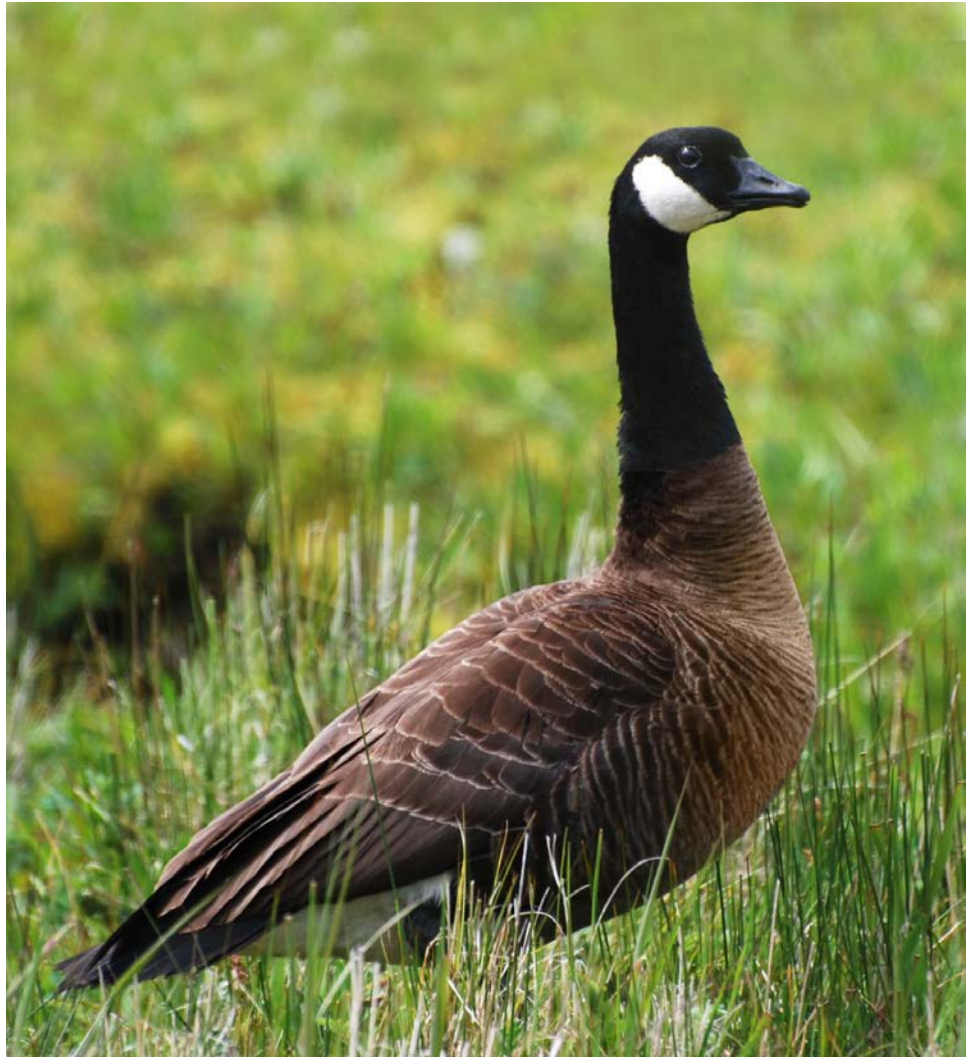




Management Plan: Dusky Canada Goose



Adopted July 2015

This management plan is one of a series of cooperatively developed plans for managing various populations of migratory birds in the Pacific Flyway. Inquiries about this plan may be directed to member States of the Pacific Flyway Council or to the Pacific Flyway Representative, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 1211 SE Cardinal Court, Suite 100, Vancouver, Washington 98683-9684. Information regarding the Pacific Flyway Council and management plans can be found on the Internet at PacificFlyway.gov.

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PACIFIC FLYWAY MANAGEMENT PLAN
FOR THE
DUSKY CANADA GOOSE

Prepared for the

Pacific Flyway Council
U.S. Fish and Wildlife Service

by the

Dusky Canada Goose Subcommittee
of the
Pacific Flyway Study Committee

October 1973
Revised July 1985
Revised July 1992
Revised July 1997
Revised March 2008
Revised July 2015

Approved by: _____ July 24, 2015
Chairperson, Pacific Flyway Council Date

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PACIFIC FLYWAY MANAGEMENT PLAN FOR THE DUSKY CANADA GOOSE

PREFACE

The Pacific Flyway Council (Council) is an administrative body that forges cooperation among public wildlife agencies for the purpose of protecting and conserving migratory game birds in western North America. The Council has a management plan for most populations of swans, geese, cranes, pigeons, and doves in the Pacific Flyway. These plans typically focus on populations, which are the primary unit of management, but may be specific to a species or subspecies. Management plans serve to:

- Identify common goals;
- Coordinate collection and analysis of data;
- Identify management issues and priority of management actions and responsibilities; and
- Identify information, including research, needed to improve management.

Flyway management plans are products of the Council, developed and adopted to help state and federal agencies cooperatively manage migratory game birds under common goals. Management strategies are recommendations, but do not commit agencies to specific actions or schedules. Fiscal, legislative, and priority constraints influence the level and timing of implementation. This Management Plan as most other Pacific Flyway management plans are intended to guide management and research for a 5-year period. This Management Plan for the dusky Canada goose (*Branta canadensis occidentalis*) is a revision of earlier plans adopted by the Council (1973, 1985, 1992, 1997, and 2008).

The U.S. Fish and Wildlife Service (USFWS) developed a Focal Species Action Plan for the dusky Canada goose (USFWS 2010) to guide dusky Canada goose management as part of a program to identify priority species for conservation work. The Focal Species Action Plan is complimentary to and based on the 2008 Pacific Flyway dusky Canada goose Management Plan (Pacific Flyway Council 2008). This Management Plan updates information in both plans.

INTRODUCTION

Dusky Canada geese comprise one of the smallest populations of geese in North America (Bromley and Rothe 2003). They nest on the Copper River Delta, Middleton Island, and in Prince William Sound of southcentral Alaska (Figure 1) and winter primarily in the Willamette Valley of western Oregon and on the floodplain of the lower Columbia River in southwest Washington (Figure 2). The most recent (2014) population index, measured by breeding ground surveys, was 15,574 birds (Appendix B).

The Copper River Delta, the primary breeding grounds and the largest coastal wetland on the Pacific Coast (Thilenius 1995), exists in a dynamic geomorphic and tectonic environment (Christensen et al. 2000) forcing managers to understand and respond to continually changing

habitat conditions that affect both geese and their predators. Most notably, the 1964 Alaska Earthquake uplifted the Copper River Delta 1.8 to 3.4 m, precipitating a series of changes to plant communities and predators that had both positive and negative effects on nest survival and productivity of dusky Canada geese (see Rothe and Bromley 2003, Grand et al. 2003). The breeding population on the Copper River Delta and Middleton Island will remain the primary focus of management until more is known about the size and annual movements of the Prince William Sound population.

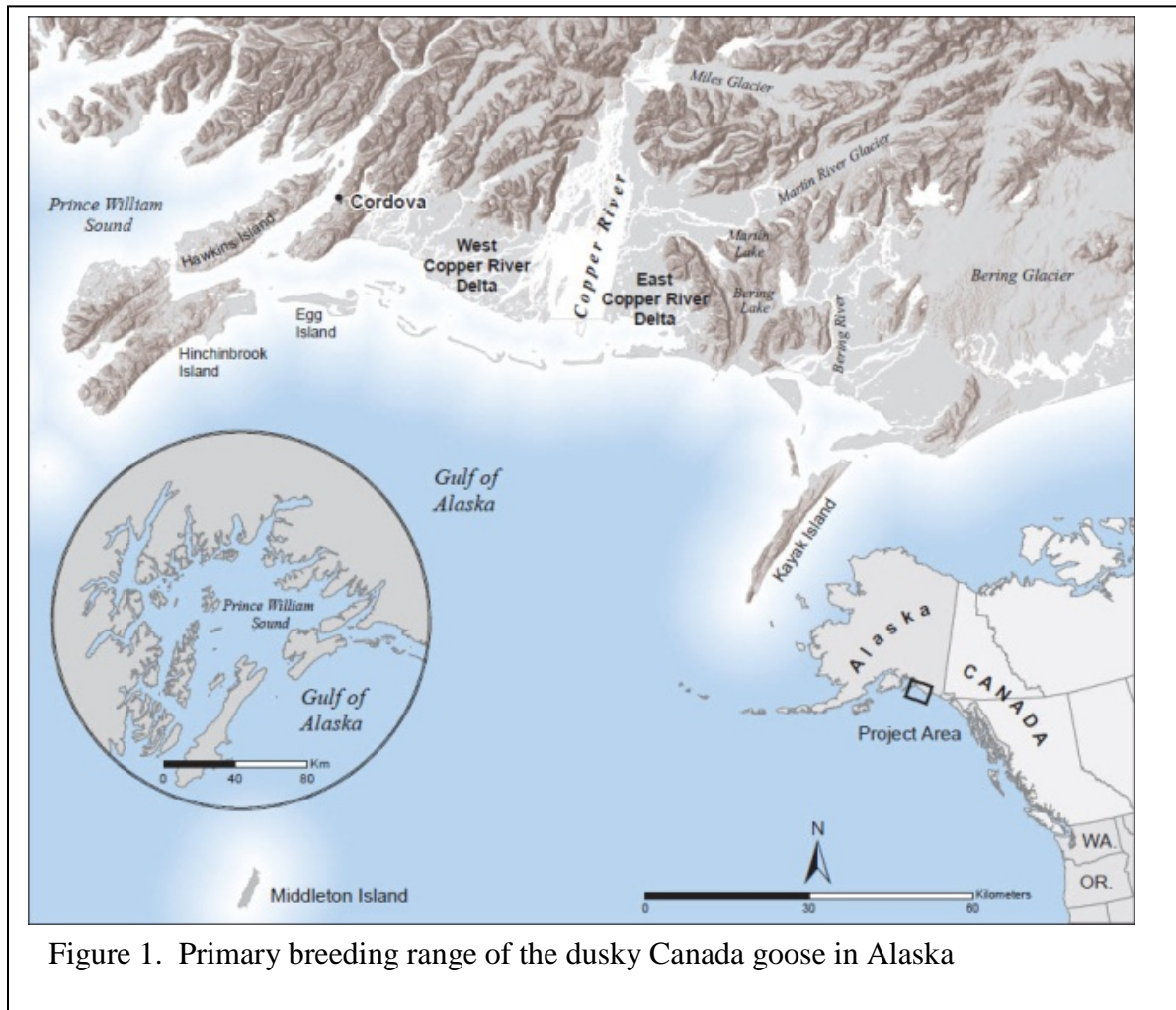


Figure 1. Primary breeding range of the dusky Canada goose in Alaska

The Willamette Valley, the main wintering area, is the largest inland river valley in the Pacific Northwest. Changing land-use patterns over the past 150 years have greatly altered valley ecosystems with recent conditions favorable to expanding goose populations. Management of dusky Canada geese on their wintering grounds is complicated by human population growth and development, agricultural practices favorable to geese, and concurrent use by other goose subspecies, including lesser (*B. c. parvipes*), Vancouver (*B. c. fulva*), and western (*B. c. moffitti*), Taverner's (*B. hutchinsii taverneri*), cackling (*B. h. minima*), and Aleutian (*B. h. leucopareia*) Canada geese (see Taxonomy below).

