxa 1995). Buffer zones placed around high concentrations of nesting oystercatchers would decrease disturbance to breeding oystercatchers. Sheltered bays that serve as winter refuge should be identified and protected.

Because black oystercatchers' habitat use is concentrated around shorelines and intertidal areas, activities managed by the Forest are likely to produce limited direct effects on this species. The Forest's management actions may influence the amount of human-induced disturbance to oystercatchers based on different types of upland activities. This type of management may become increasingly important as human activity in Prince William Sound increases as a result of the new road to Whittier. The consideration of the availability of nesting habitat in regions of the Sound could help managers direct increased human use to areas less important to black oystercatchers. If nesting habitat is limited within a region of the Sound, management of the available habitat becomes more important. Protection of areas with exceptionally high nesting densities for Prince William Sound, such as Green Island, will be important to maintain current population levels.

Montague Island tundra vole (from Lance 2002*b*)

Montague Island tundra voles were first described in the early 1900s. Based on their large size and dark coloration relative to other island and mainland populations, tundra voles from Montague Island were classified as a distinct subspecies. Research conducted in the 1990s revealed significant differences in the size and shape of Montague Island voles, but not significant genetic differentiation. Montague Island voles appeared abundant in the 1990s, although there was no attempt to estimate population size. Montague Island voles may be reproductively and genetically isolated. More sensitive genetic techniques now can be used to test genetic distinctiveness across populations. A conservation concern exists owing to the unknown population status and still questionable taxonomy of this island endemic subspecies, because it is unknown if land management practices affect this isolated population.

## CONCLUSIONS

Implementation of the process described here, development of conservation assessments for at-risk species, and use of that information in the development of management approaches represents preemptive management intended to prevent listing of species as Threatened or Endangered under the Endangered Species Act. This is a proactive approach that recognizes that adopting a long-term view of not allowing species extinctions or local extirpations may be the one fundamental and practical measure of sustainable ecosystems.

Land management actions on the Forest and adjacent areas will affect wildlife populations in ways that are not easily or accurately characterized by simple percentages (e.g., percentage of landscape roaded). Although a relatively small percentage of the overall landscape may be affected by management activities, there is the potential that a much greater proportion of high-value habitats on the National Forest may be modified.

The goal of maintaining sustainable populations of wildlife requires that suitable habitat be well distributed across the landscape. In south-central Alaska, where the forest is naturally fragmented by marine waters, rock, ice, and unproductive soils, particular attention must be paid to how that habitat is distributed. We expect that as additional information on the habitat relationships, dispersal abilities, and demographics of individual species is gathered current management standards based on the results of this effort will be updated.

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