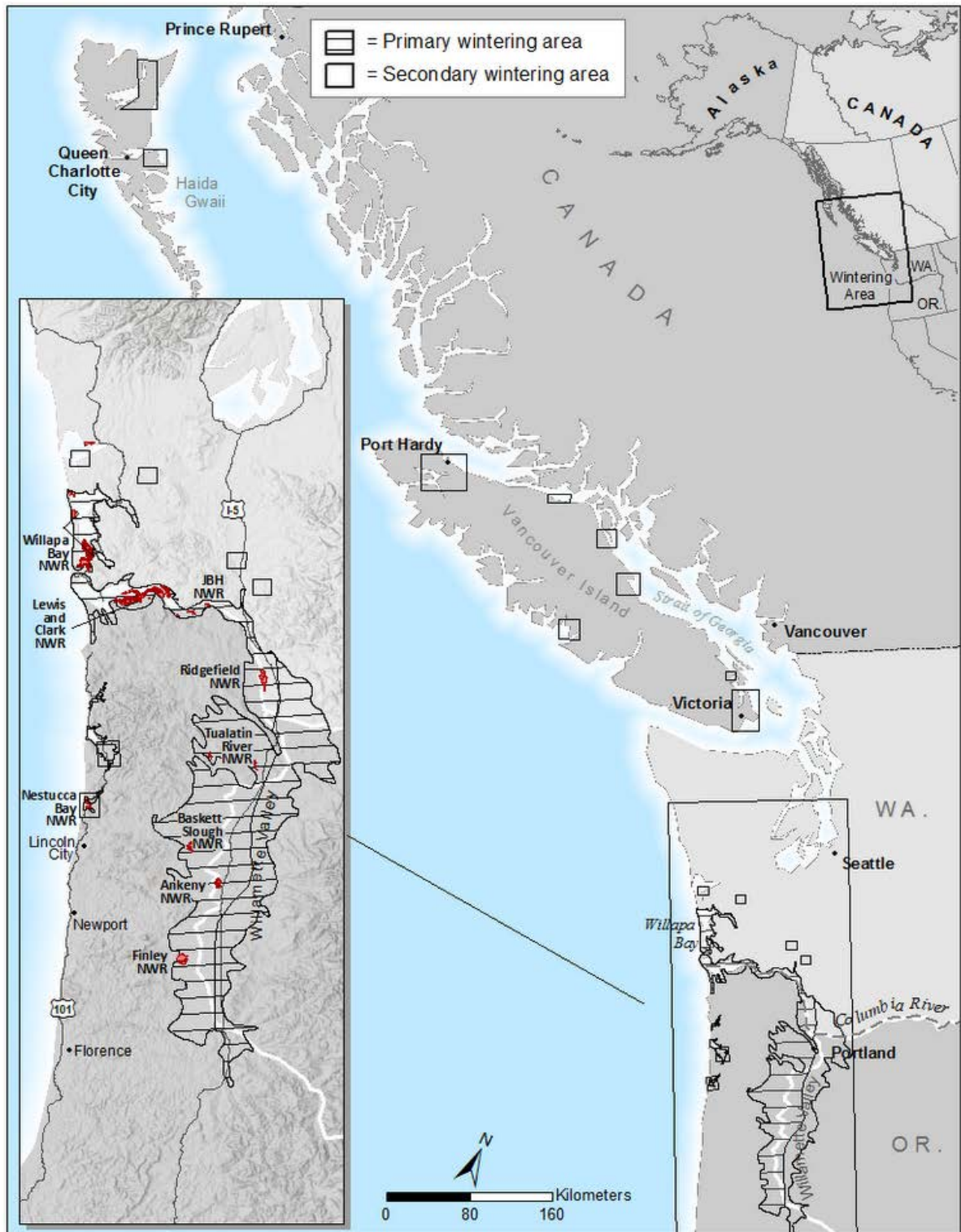


Figure 2. Primary and secondary wintering range of dusky Canada geese in British Columbia, Washington, and Oregon

Large mixed populations of Canada and cackling geese damage agricultural crops on the wintering grounds. From a management perspective, it is difficult, costly, and controversial to restrict harvest of dusky Canada geese for conservation purposes while allowing a greater harvest of more abundant goose species to reduce crop depredation. Large mixed goose populations that include dusky Canada geese make it more difficult to conduct population-specific winter inventories, establish population specific harvest regulations, and develop and implement methods of controlling crop depredation that take into account conservation concerns for the this small population.

The purpose of this Management Plan is to provide guidance for the conservation of dusky Canada geese by implementing specific management actions and research needs to achieve a population of 20,000 breeding birds based on biological, economic, and social factors and historical population estimates.

In Canada, First Nations harvest is not regulated by the Canadian Federal Government. Under Aboriginal common law and under land claims treaties, First Nation individuals can harvest migratory birds throughout the year with no bag or possession limit. From a sports harvest perspective, Canada does not recognize dusky Canada geese as a distinctly managed stock of Canada geese and there are no regulatory provisions specific to dusky Canada geese in the Canadian Federal Hunting Regulations. Therefore, this plan does not cover Canadian aboriginal and recreational harvest.

The major change to this Management Plan from the 2008 Management Plan is the closure of hunting seasons for dusky Canada geese in major use areas in southwest Washington and northwest Oregon and the elimination of hunter check stations. A list of management strategies completed or removed from the 2008 Management Plan are presented in Appendix I.

GOAL AND OBJECTIVES

The goal of this Management Plan is to maintain and enhance the dusky Canada goose population.

Objectives of this Management Plan are to:

1. Manage the number of dusky geese to achieve a population of 20,000 birds based on the most recent three-year average as measured by breeding ground surveys on the Copper River Delta and Middleton Island.
2. Maintain and enhance breeding ground habitat to support population goals.
3. Manage, enhance, and protect wintering and migration habitat to support population goals.

4. Maintain recreational hunting seasons for more abundant goose populations in southwest Washington and northwest Oregon to assist in alleviating agricultural depredation while minimizing the harvest of dusky geese on wintering areas.
5. Allow a harvest of dusky geese on breeding and migration areas to provide for recreational hunting and the harvest of more abundant goose populations.

STATUS

A. Taxonomy

The taxonomy of Canada geese along the north Pacific coast has been subject to debate for many years. The large-bodied, dark-plumaged forms of Canada geese (western, Vancouver, dusky, and lesser), likely became differentiated since the last glacial period. Most of the Alaska and British Columbia coasts were under glacial ice until about 10,000 years ago (Pewe 1975), and geese likely colonized glacial refugia or pioneered northward into emerging coastal habitats as the ice receded (see Ploeger 1968 for glacial history as a mechanism for subspeciation).

Palmer (1976) combined Vancouver Canada geese with dusky Canada geese under the subspecies *B. c. occidentalis* while Sibley and Monroe (1990) did not recognize dusky Canada geese as a subspecies in their review of world bird taxonomy. Historically, Pacific Flyway wildlife agencies have concurred with Delacour (1954) who identified 11 subspecies of Canada geese and found distinction between dusky Canada geese (*B. c. occidentalis*) and Vancouver Canada geese (*B. c. fulva*). Although dusky Canada geese have been distinguished from other Canada geese for over 150 years (see Bromley and Rothe 2003), they have been classified largely through morphological analysis, most notably by Johnson et al. (1979).

Questions regarding the uniqueness of dusky Canada geese, as well as broader taxonomic concerns stimulated genetics research on Canada goose subspecies in the Pacific Flyway (Shields and Wilson 1987, Shields and Cotter 1998, Scribner et al. 2003). Pearce and Bollinger (2003) provided more detailed means of discrimination among dusky Canada geese and other large-bodied, dark-plumaged subspecies in the Pacific Flyway.

The American Ornithologists' Union (AOU) divided North American "Canada geese" into two species (Banks et al. 2004), with large bodied subspecies (including dusky Canada geese) in the species *canadensis* (Canada goose) and small-bodied forms in the species *hutchinsii* (Cackling goose). At lower taxonomic levels, the AOU continues to reference Delacour (1954); thus, dusky Canada geese remain *B. c. occidentalis*.

Canada geese breeding on Middleton Island display a unique haplotype with Canada geese breeding in Prince William Sound (Green Island), one not found elsewhere in southcentral and southeast Alaska or in other Canada geese (Talbot et al. 2003). However, they are not sufficiently unique genetically or morphologically nor sufficiently isolated to be differentiated from dusky Canada geese breeding on the Copper River Delta (see Population Management). Middleton Island geese were not derived from Copper River Delta dusky Canada geese despite translocation efforts in the 1980s (see Campbell 1992).

B. Distribution and Abundance

Dusky Canada geese nested almost exclusively on the Copper River Delta and in Prince William Sound until the late 1970s when a few birds colonized Middleton Island in the Gulf of Alaska (Gould and Zablouil 1981) (Figure 1).

The large majority of dusky Canada geese winter in the lower Columbia River Valley of Oregon and Washington, the Willamette Valley of northwest Oregon, and estuaries along the Pacific coast from Grays Harbor, Washington (ca. 25km north of Willapa Bay) to Nestucca Bay, Oregon (Figure 2). Several hundred to 1,500 birds may winter in Prince William Sound (Hansen 1962; Isleib and Kessel 1973) while fewer than 1,000 birds winter on Haida Gwaii (formerly Queen Charlotte Islands) and Vancouver Island in British Columbia (A. Breault CWS, pers.comm.) (Figures 1 and 2). Over 60 years of banding data demonstrate the connectivity of the core population breeding on the Copper River Delta with wintering areas in the Willamette Valley (Figure 2).

Geese wintering in Prince William Sound are likely local breeders, but several geese collared on the Copper River Delta have been observed in these winter groups. The extent to which these populations interact throughout the annual cycle is unknown. Middleton Island and Prince William Sound geese winter sympatrically with Copper River Delta birds in British Columbia, Washington, and Oregon, with some preference for using Willapa Bay, WA (Alaska Dept. Fish and Game, unpubl. data) (Figure 2).

The dusky Canada goose population was estimated on the wintering grounds from 1947–1985 using various methods summarized by Bromley and Rothe (2003). Winter population estimates fluctuated from less than 10,000 birds in the early 1950s to over 26,000 birds in 1975 before declining to less than 10,000 birds in the mid-1980s (Appendix A).

Beginning in the 1970s there was an influx of other subspecies of Canada and cackling geese into the Willamette Valley as a result of distributional changes from more southerly wintering areas. This created difficulties separating dusky Canada geese from these other subspecies and forced a series of modifications to survey methodology before ultimately abandoning the use of winter surveys as the official population index.

Aerial breeding population surveys have been conducted annually on the Copper River Delta since 1979 and the current array of transects has been monitored since 1986 (Eldridge 2005, Hodges and Eldridge 2007). This survey plus a breeding survey on Middleton Island was adopted as the official population index by the Pacific Flyway in 2008 (Fischer 2006, Pacific Flyway Council 2008). The current breeding population index includes adjustments for visibility and reneating on the Copper River Delta and adds adults counted on Middleton Island (see Breeding Ground Index, sidebar p.8).

Since 1986 the breeding population index has ranged from a high of 17,833 birds (1992) to a low of 6,706 birds (2009). In 2009, the breeding population index on the Copper River Delta was at an historical low of 5,281 birds. Low numbers in 2009 caused the 3-year average population index for dusky Canada geese on the Copper River Delta and Middleton Island to drop below 10,000 birds. This triggered management actions in the 2008 Pacific Flyway Dusky Canada

Goose Management Plan including harvest reduction in Alaska, Washington, and Oregon. Above average production from 2008 to 2014 increased the breeding population index to 15,574 birds (Figure 4). The combined Copper River Delta and Middleton Island 3-year average population index for 2011, 2012, and 2014 was 13,678 birds (Appendix B).

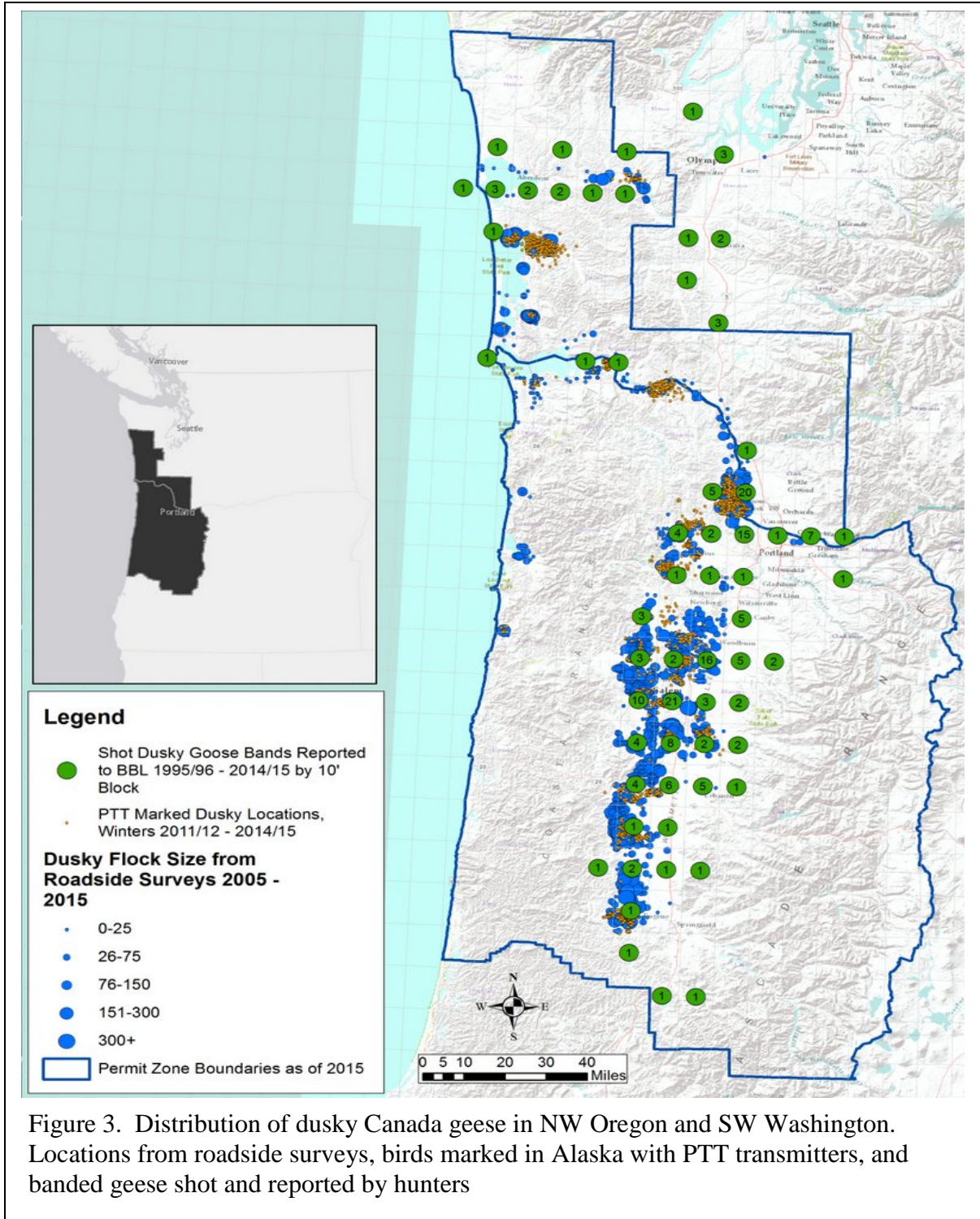


Figure 3. Distribution of dusky Canada geese in NW Oregon and SW Washington. Locations from roadside surveys, birds marked in Alaska with PTT transmitters, and banded geese shot and reported by hunters

BREEDING GROUND INDEX

Refinement of the aerial breeding ground index involves a correction factor for breeding birds that are missed by aerial observers. A ratio is calculated by dividing nest density (measured by ground observers) by breeding pair density (measured by aerial observers). Ground and air surveys from 1993-1995, 1998, 2004, and 2007 were used to calculate the ratio of 3.392 (SE=0.169) nests observed from the ground for each pair of geese observed from the air (Hodges and Eldridge 2007). This ratio is further adjusted by dividing 3.392 by a nest detection rate of 0.832 (SE=0.067), to account for nests missed by ground crews, and a renesting rate of 1.220 (SE=0.032) nests per female prior to May 15 (Eldridge et al. 2005; Fondell et al. 2006). This adjustment or “correction factor” ($3.392 / 0.832 / 1.220 = 3.3416$, SE=0.324) is used to produce the estimate of the number of breeding birds (also referred to as Indicated Paired Birds). Coordinated ground/air surveys are scheduled to be repeated every three years to update the “correction factor.”

The number of birds observed in flocks (flocked birds) is then added to the estimate of breeding birds to produce an index of total birds (indicated total birds) on the Copper River Delta. Finally, adding the biennial count of adult birds on Middleton Island (indicated adult birds) to the index of total birds on the Copper River Delta produces the Breeding Ground Index. The population objective is based on this index (Figure 4 and Appendix B).

Good estimates are lacking for the number of Canada geese breeding in Prince William Sound due to the difficulty of surveying them in forested habitat. Therefore they are not included in population indices (Isleib and Kessel, 1973). The Copper River Delta and Middleton Island birds will remain the primary focus of population assessment until better estimates are available for Prince William Sound.

Population peaks in the mid-1970s were attributed to reduced harvest as a result of cooperative management, creation of wildlife refuges in southwest Washington and western Oregon, and an increase of winter foraging habitat. The subsequent decline in the mid-1980s was attributed to accelerated plant succession on the Copper River Delta resulting from cataclysmic uplift caused by the 1964 Alaska Earthquake. These vegetative changes improved habitat for mammalian and avian predators and subsequently increased predation on eggs, goslings, and adults. Since 2008, productivity has been well above average (Appendix C) and is likely the major contributing factor to the population increase. However, the contribution of any specific factor that led to increased productivity, or recruitment, has not been identified.

C. Nesting and Production

Copper River Delta: A comprehensive account of factors effecting nesting and productivity of dusky Canada geese were previously presented by Bromley and Rothe (2003). The Copper River Delta (Figure 1) is a highly dynamic region continually influenced by tectonic, glacial, riverine and tidal forces. Habitat conditions, regardless of time scale, are not static on the nesting grounds. Prior to 1964, periodic tidal flooding of the low-lying delta and brackish waters maintained broad expanses of sedge meadows. Mixed forb/low shrub communities were only found on elevated slough banks and channels that bisected the area (Trainer 1959). Flooding of goose nests was minor, but the most frequent cause of nest loss at the time (see Bromley and Rothe 2003). Avian nest depredation was slight, and mammalian predators were considered rare

on the nesting grounds. Overall, nest success and productivity were high (see Bromley and Rothe 2003).

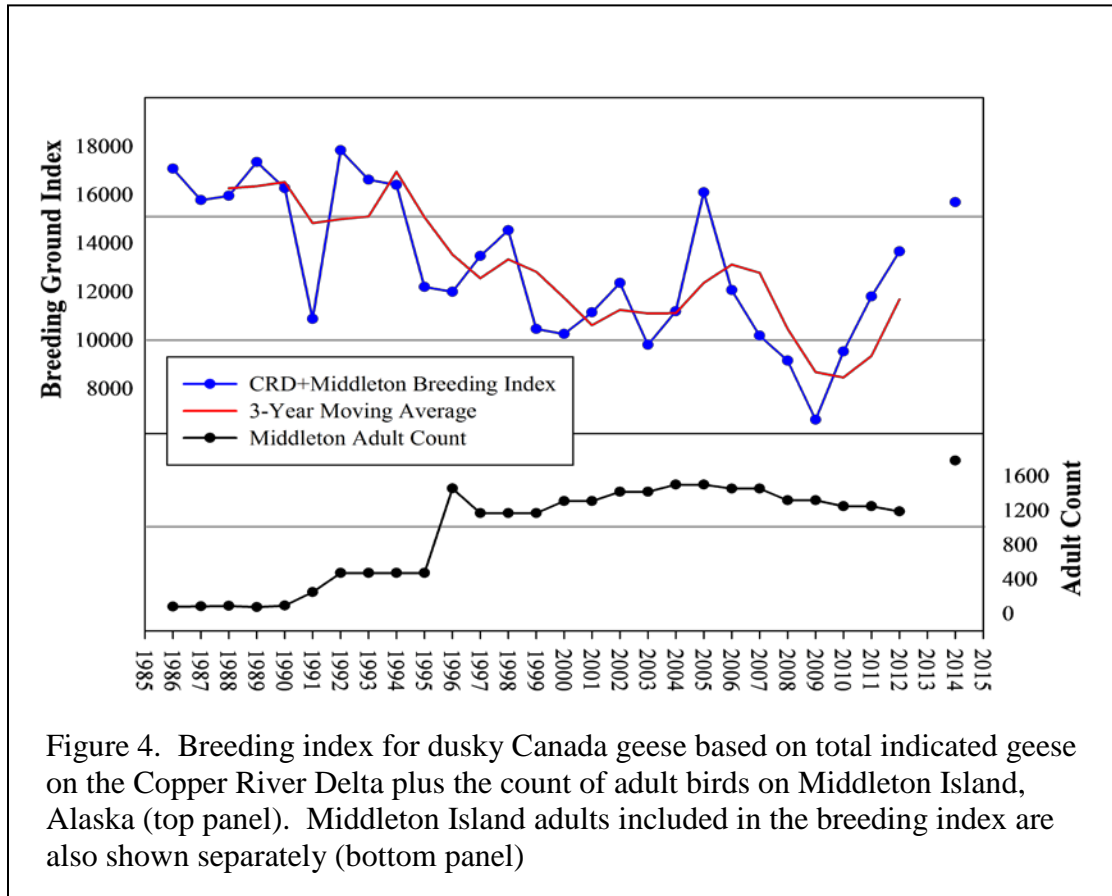


Figure 4. Breeding index for dusky Canada geese based on total indicated geese on the Copper River Delta plus the count of adult birds on Middleton Island, Alaska (top panel). Middleton Island adults included in the breeding index are also shown separately (bottom panel)

The 1964 Alaska Earthquake raised the Copper River Delta up to 3.4m, reducing the frequency of tidal flooding and initiating an overall drying process (Reimnitz 1972, Thilenius 1995) that continues today. Drier conditions led to a rapid invasion and growth of shrubs, and eventually allowed the proliferation of spruce and cottonwood trees (Campbell 1990a). Mammalian predators gained access and became more prevalent on the breeding grounds (Campbell and Griese 1987). Nest depredation increased from less than 6% in 1959 (Trainer 1959) to an average of over 60% from the 1990s to early 2000s (Campbell 1990b, Crouse et al. 1996, Grand et al. 2006). Bald eagles increased in the region (Bowman et al. 1997) and in some years accounted for as much as 80% of nest depredation (Anthony et al. 2004).

Studies conducted from 1997–2003 found nest success was generally low but variable (20–80%) (Grand et al. 2006, Miller et al. 2006a, Fondell et al. 2006b); gosling survival (to 50 days) was low, (20–40%), (Fondell et al. 2008a) and production was low (Figure 5, Appendix C). Intra and inter-annual variability in nest success was attributed to: variation in abundance of alternative prey (eulachon, *Thaleichthys pacificuhis*; Miller et al. 2006b); renesting rates (Fondell et al. 2006a, Grand et al. 2006); nest initiation date (Fondell et al. 2006a); vegetation density at and near the nest site (Miller et al. 2007); and nest location (islands vs mainland; Fode 2012).

Predators were identified as causing significant gosling mortality (Fondell et al. 2008a) and low productivity was considered the ultimate cause of population decline (see Section J below and Bromley and Rothe 2003). Abundance of bald eagles and timing of eulachon (*Thaleichthys pacificus*, a small anadromous fish) migration into the Copper River influence predation rates. Anthony et al. (2004) suggested that bald eagles may account for as much as 80% of nest predation. Bald eagles increased in the Prince William Sound region over the long term (Bowman et al. 1997) and aggregate near eulachon spawning runs (Bowman 1999, Marston et al. 2002, N. Maggiulli, Oregon State Univ. personal observations). Timing of eulachon spawning varies considerably within and among years (Moffitt et al. 2002) but when coincidental with goose nesting, eulachon likely serve as alternate prey for nest predators (Miller et al. 2006), reducing nest predation (Miller et al. 2006).

While predation by immature and non-breeding eagles appears inversely related to abundance of eulachon, the relationship among nesting eagles, predation on geese, and eulachon timing and abundance is unknown. Currently, there are no quantitative estimates of spawning eulachon or bald eagle abundance on the Copper River Delta. Subsistence and commercial fisheries provide some rough estimates of eulachon abundance (Moffitt et al. 2002).

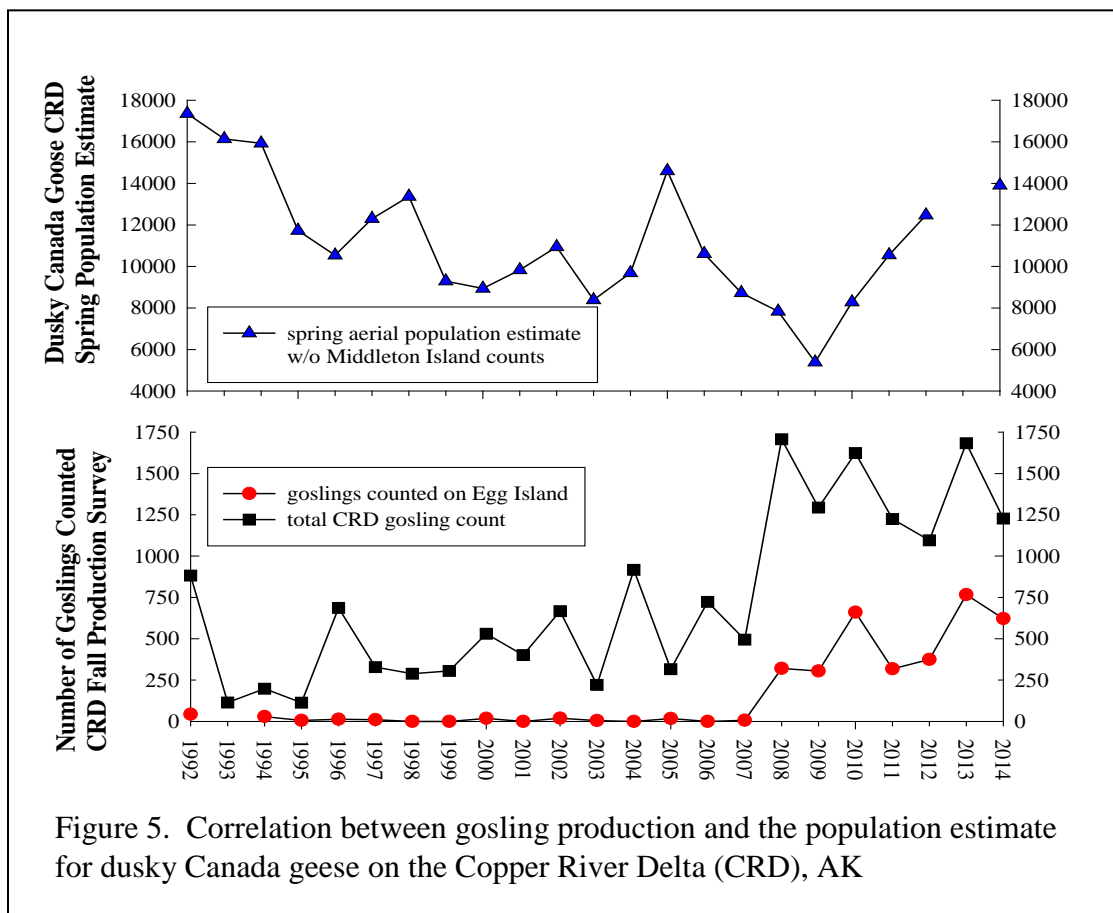


Figure 5. Correlation between gosling production and the population estimate for dusky Canada geese on the Copper River Delta (CRD), AK

Productivity has had a large effect on both past and present population dynamics (Schmutz et al. 1997). Since 2009, production (Appendix C) has positively correlated with population trend (Figure 5). The number goslings counted on Egg Island (Figure 5) since 2008 may be the primary

factor for the population increase since 2009. Goslings are not uniformly distributed throughout the Copper River Delta. Most (26–53%) of the total gosling count on the Copper River Delta since 2010 was observed on Egg Island (Figure 1; Figure 5, Petrula and Smith 2014). During the 1990s the number of geese observed on Egg Island during spring aerial surveys declined dramatically as did nest densities and production (B. Campbell, ADFG, unpubl. data, Youkey 1998, Hodges and Eldredge 2007) and nest plots were discontinued in 2001 (Fode and Logan 2001). An active coyote den possibly contributed to fewer nests (Youkey 1998).

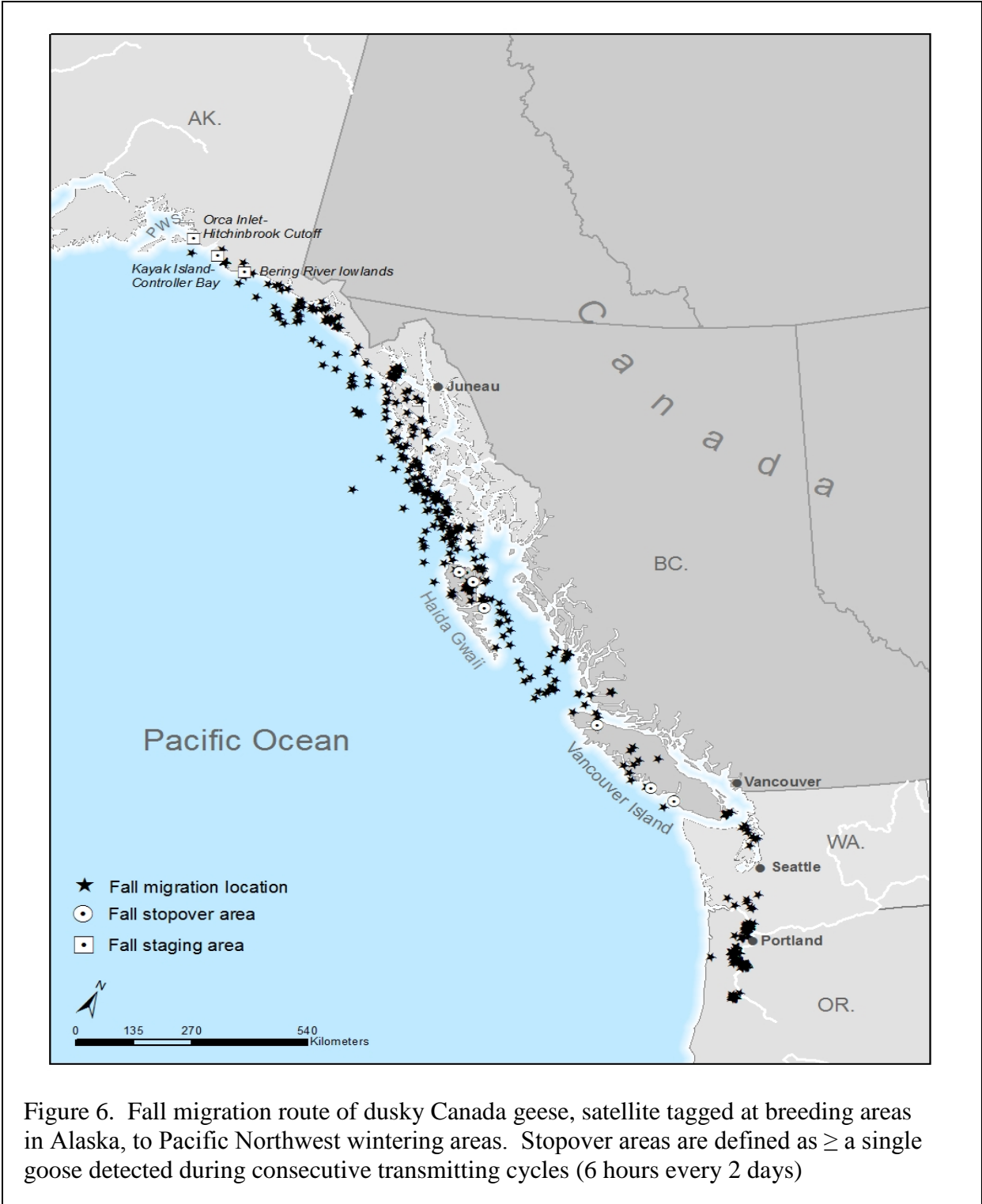
Middleton Island and Prince William Sound: Middleton Island is located approximately 110 km south of the Copper River Delta in the Gulf of Alaska (Figure 1; see Bromley and Rothe 2003 for a more complete account of Middleton Island Canada geese). Nesting Canada geese were first documented in 1981 (Gould and Zablouil 1981) on this approximately 7.5 km long by 3 km wide island. The island was raised 4.6m by the 1964 Alaska Earthquake creating coastal sedge/forb meadows with brackish and fresh water ponds which likely created nesting and brood rearing habitat. Absent mammalian predators goose numbers grew rapidly (Campbell and Rothe 1989, 1990; Rosenberg et al. 1996) to its current size of approximately 1,780 adults (Petrula et al. 2014; Appendix D). The number of adults has stabilized during the last 12 years in spite of high productivity (Figure 4; Appendix D). Recruitment rates are unknown.

Little is known about the breeding biology of Canada geese nesting in Prince William Sound, the forested region immediately west of the Copper River Delta (Figure 1). Anecdotal observations and results of a pilot study indicate that nests can be found throughout Prince William Sound on small forested islands, islets, and peninsulas. Other habitats in Prince William Sound have not been thoroughly searched for nesting dusky Canada geese. Spring snow cover may limit nest site availability over much of the region. Nests were found close to shore in thick moss substrate and under or near conifer cover. Clutch sizes were similar to dusky Canada geese nesting on the Copper River Delta and Middleton Island (M. Petrula, Alaska Dept. of Fish and Game, unpubl. data).

D. Molt and Post-Molt Staging Areas

Dusky Canada geese undergo wing molt from early July to early August. Family groups of molting adults and goslings are dispersed throughout the Copper River Delta; frequently observed grazing along vegetated banks of sloughs and channels, and large flocks of molting adults (100s to 1,000) are observed on the mud flats at the mouths of major sloughs and rivers (e. g. Mountain slough, Eyak River, Glacier River, Alaganik slough (Petrula and Smith 2014). Molting flocks of adults also utilize lakes and ponds east of the Copper River in the vicinity of the Bering glacier (Figure 1) (M. Petrula, Alaska Dept. of Fish and Game, pers.comm.).

In Prince William Sound, small groups of molting adults and young are observed in sub-alpine ponds and muskeg meadows. A large molting flock of 500 hundred Canada geese (unknown sub-species), containing one bird collared on the Copper River Delta, was observed at Columbia Bay in Prince William Sound (M. Burcham, Chugach National Forest, pers. comm.).



Some adults (failed nesters) migrate to separate molting areas in the northern Gulf of Alaska. Forty-one percent (9 of 22) of satellite-marked females from Middleton Island molted in Prince William Sound ($n=8$) or the Martin River, east of the Copper River ($n=1$) but all geese satellite-marked in Prince William Sound remained there to molt. Most geese marked on the Copper

River Delta molted there, although several moved to more distant molting locations including Glacier Bay in southeast Alaska (M. Petrula, Alaska Dept. of Fish and Game, unpubl. data.).

Post-molt, most Copper River Delta (20 of 28) and Middleton Island ($n=2$) females staged in Prince William Sound (lower Orca Inlet/Hawkins Island) where they remained until fall migration. Remaining Copper River Delta birds staged in nearshore areas of the northeastern Gulf of Alaska (Kayak Island, Controller Bay, and the Bering River lowlands) prior to fall migration. All Prince William Sound females remained there until migrating south (Figure 6).

E. Migration

The following information is based on satellite telemetry, neck collar observations, and band recoveries. Dusky Canada geese migrate along the Pacific coast of Alaska, British Columbia, and Washington (Figure 6). Islands in eastern Prince William Sound and Haida Gwaii are important fall staging areas (Figure 6) (M. Petrula, Alaska Dept. of Fish and Game, A. Breault, CWS, unpubl. data). An unknown proportion of Prince William Sound geese do not migrate.

Fall Migration: Dusky Canada geese begin migrating from post-molt staging areas in Alaska to wintering areas in late September (range, 22 Sept.–5 Dec.) with Prince William Sound geese departing 2 weeks later on average (6 November) than geese from Middleton Island and the Copper River Delta (20 October). Copper River Delta and Middleton Island geese are more likely to use stop-over sites during migration than geese from Prince William Sound. Haida Gwaii, the most frequently used fall staging area, was the only location geese staged for appreciable periods (range 1–91 days; mean = 21 days). Mean arrival dates in the Pacific Northwest were 31 October, 5 November, and 14 November for Copper River Delta, Middleton Island, and Prince William Sound birds, respectively (range, 9 Oct.–25 Dec.; all locations) (M. Petrula, Alaska Dept. of Fish and Game, unpubl. data).

Spring Migration: Dusky Canada geese depart wintering areas in the Pacific Northwest in late March to early April (mean, 1 April; range 19 March–23 April, reversing their fall route and arriving back in Alaska soon after departure (mean, 8 April; range 26 March–23 April; M. Petrula, Alaska Dept. of Fish and Game, unpubl. data).

F. Wintering Grounds

The primary wintering range of the dusky Canada goose is the lower Columbia River floodplain and the Willamette Valley (Figure 2). Dusky Canada geese most frequently congregate near state and federal management areas in northwest Oregon and southwest Washington (Figure 2). This includes the most densely populated and fastest growing region of Oregon. Ninety-six percent of the land in the Willamette Valley is in private ownership and 41 percent of the land base is for agriculture (Oregon Dept. Fish and Wildlife 2006).

The number and subspecies composition of the wintering Canada geese aggregating in these areas has changed dramatically over the past 50 years. The dusky Canada goose population declined from peak estimates in the 1970s while the total number of Canada geese may be at or near record highs; but precise estimates are lacking. The presence of large numbers of multiple subspecies of geese has led to complicated management actions designed to protect dusky

Canada geese while allowing sport hunting of more abundant subspecies to reduce crop depredation and provide recreation (see below).

G. Agricultural Depredation

The dramatic increase of all Canada geese in the region has resulted in increasing complaints of crop depredation on private lands. Goose depredation has caused economic damage and has been a recurrent management problem and concern on wintering areas, primarily in northwest Oregon (Pacific Flyway Council 1998).

Strategies to address the collective effects of seven goose populations on agricultural lands have been developed in the NW Oregon/SW Washington Canada Goose Agricultural Depredation Control Plan (Depredation Plan) (Pacific Flyway Council 1998). The Depredation Plan reviews research on crop depredation and provides guidance for management of goose habitats on private and public lands, as well as approaches to managing hunting programs to mitigate crop damage. The Depredation Plan includes consideration for goals, objectives, and management procedures identified in Pacific Flyway management plans for each goose population, including Dusky Canada geese.

Economic loss and spatial extent of agricultural depredation is poorly quantified. Based on a survey of Oregon agricultural producers, crop damage by geese was estimated to be almost \$15 million in 1997 with over a third of that loss from grass seed crops (Oregon Dept. of Agriculture 1998). In response to studies differing on the extent and impact of geese foraging on agricultural crops, Borman et al. (2002) developed protocols to verify and measure effects of goose grazing on grain yields. We are unaware of any quantitative assessment using these protocols.

The Oregon Goose Control Task Force (Task Force) was created by the Oregon State Legislature in 2009 to study ways to address agricultural crop losses created by current goose populations in the state. The Council addressed 6 of the twelve recommendations provided by the Task Force (Pacific Flyway Council 2010).

H. Public Use

Canada geese, including dusky Canada geese, provide recreational opportunities to hunters and non-consumptive users. Sport hunting occurs throughout their range. As the dusky Canada goose population declined, hunting seasons became more restrictive and regulations more complex. State and federal areas along the Columbia River and in the Willamette Valley host thousands of visitors to view or photograph geese. Students and teachers from universities, colleges, and public schools use these areas for environmental education.

In Alaska, there is dissatisfaction among hunters in the Copper River Delta and Prince William Sound regions who must forego opportunity to hunt migrant Canada geese to support dusky Canada goose management efforts. The Canada goose season is closed for the first 28 days of the sport harvest season, allowing dusky Canada geese to move to barrier islands or depart on their southward migration. This precludes harvest of migrant cackling, Taverner's, and lesser

Canada geese. Depending upon the timing and pattern of goose migration, annual hunting opportunity can be reduced or lost in this area.

I. Scientific Use

Dusky Canada geese have been the subject of a number of studies, both on nesting and wintering areas (see Chapman et al. 1969, Campbell and Cornely 1991, Rothe and Bromley 2003, this Management Plan). Since 1997 research has focused on dusky Canada goose breeding biology and nesting ecology in relation to changing habitats on the Copper River Delta, and on the dynamics of nest and goose predators. Satellite telemetry and genetics studies to better document interchange, distribution, and seasonal movements of Prince William Sound, Middleton Island, and Copper River Delta birds are currently in progress (M. Petrula, Alaska Dept. of Fish and Game, unpubl. data). Research conducted at Oregon wintering areas focused on identifying important roosting sites and quantifying the carrying-capacity of public lands for geese (Mini 2012).

J. Current Management

Population Management.—Active management of dusky Canada geese began in the early 1950s. Production assessments and banding were conducted on the breeding grounds and midwinter inventories began on the wintering grounds. A dusky Canada Goose Subcommittee of the Pacific Flyway Study Committee was established by the Pacific Flyway Council in 1972. The Subcommittee developed guidelines for management of the population in the flyway's first goose management plan (Pacific Flyway Council 1973). The management plan and guidelines, with revisions, have been followed since 1973.

Nesting Area Management.—

Management Authority—Nearly all dusky Canada goose nesting habitat is within the Chugach National Forest under management authority of the U.S. Forest Service (USFS). In 1962, the USFS and Alaska Department of Fish and Game (ADFG) entered into the Copper River Delta Cooperative Management Agreement, recognizing wildlife and fisheries as the most important resources of the Copper River Delta, and clarifying agency roles in management. This agreement was revised in 1986 and expanded to include the Bureau of Land Management, USFWS, and Alaska Department of Natural Resources. In 1978, the Alaska Legislature created the Copper River Delta Critical Habitat Area, encompassing federal, state, and private lands to facilitate management of biological resources and habitats.

The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) provides that “*management of the Copper/Rude and Copper/Bering River Deltas will emphasize the conservation of fish and wildlife and their habitats.*” This legislative mandate and provisions of the Chugach National Forest Revised Land and Resource Management Plan (Forest Plan; USDA Forest Service 2002) establish policy direction and frameworks for cooperative management of dusky Canada goose nesting habitat. The Forest Plan is currently being revised (as of 2015).

A memorandum of understanding intended to facilitate voluntary cooperation among the U.S. Department of the Interior, USFWS; the U.S. Department of Agriculture, USFS and the Animal and Plant Health Inspection Service – Wildlife Services; Alaska Department of Fish and Game

(ADFG); the Oregon Department of Fish and Wildlife (ODFW); and the Washington Department of Fish and Wildlife (WDFW) under the authority of the Migratory Bird Treaty Act of 1918 for protection, management, and maintenance of the dusky Canada Goose population in the Pacific Flyway has expired and is scheduled for renewal following the adoption of this Management Plan.

Habitat Manipulation—Since 1984, artificial nest islands of eight different designs have been installed on the Copper River Delta to deter nest predation (Fode, 2012) as part of a cooperative project planned and implemented by the USFS; with assistance from ADFG and major funding contributions from Ducks Unlimited Inc. and ODFW. Over 300 islands have been available annually to nesting geese since 1996, averaging 312 islands in the past five years (Appendix E). Occupancy rates increased from about 10% initially to a high of 50% in 2011, averaging almost 30% annually. Since 1984, 1,744 of 2,834 nest attempts have been successful, with an average nest success of 63%, compared to an average of 35% success on natural nest sites (Fode et al. 2006).

The benefit of artificial islands to population size and growth rates has not been documented. To determine if artificial nest islands can increase population size requires developing a population model based on updated information on all facets of reproductive ecology including assessing overall productivity if islands were unavailable to birds and documenting gosling survival rates prior to fall migration (Maggiulli and Dugger 2011).

Other habitat enhancement techniques, such as pond development, creation of large islands in ponds, and cutting off peninsulas have been tested but not considered to be practical and effective in reducing nest predation. An initial decline in aquatic and wetland habitats following the 1964 earthquake may have been mitigated by beaver (*Castor canadensis*) colonization and subsequent water impoundment (Cooper 2007).

Predator Management—Predator management on the Copper River Delta is complicated by the diverse and evolving composition of predator species, and their unpredictable interactions. Campbell and Griese (1987) and Crowley (2011) suggested management options for reducing predation on adult geese, nests, and goslings. Control measures were evaluated carefully to consider potential effects on both predator and prey populations and the public's interest in all wildlife species (summary follows).

Brown bears: Brown bears are not currently considered the significant threat to dusky Canada goose production as they were during the 1980s (Campbell 1990, Campbell 1991, Campbell et al. 1988). Sows with cubs caused substantial nest losses in some years, but the proportion of nests destroyed by brown bears declined from 50% during Campbell's studies to 13% during the late 1990s (Anthony et al. 2004). Crowley (2011) suggests this was due to an increase in alternate prey (moose calves).

Brown bear hunting regulation on the Copper River Delta were liberalized beginning in 1997 when the bag limit was increased from one bear every four years to one bear per year. Sealing and reporting restrictions were removed in 2005, and 10 days were added to the season beginning in spring 2010 (Crowley 2011). Further liberalization would result in an unsustainable

bear harvest putting the population at risk, while reducing bear viewing opportunities; a popular activity (Crowley 2011).

Coyotes: Crowley (2011) found no relationship between coyote abundance and dusky Canada goose production, and Anthony et al. (2004) reported that nest depredation by canids was much lower in the late 1990s (<5%) than reported in the late 1980s (17%) by Campbell (1986). Snowshoe hares (*Lepus americanus*) are the most important prey of coyotes on the west Copper River Delta (Carnes 2004). Coyotes were aerially hunted on the Copper River Delta for a bounty which most likely controlled population size into the 1960s (Crowley 2011). After statehood aerial gunning ceased and coyote numbers increased, but numbers have been stable in recent years (Crowley 2011).

Coyote hunting is allowed year round on the Copper River Delta with no bag limit. Harvest occurs mostly within the Copper River Highway corridor. Some recreational trapping occurs. Coyote control on the west Copper River Delta would be impractical due to the region's large size and logistical difficulties. Eradicating any coyotes (and perhaps other predators) from Egg Island, where a major proportion of goslings are currently reared (Petrula and Smith 2014), may be the most practical option for increasing productivity (Crowley 2011).

Wolves: Wolf predation on geese and nests has not been considered significant enough to manage wolves for direct enhancement of dusky Canada goose production (Crowley 2011). Wolves immigrated to the Copper River Delta after moose were introduced in the 1950s. Numbers peaked around 1988 at 18–20 wolves, and have since declined and stabilized at lower densities (Griese 1989, Crowley 2006). Wolves are known to prey on dusky Canada geese (Stephenson and Vanballenberghe 1995), but wolf numbers are low (2–6 wolves) on the west Copper River Delta (Crowley 2011) where most dusky Canada geese breed and road-accessible trapping occurs. Wolves are more abundant on the east Copper River Delta (Carnes 2004) where trapping effort is minimal. Wolf harvest regulations are liberal (Crowley 2011).

Other mammalian predators: With the exception of mink (*Mustela vison*), other mammals that occur on the Copper River Delta are not considered threats to dusky Canada geese (Anthony et al. 2004, Crowley 2011). Fondell et al. (2008) identified mink as a significant predator of goslings on the west Copper River Delta. There are no estimates of mink density on the west Copper River Delta, but they are thought to be common to abundant (Crowley 2007). Average annual harvest during the 1970s was 200 mink (Alaska Dept. Fish and Game, unpubl. data). Recent harvest is 40–60 mink per year (Crowley 2011) under liberal harvest regulations. Crowley (2011) recommended two potential management options: 1) encourage trappers to harvest mink (and coyotes) and 2) investigate the feasibility of conducting an agency sponsored spring mink control program.

Avian predators: There is a particularly diverse suite of birds that prey on and scavenge goose eggs, goslings, and adult birds. These include magpies, ravens, and crows; gulls and jaegers; owls, hawks, and bald eagles. Bald eagles can be responsible for up to 80% of dusky Canada goose nest losses each year (Anthony et al. 2004) and also appear to be a major predator of goslings (Fondell et al. 2008) (See discussion under Section C. Nesting and Production, above). No practical management actions have been identified to reduce eagle predation.

Wintering Area Habitat Management.—

Hunting mortality of dusky Canada geese was very high in the late 1950s when a large percentage of the population was concentrated on a relatively small area of privately owned land in the Willamette Valley and lower Columbia River during winter. As a result, the USFWS purchased much of this land and established Ankeny, Finley, Baskett Slough, and Ridgefield National Wildlife Refuges during the mid-1960s. The primary purpose of these refuges was to provide protected and managed habitats for dusky Canada geese. Current management emphasizes production of food for wintering Canada geese and undisturbed areas where geese can rest and feed. Refuge farming practices encourage green forage, moist-soil vegetation, and row crops. However, carrying-capacity for geese on public lands may have declined since 1998, primarily during mid- and late-winter (Mini 2012).

ODFW and WDFW also own lands managed to provide habitat to wintering dusky Canada geese in the Sauvie Island, Fern Ridge, and Vancouver Lake/Shillapoo areas. ODFW expanded Fern Ridge Wildlife Management Area (WMA) by 300 acres and Sauvie Island WMA by 175 acres since 2008. In addition, Willapa, Tualatin River, and Nestucca Bay National Wildlife Refuges provide additional winter habitat.

Harvest Management.—

Hunting Season Structure—Seasons in Washington and Oregon between 1952 and 1983 provided from 7 to 11 weeks of hunting after most dusky Canada geese had arrived on wintering areas, bag limits varied between two and three geese per day, and harvest rates averaged over 25% of the population. In 1983 and 1984, Pacific Flyway agencies responded to the decline in dusky Canada goose numbers by restricting harvest in primary dusky Canada goose migration and wintering areas. In Alaska's Units 5 and 6, the opening of Canada goose season was delayed to allow time for dusky Canada geese to migrate out of those areas and to buffer harvest with other migrating Canada goose subspecies.

In 1985, the Northwest Special Permit Zone in Oregon and the Southwest Permit Zone in Washington were established with additional restrictions, including annual dusky Canada goose quotas for emergency season closures (300 from 1985–1995; 204 in 1996; 250 during 1997–2008 and 2014; 135 during 2008–2013). Bag limits were reduced to one dusky Canada goose per season in the permit zones, and successful hunters were required to report harvest to check stations. Hunters have had to complete goose identification training and, beginning in 1996, pass an identification test to receive a permit. Those who take a dusky Canada goose or fail to report at check stations were excluded from hunting in the special permit zones for the remainder of the season, and had to pass another identification test prior to hunting in a subsequent season. Late seasons (extending as late as March 10) were enacted in 1996 and 1997 in both states to manage spring crop depredation.

Success of past regulatory regimes has varied. During restrictive season structures in the mid-1980s and early 1990s the total annual harvest of dusky Canada geese did not exceed the quota limits (Appendix F), but it was common for some specific hunt areas to reach their annual unit quotas and close for the season. Sheaffer (1993) found that average annual survival rates for dusky Canada geese were very high (76–85%) during this period, and that the population was not

adversely affected by hunting regulations. However, that study also indicated that small changes in adult survival could lead to large changes in population levels, and that continued conservative regulations were necessary, given low recruitment rates.

Although open hunt areas expanded in Oregon and Washington to include nearly all areas in which dusky Canada geese winter, the reported dusky goose harvest has declined and specific hunt units have seldom filled their quotas. Over the past ten years, an average annual reported harvest of <60 dusky Canada geese has been recorded at check stations, while the reported harvest of other Canada geese has been maintained at about 12,000 (Appendix F). Dusky Canada goose adult survival estimates remained stable (mean=0.809, SE=0.009) from 2002–2015 (T. Sanders, USFWS pers. comm.).

Due to operating cost of check stations, barriers those stations create for goose hunter retention and recruitment in the wintering areas; and evidence that reported dusky harvest may be less than 50% of the true harvest in the quota areas; managers are implementing a new dusky goose harvest strategy beginning with this Management Plan. There will be no open season for dusky Canada geese on wintering areas in northwest Oregon and southwest Washington and no requirements to operate check stations for goose hunters. Seasons for other populations of geese would remain open based on harvest strategies in their respective management plans.

Beginning with the 2009 hunting season, a combined (and reduced) harvest quota of 175 birds was implemented for Washington, Oregon and Alaska because the 3-year average population estimate fell below 10,000. Alaska implemented a permit-only Canada goose hunt on the Copper River Delta (Alaska Game Management Units 6B and 6C) and in portions of eastern Prince William Sound (Hinchinbrook and Hawkins Island in Unit 6D). Season dates did not change but the season would close if 40 dusky Canada geese were harvested. Seasons were liberalized in 2014 when the 3-year average breeding population estimate exceeded 12,500 (Pacific Flyway Council 2008).

Harvest Distribution—Approximately 26,110 dusky Canada geese (70% adults and 30% goslings) have been banded in Alaska since 1951. Most (98%) geese were banded on the Copper River Delta; 100 were banded in Prince William Sound (including Hinchinbrook Island and Columbia Bay); 85 by the Bering Glacier; and 392 on Middleton Island. Approximately 58% of banded adults and 40% of banded goslings were also marked with a red (Copper River Delta) or green (Middleton Island and Prince William Sound) neck collar. Most geese were captured and marked during the molt; more recently a few females were nest trapped and marked in spring.

Band recoveries and neck collar resightings have been used to estimate survival rates during selected periods since marking began (see Bromley and Rothe 2003, Sanders 2015). Maintaining an adequate number of marked individuals in the population is required to continue estimating dusky survival rates. Current marking strategies include banding 600 dusky geese every other year; 300 hundred of which will receive a neck collar for mark-resight analysis (Sanders 2015).

During 1951–1984, prior to restrictive seasons, band recovery data indicated that about 70% of the harvest of dusky Canada geese occurred in Oregon and the remaining 30% was distributed

about equally between Washington, British Columbia, and Alaska (Appendix H). With increased hunting restrictions since 1985, band recoveries declined in all areas, especially Oregon. The lower proportion of bands recovered in Oregon (average 49%) caused proportional increases to 26% in Alaska and 16% in Washington (Appendix H). Band recovery distributions should be interpreted with caution because (1) band reporting rates likely vary across the range, and the effect of check stations on reporting rates is unknown, and (2) numbers of band recoveries have been low under restrictive seasons.

Historically, most band recoveries in Alaska are from the Cordova/Copper River Delta area and adjacent Gulf of Alaska coast, but not in southeast Alaska. Most band recoveries reported in British Columbia are from the Haida Gwaii, although band recoveries from this area have declined recently. Less than 1% of band recoveries have been recorded from other areas of the Pacific Flyway.

Harvest Subspecies Composition—Through the mid-1960s, dusky Canada geese comprised 80% or more of western Oregon goose harvest (Chapman et al. 1969). As the population of Taverner's Canada geese increased in that area, the proportion of dusky Canada geese in the total goose harvest decreased. However, a combination of traditional hunting practices and behavioral differences between subspecies resulted in a higher proportion of dusky Canada geese in the harvest than expected from subspecies composition (Simpson and Jarvis 1979). From 1982–1985 dusky Canada geese made up 48% of Canada geese harvested at five state and federal management areas. During that same period, the proportion of dusky Canada geese among all Canada geese wintering in the area averaged only 18% (Figure 2). During 1976–1983, before seasons were implemented to redirect harvest away from the subspecies, dusky Canada geese were about 2.6 to 3.1 times more vulnerable to harvest than Taverner's geese (Simpson and Jarvis 1979, Jarvis and Cornely 1988).

Restrictive harvest regulations instituted in 1984 were designed to allow continuation of a Canada goose harvest on the wintering grounds by emphasizing harvest of other subspecies while protecting dusky and cackling Canada geese. Initially, dusky Canada geese made up 11% of the reported Canada goose harvest in the Oregon and Washington wintering area during 1985, but their proportion of the reported harvest has fallen to <0.5% in recent seasons. Cackling Canada geese have made up the majority of the reported Canada goose harvest in the dusky Canada goose wintering areas since 1998 and currently comprise approximately 66% of the reported harvest.

Classification criteria at check stations are accurate in detecting most dusky Canada geese, but estimates of “dusky Canada goose” harvest from check stations include other large dark Canada geese. A genetic analysis of 105 hunter-killed birds classified by check station personnel as dusky Canada geese indicated that approximately 35% of females and 50% of males probably originated from somewhere other than the Copper River Delta and Prince William Sound (Pearce et al. 2000).

An analysis of another 45 geese not classified at check stations as dusky Canada geese (but morphologically similar) roughly 2% were genetically characterized as dusky Canada geese. These results indicate that dusky Canada goose classification criteria is accurate in detecting

nearly all dusky Canada geese, but that estimates of dusky Canada goose harvest from classified geese include other large, dark Canada geese.

One classification problem which may have influenced the number of dusky Canada geese recorded at some check stations is the continued presence of a small group of dusky Canada geese and presumed western-dusky hybrids (“wuskys”) that breed around Willapa Bay, Washington and on islands near the mouth of the Columbia River. These geese, known as resident dark geese are not the object of this Management Plan. They are descendants of a captive breeding program initiated by Willapa NWR in 1958, when 40 dusky Canada goose goslings were relocated from the Copper River Delta to a pen near the refuge headquarters (Welch, pers. comm.). This flock grew to about 400 by the mid-1970s, when the pen and nearby nest structures were dismantled.

Since 1999, approximately 1,200 dark Canada geese have been banded and collared on Miller Sands Island, Oregon, where approximately 40 nests of dark Canada geese are recorded annually. Recent estimates of flock size are not available. Harvest of unmarked resident dark geese were likely tallied as dusky Canada geese at check stations and counted toward quotas. Continued neck collaring of this small population would allow hunters to positively identify resident dark geese and harvest them without being in jeopardy of a citation for violating the season closure for dusky Canada geese.

MANAGEMENT ISSUES

Issues identified in this section are addressed in Recommended Management Procedures that follows this section.

A. Breeding Grounds

1. Changes on the Copper River Delta, resulting from uplift of the area during the 1964 Alaska Earthquake, have adversely affected goose production. Woody vegetation has increased greatly. Trends in plant succession warrant continued monitoring, especially with regard to changes in habitat use by dusky Canada goose and habitat characteristics that favor avian and mammalian predators.
2. There is considerable annual variation in the impacts of specific avian and mammalian predators on dusky Canada geese. There is a continuing need to describe and monitor the changing predator-prey dynamics on the breeding grounds, particularly to measure predation on adult dusky Canada geese and pre-fledging goslings (i.e., recruitment). This is most practical and may be most beneficial on Egg Island.
3. Eulachon are important alternative prey for eagles during spring, but timing and abundance of eulachon runs may vary annually. When large runs of eulachon are synchronous with goose nesting, eagle predation on geese is reduced and nest success (and possibly gosling survival) is improved. When goose nesting and eulachon runs are poorly synchronized nest success is reduced. However, long-term patterns and mechanisms for the variation in timing and escapement of eulachon runs have not been identified nor well correlated with nest success and productivity.

4. Geese nesting on artificial islands on the Copper River Delta have improved nest success compared to geese nesting in other Copper River Delta habitats. Existing islands should be monitored and maintained with an additional focus on replacing/relocating islands to improve use. An assessment of the artificial island program should be completed prior to adding islands to the program including: habitat variables, success by type, use, distribution, and contribution to population (gosling mortality and recruitment rates).
5. Maintain a regular schedule of inventories and population monitoring surveys as necessary to accurately assess population status and trends and guide harvest strategies. In addition, this information will be useful for developing a population model. The frequency and methods used to assess the aerial:ground correction factor for the spring population survey should be reviewed (Hodges and Eldredge 2007).
6. Maintain a regular schedule of leg-banding and neck collaring a minimum number of birds on breeding areas to determine survival rates, estimate population, determine distribution and habitat use, and help monitor success of research and management actions

B. Wintering Grounds

1. Numbers of Canada geese wintering in northwest Oregon and southwest Washington have increased significantly since the 1980s, with some populations reaching or exceeding population objectives. This has resulted in increased complaints of crop depredation and associated economic loss and become a major management concern.
2. Efforts to haze or harvest more abundant subspecies of Canada geese while protecting dusky Canada geese are very time-consuming, controversial, and/or expensive. Dusky Canada geese are more vulnerable to hunting due to their behavior and habitat use patterns. Controlled goose hunts using specific open areas, check stations, stringent harvest permit requirements, hunter education, and law enforcement require substantial commitments of personnel, time, and money. General goose seasons with a dusky Canada goose closure, though relatively simple to implement, may be controversial since harvest of any medium sized, dark breasted Canada goose could lead to a citation if measurements taken by an enforcement officer meet the regulatory definition of a dusky Canada goose.
3. Conversion of bottomland pastures and other agricultural lands along the Columbia and Willamette rivers to other uses, including commercial and residential development and crops not beneficial to wintering geese, has reduced goose foraging habitat. This habitat loss concentrates geese on remaining lands, increasing depredation concerns.
4. Available acreage in Federal and State refuge lands managed for wintering Canada geese is insufficient to support goose populations. The current social, political, and economic environment hinders the addition of refuge lands to provide adequate habitat.

5. In the absence of check stations and the difficulty in identifying subspecies by many hunters, an enforcement strategy is necessary to deter illegal harvest of dusky Canada geese.
6. A regular schedule of inventories and population monitoring surveys are necessary to accurately assess population status, trends, distribution, and will help guide harvest strategies. Assessment of adult survival, following set protocols, is necessary to evaluate mechanisms of population change.

RECOMMENDED MANAGEMENT STRATEGIES

The following management procedures are recommended even though the degree and timing of their implementation by the agencies involved may be influenced by human resource, fiscal and legislative constraints. Whenever possible, management actions in this Management Plan should be integrated with those in management plans for other Pacific Flyway goose populations, local and regional land use plans, and habitat conservation programs. Management actions should be accompanied by monitoring efforts to examine their effectiveness in meeting population and habitat objectives in an adaptive management approach.

This plan identifies three action levels for increasingly intensive management efforts to benefit the population status of dusky Canada geese. These levels are designed to ensure adequate time for management actions to take effect, based on biological constraints and the expected response times of dusky Canada geese to the proposed management actions. These action levels listed here apply only to management strategies and do not coincide with the regulation package categories in the harvest strategy.

Most of the more intensive actions have considerably higher monetary and socio-political costs to the participating agencies and thus are reserved for lower population levels. These actions are intended to provide reasonable opportunity for the dusky Canada goose population to recover from low levels. Significant improvements in the total population of dusky Canada geese will continue to be dependent on sustaining and enhancing that major portion of the population breeding on the Copper River Delta. Therefore, this plan identifies three increasingly intensive action levels primarily designed to maintain and enhance the number of dusky Canada geese on the Copper River Delta.

The choice of specific population levels that trigger certain management actions is based on the current best estimates of factors influencing the status of dusky Canada geese and the projected population responses to specific management actions. The population triggering levels are scaled to the first objective in the plan: Manage the number of dusky geese to sustain the population objective of 20,000 geese.

Action levels are triggered by the most recent 3-year average indices, except that declines from level 2 to level 3 will be triggered by the most recent annual index. If a reliable annual population index is unattainable in any given year, the last complete index survey and other relevant data on annual status will be used to determine the action level to be implemented.

Reliability of annual surveys will be made by survey crews. A survey index that is deemed unreliable will not trigger a change in action level for the current year. If results of the subsequent survey support a change in action level, it will be implemented.

ACTION LEVEL 1:	20,000–10,000
ACTION LEVEL 2:	9,999–5,000
ACTION LEVEL 3:	below 5,000

Management strategies that relate to these levels are described in each section below. Action Level 1 tasks will be implemented at all population levels. Action levels 2 and 3 are additive to Action Level 1 tasks. In the event that Action Level 3 is reached, the agencies will initiate a thorough population risk assessment, review the conservation status of dusky geese, and re-evaluate all feasible and practical intensive management options. Action Level 3 Tasks presented below are intended to guide this process.

A. Action Level 1

Habitat.—

1. Continue to maintain and monitor the current number of dusky Canada goose artificial nest islands with a goal of increasing occupancy and minimizing costs.

Lead Agencies: USFS
Participating: ADFG, USFWS
Priority: 1
Schedule: Ongoing

2. Monitor habitat suitability and evaluate potential to enhance nesting habitat and increase productivity on barrier islands of the Copper River Delta.

Lead Agencies: USFS, ADFG
Participating: USFWS
Priority: 1
Schedule: Ongoing

3. Monitor timing and abundance of eulachon runs and correlate with dusky Canada goose nest success.

Lead Agencies: USFS, ADFG
Participating: USFWS
Priority: 1
Schedule: Ongoing

4. Complete vegetation mapping of the Copper River Delta at 10-year increments to quantify vegetation change over time and implications to dusky Canada geese.

Lead Agencies: USFS

Participating: ADFG, USFWS
Priority: 1
Schedule: 2018

5. Continue a policy of habitat protection of USFS lands on the Copper River Delta and Prince William Sound and manage the Copper River Delta Critical Habitat Area to prevent habitat degradation and protect dusky Canada goose nesting and brood rearing habitat.

Lead Agencies: USFS, ADFG
Priority: 1
Schedule: Ongoing

6. Identify and protect habitat along migration routes through Council or agency actions and by developing cooperative agreements with other land management agencies.

Lead Agencies: USFWS, ADFG, WDFW, ODFW, PCJV
Participating: CWS, BCMOE
Priority: 2
Schedule: Ongoing

7. Review management plans for existing state and federal managed areas for goose resting, feeding, and sanctuary and develop cooperative land management agreements or other means to improve habitat management for dusky Canada geese during winter including maintenance and land acquisition as feasible.

Lead Agencies: WDFW, ODFW, USFWS, NGOs
Participating: Other federal, state, and private organizations
Priority: 1
Schedule: Ongoing

8. Develop or revise, as needed, cooperative management plans and programs for public lands, other than national wildlife refuges and state management areas that result in increased goose food production and reduced disturbance of geese during winter, especially for dusky Canada geese.

Lead Agencies: ODFW, WDFW, USFWS
Participating: Other federal, state, and private organizations
Priority: 1
Schedule: Ongoing

9. Periodically analyze and report survey and neck-collar resight information to monitor timing and use at important winter and staging areas.

Lead Agencies: USFWS
Participating: ODFW, WDFW, other federal, state, and private organizations
Priority: 1
Schedule: Ongoing

Inventories.—

1. Estimate abundance and population trends by conducting a spring aerial survey of birds on the nesting grounds along standard density-stratified transects. Conduct experimental surveys in additional areas where breeding dusky Canada geese are detected.

Lead Agency: USFWS
Priority: 1
Schedule: Annually

2. Estimate abundance and productivity of dusky Canada geese on Middleton Island as a component of a breeding ground population estimate.

Lead Agency: ADFG
Participating: USFWS, ODFW, WDFW
Priority: 1
Schedule: Biennial; annually at Action Level 2

3. Periodically determine visibility correction factor for spring aerial survey by comparing aerial survey and ground nest plot data to derive an air: ground ratio estimate used to adjust the spring index (see Hodges and Eldredge 2007).

Lead Agency: USFS
Participating: USFWS, ADFG, ODFW, WDFW
Priority: 1
Schedule: 3-year intervals, next in 2017

4. Conduct annual aerial surveys in July to estimate (index) production on the Copper River Delta.

Lead Agency: ADFG
Priority: 1
Schedule: Annual

5. Biennially, leg-band and collar ≥ 300 adult geese and in addition leg-band only ≥ 300 adult geese. Recovery and re-sight data will be used to determine survival rates and distribution and monitor success of research and management actions (see Inventories Task 7).

Lead Agencies: ADFG
Participating: USFWS, USFS
Priority: 1
Schedule: Ongoing, next in 2016 and 2018

6. Compile breeding and wintering season records of Canada geese in Prince William Sound, evaluate potential methods for an index survey, and explore additional options to mark a sample of geese.

Lead Agency: ADFG, USFS
Participating: USFWS, ASC, USFS
Priority: 2

Schedule: Ongoing

7. Conduct annual Canada goose monitoring in northwest Oregon and southwest Washington to locate birds marked on the breeding grounds, estimate annual survival rates, and determine the distribution and habitat use of collared birds marked in Alaska. (see Inventories Task 5).

Lead Agencies: ODFW, WDFW

Participating: USFWS

Priority: 1

Schedule: Ongoing

8. Continue a banding and marking program on resident dark-geese that breed on the lower Columbia River to simplify identification of these birds by hunters and to avoid counting them as dusky Canada geese during population and habitat use surveys.

Lead Agencies: WDFW, ODFW

Participating: USFWS

Priority: 1

Schedule: Ongoing

9. Document dusky migration chronology and winter distribution in British Columbia to develop and implement a monitoring program based on standardized protocols.

Lead Agencies: CWS, BCMOE

Priority: 1

Schedule: Ongoing

Crop Depredation Control.—

1. Take advantage of and seek new opportunities to secure additional goose winter use areas for resting, feeding, and sanctuary through either fee acquisition or development of conservation/agricultural easement programs.

Lead Agencies: ODFW, WDFW, USFWS

Participating: Other federal, state, and private organizations

Priority: 1

Schedule: Ongoing

Outreach and Education.—

1. Improve efforts to educate hunters on goose identification and the rationale for current regulations in an effort to reduce the take of dusky Canada geese during closed seasons in Oregon and Washington while maintaining goose hunting for other subspecies of Canada geese through the full framework to mitigate crop depredation.

Lead Agencies: USFWS, ADFG, ODFW, WDFW

Priority: 1

Schedule: Ongoing

3. Establish effective Law Enforcement programs to deter illegal harvest and reduce the take of dusky Canada geese during closed seasons in Oregon and Washington.

Lead Agencies: USFWS, ODFW, WDFW
Priority: 1
Schedule: Ongoing

Maintain or establish interpretive programs to promote conservation at state and federal refuges and wildlife management area visitor centers and provide written and pictorial information on the life history and management of the dusky Canada goose.

Lead Agencies: ADFG, WDFW, ODFW, USFS, USFWS
Priority: 2
Schedule: Ongoing

Research Needs.—

1. Develop a habitat suitability map/model for nesting and brood-rearing dusky Canada geese and periodically re-evaluate dusky Canada goose habitat use patterns during nesting and brood-rearing in relation to plant community succession. Compare nest success of dusky Canada geese among seral types on the Copper River Delta.

Lead Agencies: USFS
Participating: TBD
Priority: 1
Schedule: TBD

2. Design a monitoring program to assess status of eulachon stocks on the Copper River Delta, including annual variation in strength and timing of runs, and factors that may affect sustainability.

Lead Agencies: USFS
Participating: ADFG
Priority: 1
Schedule: TBD

3. Mark and track Middleton Island progeny to determine emigration pattern, staging areas, and seasonal distribution.

Lead Agencies: ADFG
Priority: 1
Schedule: TBD

4. Develop a comprehensive population model based on extant data that integrates demographic parameters influencing recruitment and population size. Parameters include but are not limited to re-nesting rates, clutch size, nest success, and annual survival of goslings and adults.

Lead Agencies: TBD
Participating: USGS Alaska Science Center
Priority: 2
Schedule: TBD

5. Determine timing and patterns of migration and spring distribution of nonbreeding dusky Canada geese including subadults.

Lead Agencies: TBD
Participating: TBD
Priority: 2
Schedule: TBD

6. Determine relationships among nesting (territorial) bald eagles, eulachon (and other alternative prey), and goose predation rates during dusky Canada goose breeding season. Predation by immature and non-breeding eagles seems inversely related to abundance of eulachon, but the role of nesting eagles (territorial birds) in predation on geese is unknown; studies of feeding ecology of nesting pairs may be important (see Research Need 7).

Lead Agencies: USFS
Participating: USFWS, ADFG
Priority: 2
Schedule: TBD

7. Investigate feasibility of reducing predation by bald eagles by removing eagle roosting and perching sites with the intent of making areas less suitable for eagles.

Lead Agencies: USFS
Participating: USFWS, ADFG
Priority: 2
Schedule: TBD

B. Action Level 2

1. In suitable habitats, maximize number of artificial nest islands on the Copper River Delta if determined to be cost effective in increasing recruitment.

Lead Agency: USFS
Participating: ADFG, ODFW, WDFW, USFWS, DU
Schedule: TBD

2. If evidence of low productivity on Egg Island, monitor prior to and during nesting and brood rearing for coyotes or other mammalian predators, and if present attempt to remove through legal methods and means.

Lead Agencies: USFS, ADFG
Participating: USFWS
Schedule: TBD

3. Implement feasible habitat enhancement practices on the barrier islands, based on previous research and monitoring (see Action Level 1, Habitat Task 2 and Action Level 2, Habitat Task 2).

Lead Agencies: USFS, ADFG
Participating: USFWS
Schedule: TBD

4. Evaluate the feasibility of a mink control program that would increase nest success and gosling survival on the Copper River Delta.

Lead Agencies: USFS, ADFG
Participating: USFWS
Schedule: TBD

C. Action Level 3

1. Manage mammalian predator populations through public hunting and trapping, and other feasible and practical means. Implement directed predator control programs that have been deemed feasible and have undergone public review including the development of an environmental analysis for NEPA compliance on directed predator control options.

Lead Agencies: USDA Forest Service, ADFG, USFWS
Participating: USFS, USFWS, USDA-WS
Schedule: Ongoing

2. If feasible implement a mink control program in spring prior to or during incubation and brood rearing.

Lead Agencies: USDA-WS,
Participating: ADFG, USFS
Schedule: TBD

HARVEST ISSUES

Issues identified in this section are addressed in the Recommended Harvest Strategy that follows this section.

A. Breeding Grounds

1. Maintain recreational goose hunting opportunity in Alaska for dusky Canada geese and migrant geese while allowing the population to increase toward the objective of 20,000 birds.

B. Wintering Grounds

1. Maintain recreational goose hunting opportunity in Oregon and Washington to help alleviate agricultural depredation while allowing the population to increase toward the objective of 20,000 birds.

RECOMMENDED HARVEST STRATEGY

The harvest strategy is based on a 3-year moving average of the dusky Canada goose population index. The term of this harvest strategy is for three years after implementation of the Management Plan; after which the dusky Canada goose subcommittee will evaluate the harvest strategy to determine if it warrants continuation. If it is determined that continuation is unwarranted, the subcommittee will consider other options for a harvest strategy.

If at any time the dusky Canada goose population declines to below 10,000 geese or adult dusky Canada goose annual survival (most recent reliable estimate), as measured by resighting of neck collared birds, declines by 10% from mean levels observed during 2002–2015, the subcommittee will meet to determine if alternative harvest strategies should be considered for subsequent hunting seasons.

If the dusky Canada goose population declines to below 7,500 geese, the subcommittee will work with the Canadian Wildlife Service and British Columbia Ministry of Environment to identify areas and opportunities for harvest control in British Columbia; and, if feasible, to develop and implement measures that support conservation of Canada geese in B.C.

A prescriptive harvest strategy is established as follows for sport hunting seasons in identified dusky Canada goose use areas of Alaska, Washington, and Oregon:

Regulation Package	Population Index (3-year average)
Very Restrictive	<5,000
Restrictive	5,000 – 7,500
Standard	>7,500

Area and Regulation	Regulation Package		
	Very Restrictive	Restrictive	Standard
Alaska (Game Management Unit 6A,6B,6C and 6D in part) ^{1,2}			
Framework Dates	September 1 to December 16		
Bag Limit	Permit Only ³	2 per day	4 per day
Season Length	September 28 to December 16		
Open Areas	All Areas		
Southwest Washington and Northwest Oregon Permit Zones ⁵			
Dusky Canada Goose Season	Closed		
Other Canada Goose Seasons	As determined by specific Canada goose harvest strategies		
Framework Dates	Saturday closest to September 24 through March 10		
Bag Limit	As determined by specific Canada goose harvest strategies		
Season Length	As determined by specific Canada goose harvest strategies		
Open Areas	Only Agricultural Lands ⁶		Normal Hunting Areas

¹Canada goose harvest at Middleton Island in GMU 6 is by registration permit only. A permit allows the harvest and possession of 1 Canada goose. The harvest of Canada geese on Middleton Island will close once 5 dusky Canada geese are taken.

²In 6D Hinchinbrook and Hawkins islands and adjacent marine waters.

³Closed to dusky Canada geese. Open to other Canada geese by permit only.

⁴Dusky Canada geese, daily bag limit of 2 per day.

⁵The States of Oregon and Washington must implement rules which ensure all goose hunters in the permit zones have passed a goose identification exam provided by either state.

⁶If the dusky Canada goose population is less than 7,500 geese, (based on the 3-year average index), Oregon and Washington will implement regulations to ensure the hunting of Canada geese occurs only on or over agricultural fields or pastures with crops or forage that may be damaged by geese. Standard seasons for harvest of Canada geese other than dusky Canada geese in the permit zones may be resumed when the dusky Canada goose population (based on the 3-year average index) exceeds 10,000 geese. If the dusky Canada goose index is less than 5,000 geese in any year, additional restrictions, including the closure of all Canada goose hunting will be considered.

ANNUAL PLAN REVIEW

The Subcommittee shall meet twice annually, or as needed, to review progress towards achieving the goal and objectives of this plan, and to recommend actions and revisions. The Subcommittee shall report to the Pacific Flyway Council through its Study Committee on accomplishments and shortcomings of the cooperative management efforts. This Subcommittee shall coordinate management activities with those of the subcommittees on lesser/Taverner Canada geese, cackling Canada geese, and Pacific population of western Canada geese.

The Subcommittee shall be composed of a representative from the Canadian Wildlife Service, U.S. Fish and Wildlife Service, and state and provincial agencies responsible for management of the dusky goose population. It shall be the responsibility of those members to assure that the objectives and procedures of this plan are integrated and coordinated with those plans and activities of the various wildlife and land management agencies and local planning systems within their agency's venue. Chairmanship shall be appointed biennially and rotated among member agencies (except for Canadian agencies). The Subcommittee will exercise its prerogative to invite to attend and participate (ex officio) at meetings any individual, group, agency, or representative whose expertise, counsel, or managerial capacity is required for the coordination and implementation of management programs.

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APPENDICES

APPENDIX A. Abundance estimates of dusky Canada geese derived from observations of marked birds during winter

Winter	Estimate	SE
1989-90	12,438	997
1990-91	19,768	2,001
1991-92	17,996	1,580
1992-93		
1993-94		
1994-95	7,948	2,292
1995-96	18,175	5,880
1996-97	11,198	1,711
1997-98	21,280	3,642
1998-99	13,447	1,679
1999-00	15,459	2,459
2000-01	17,346	2,719
2001-02	17,191	2,820
2002-03	16,724	1,856
2003-04	14,892	1,767
2004-05	21,788	2,367
2005-06	11,901	1,125
2006-07	14,112	2,802

APPENDIX B. Estimates of dusky Canada geese from spring aerial surveys on the Copper River Delta, biennial counts of adults on Middleton Island, and management index of total dusky Canada geese adopted in 2008

	Indicated total		Indicated breeding		Adjusted breeding	Birds	Breeding and	Middleton Island	Management	3-year running
	birds index	SE	birds index	SE	birds index ¹	in flocks	Flocked	adults ²	Index ³	average
1986	5,469	356	4,811	389	16,335	658	16,993	80	17,073	
1987	5,408	504	4,294	409	14,580	1,114	15,694	84	15,778	
1988	5,296	364	4,412	325	14,981	884	15,865	90	15,955	16,269
1989	6,582	565	4,463	369	15,154	2,119	17,273	75	17,348	16,360
1990	5,442	669	4,482	457	15,218	960	16,178	93	16,271	16,525
1991	3,773	437	2,861	356	9,714	912	10,626	249	10,875	14,831
1992	6,648	835	4,472	284	15,184	2,176	17,360	473	17,833	14,993
1993	6,334	495	4,096	265	13,908	2,238	16,146	473	16,619	15,109
1994	5,810	432	4,226	253	14,349	1,584	15,933	473	16,406	16,953
1995	3,685	323	3,357	250	11,398	328	11,726	473	12,199	15,075
1996	3,509	267	2,936	190	9,969	573	10,542	1,456	11,998	13,534
1997	4,208	271	3,379	176	11,473	829	12,302	1,168	13,470	12,556
1998	4,814	350	3,571	203	12,125	1,243	13,368	1,168	14,536	13,335
1999	3,068	224	2,599	174	8,825	469	9,294	1,168	10,462	12,823
2000	3,009	184	2,477	128	8,410	532	8,942	1,309	10,251	11,750
2001	3,157	202	2,788	181	9,466	369	9,835	1,309	11,144	10,619
2002	3,836	294	2,966	173	10,071	870	10,941	1,416	12,357	11,251
2003	3,083	222	2,215	129	7,521	868	8,389	1,416	9,805	11,102
2004	3,198	235	2,712	190	9,208	486	9,694	1,499	11,193	11,118
2005	5,050	614	3,986	418	13,534	1,064	14,598	1,499	16,097	12,365
2006	3,412	326	3,006	301	10,207	406	10,613	1,453	12,066	13,119
2007	2,848	188	2,456	157	8,339	392	8,731	1,453	10,184	12,782
2008	2,512	192	2,222	167	7,545	290	7,835	1,317	9,152	10,467
2009	1,768	165	1,513	103	5,137	255	5,392	1,317	6,709	8,682
2010	2,714	193	2,324	131	7,891	390	8,281	1,249	9,530	8,464
2011	3,736	326	2,845	202	9,660	891	10,551	1,249	11,800	9,346
2012	4,093	365	3,498	270	11,877	595	12,472	1,188	13,660	11,683
2013 ⁴	-	-	-	-	-	-	-	-	-	-
2014	5,054	435	3,649	256	12,390	1,404	13,794	1,780	15,574	13,678

¹ Indicated breeding bird index x 3.3954 (adjustment for nest detection and re-nesting rates)

² Surveys conducted every other year.

³ Adjusted breeding bird index + flocked + Middleton Island adults

⁴ Survey not completed due to aircraft and weather delays

APPENDIX C. Percent young of the year and total birds estimated (adults + goslings*2) for dusky Canada geese recorded during July aerial surveys¹ of the west Copper River Delta, Alaska 1971–2014

Year	% Young	Geese estimated	Year	% Young	Geese estimated
1971	16.2	5717	1994	5.7	6977
1972	10.6	8193	1995	3.9	5818
1973	36.0	5873	1996	21.6	6329
1974	51.4	8199	1997	10.8	6253
1975	17.9	8990	1998	11.7	4919
1976	24.2	7092	1999	14.7	4156
1977	44.3	10521	2000	22.7	4397
1978	24.8	11014	2001	25.4	3165
1979	16.0	12700	2002	30.5	3708
1980	23.7	7500	2003	7.2	5929
1981	17.9	8740	2004	27.8	5678
1982	23.7	8473	2005	11.8	5364
1983	15.0	7740	2006	23.1	6261
1984	18.3	11913	2007	20.9	4741
1985	3.6	13780	2008	47.2	7238
1986	11.1	13309	2009	36.9	7017
1987	9.5	12448	2010 ²	39.3	8265
1988	19.9	6917	2011 ³	37.4	6564
1989	9.4	6114	2012	29.7	7373
1990	23.5	5530	2013	43.0	7831
1991	21.5	7098	2014	26.8	9154
1992	23.1	7633			
1993	5.0	4542			
			10-year Avg. ⁴	31.6	6980
			44-year Avg.	21.9	7575

¹ Surveys conducted by fixed-winged aircraft prior to 1992; with Robinson R-22 or R-44 helicopter 1992-2014.

² Highest count of 2 surveys conducted 2 days apart; other survey 36.3%, 7482 total geese.

³ Incomplete survey; approximately 80% coverage.

⁴ Most recent 10-year average.

APPENDIX D. Numbers of dusky Canada geese counted on Middleton Island, Alaska during June 1996–2014

Year ¹	Number of Adults	Average brood size ² (SD)	Number goslings	Number broods	Total Geese ³	% Young
1996	1497	3.66 (1.7)	673	192	2170	31.0
1997	1168	3.84 (1.6)	884	223	2052	43.1
2000	1309	3.85 (1.7)	1220	315	2529	48.2
2002	1416	3.24 (1.5)	806	245	2222	36.3
2004	1499	3.46 (1.6)	876	254	2375	36.9
2006	1453	3.52 (1.9)	974	283	2427	40.1
2008	1317	3.31 (1.5)	795	240	2112	37.6
2010	1249	3.75 (1.6)	976	313	2225	43.9
2012	1193	3.30 (1.7)	924	289	2117	43.6
2014	1780	3.59 (1.5)	1324	369	3104	42.7
Average	1388	3.55 (1.6)	945	272	2333	40.3

¹Surveys were conducted within a 4-day period between June 19 and June 28

²Average number of goslings in known-sized broods

³Adults + estimated young

APPENDIX E. Artificial nest islands on west Copper River Delta, occupancy by dusky Canada geese, and nest success

Year	Islands in Program	Islands Monitored ¹	Islands Available	Nest Attempts		Successful Nests		Destroyed Nests		Unknown Nests	
	No.	No.	No.	No.	%	No.	%	No.	%	No.	%
1984	39	39	39	5	13	5	100	0	0	0	0
1985	37	37	37	4	11	3	75	1	25	0	0
1986	132	121	116	10	9	4	40	4	40	2	20
1987	279	279	256	24	9	16	67	4	17	4	17
1988	534	520	480	55	11	40	73	9	16	6	11
1989	524	303	238	30	13	17	57	6	20	7	23
1990	546	327	288	39	14	28	72	8	21	3	8
1991	603	379	338	63	19	35	56	11	17	17	27
1992	582	331	254	43	17	34	79	7	16	2	5
1993	601	379	292	66	23	40	61	7	11	19	29
1994	548	302	258	58	22	12	21	35	60	11	19
1995	496	324	256	64	25	20	31	34	53	10	16
1996	409	395	337	93	28	56	60	26	28	11	12
1997	366	364	328	90	28	54	59	30	33	6	7
1998	367	366	345	104	30	42	40	44	42	18	17
1999	362	356	354	99	28	52	53	43	43	2	2
2000	359	354	346	110	32	83	75	25	23	0	0
2001	361	357	337	147	44	82	56	52	36	1	6
2002	360	349	344	105	31	79	83	7	7	0	0
2003	345	345	334	108	32	66	61	39	36	0	0
2004	336	336	331	137	41	99	72	30	22	8	6
2005	334	334	317	137	43	86	63	40	29	11	8
2006	328	328	320	156	49	53	40	63	47	18	13
2007	331	331	314	154	49	62	40	83	54	9	6
2008	331	331	322	130	40	85	65	39	30	6	5
2009	330	330	320	144	45	126	88	16	11	2 ²	1
2010	325	325	319	168	53	124	74	36	21	1 ²	
2011	308	308	303	152	50	84	55	54	36	5 ²	
2012	256	256	236	119	50	72	61	45	38	2 ²	
2013	301	301	295	96	32	77	80	9	9	8 ²	
2014	374	374	369	124	29	108	87	5	4	2	2

¹Approximately half the nest islands in the program were monitored 1989-1995. Summary data for those years only apply to the monitored islands

²Total nests where eggs were abandoned

APPENDIX F. Subspecies composition and estimated harvest of Canada geese from check station data in southwest Washington and western Oregon

Northwest Oregon											
Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
1984-85		0	603	0	641	0	0	21	1,265	0.0%	47.7%
1985-86		8	157	257	1,156	2	95	0	1,675	0.5%	9.4%
1986-87		19	134	103	1,157	0	0	127	1,540	1.2%	8.7%
1987-88		54	118	235	2,524	3	258	1	3,193	1.7%	3.7%
1988-89		26	142	273	3,067	3	415	0	3,926	0.7%	3.6%
1989-90		16	79	346	2,563	5	1,623	2	4,634	0.3%	1.7%
1990-91		18	177	572	2,684	6	1,846	0	5,303	0.3%	3.3%
1991-92		42	121	378	2,287	9	1,091	0	3,928	1.1%	3.1%
1992-93	1	36	147	422	2,294	8	1,333	0	4,241	0.8%	3.5%
1993-94	0	72	188	748	2,699	41	1,348	4	5,100	1.4%	3.7%
1994-95	1	1,220	142	447	2,669	9	1,415	10	5,913	20.6%	2.4%
1995-96	1	1,758	83	462	1,885	10	598	2	4,799	36.6%	1.7%
1996-97	1	2,503	87	809	1,773	9	1,110	0	6,292	39.8%	1.4%
1997-98	0	3,113	112	853	2,439	26	1,448	11	8,002	38.9%	1.4%
1998-99	0	5,641	127	751	3,266	40	1,513	6	11,344	49.7%	1.1%
1999-00	1	7,302	93	418	3,002	8	1,525	2	12,351	59.1%	0.8%
2000-01	0	4,972	70	385	3,259	28	1,319	2	10,035	49.5%	0.7%
2001-02	0	3,676	51	306	1,335	19	1,161	10	6,558	56.1%	0.8%
2002-03	0	5,113	42	225	1,732	18	1,293	2	8,425	60.7%	0.5%
2003-04	0	3,631	43	343	1,459	129	1,128	2	6,735	53.9%	0.6%
2004-05	0	6,789	34	552	2,018	26	1,250	3	10,672	63.6%	0.3%
2005-06	3	4,734	36	525	1,959	9	1,222	1	8,489	55.8%	0.4%
2006-07	1	5,497	24	347	1,908	25	1,253	7	9,062	60.7%	0.3%
2007-08	33	5,899	34	446	1,982	30	1,311	35	9,770	60.4%	0.3%
2008-09	35	6,221	43	467	2,414	44	1,429	18	10,671	58.3%	0.4%
2009-10	81	6,400	26	373	2,157	18	1,233	11	10,299	62.1%	0.3%

APPENDIX F (cont.)

Northwest Oregon											
Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
2010-11	58	5,807	31	485	1,676	9	1,251	16	9,333	62.2%	0.3%
2011-12	118	6,929	26	441	1,437	3	1,155	17	10,126	68.4%	0.3%
2012-13	113	6,332	15	249	1,068	3	1,236	7	9,023	70.2%	0.2%
2013-14	92	5,833	19	231	1,197	4	1,365	11	8,752	66.6%	0.2%
2014-15	98	7,191	26	196	957	1	1,305	19	9,793	73.4%	0.3%

Southwest Washington											
Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
1984-85		0	37	0	63	0	20	0	120	0.0%	30.8%
1985-86		11	66	116	113	0	67	25	398	2.8%	16.6%
1986-87		8	36	51	172	0	241	0	508	1.6%	7.1%
1987-88		7	45	225	478	4	224	35	1,018	0.7%	4.4%
1988-89		17	43	136	617	0	763	7	1,583	1.1%	2.7%
1989-90		37	52	92	455	9	391	0	1,036	3.6%	5.0%
1990-91		28	65	165	555	20	383	3	1,219	2.3%	5.3%
1991-92		39	88	295	675	14	483	15	1,609	2.4%	5.5%
1992-93		84	91	270	1,340	25	722	2	2,534	3.3%	3.6%
1993-94		93	90	299	944	8	697	4	2,135	4.4%	4.2%
1994-95		422	77	246	1,011	31	704	6	2,497	16.9%	3.1%
1995-96		334	59	144	862	12	536	1	1,948	17.1%	3.0%
1996-97		1,030	35	475	1,705	18	932	3	4,198	24.5%	0.8%
1997-98		1,311	58	392	2,197	33	742	5	4,738	27.7%	1.2%
1998-99		1,820	46	306	1,877	34	833	9	4,925	37.0%	0.9%
1999-00		1,455	27	209	1,265	155	623	33	3,767	38.6%	0.7%
2000-01		1,450	32	235	1,242	95	687	35	3,776	38.4%	0.8%
2001-02		758	23	130	644	112	496	11	2,174	34.9%	1.1%
2002-03		1,291	38	153	896	93	591	61	3,123	41.3%	1.2%
2003-04		674	28	104	483	78	413	19	1,799	37.5%	1.6%

APPENDIX F (cont.)

Southwest Washington											
Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
2004-05		1,079	25	123	597	122	461	53	2,460	43.9%	1.0%
2005-06		1,037	31	157	863	108	584	32	2,812	36.9%	1.1%
2006-07	8	1,212	27	143	628	124	450	45	2,637	46.0%	1.0%
2007-08	2	1,282	22	113	729	125	323	51	2,647	48.4%	0.8%
2008-09	4	1,723	45	158	946	198	458	41	3,573	48.2%	1.3%
2009-10	13	1,412	32	76	736	87	383	42	2,781	50.8%	1.2%
2010-11	5	1,345	20	94	547	59	322	37	2,429	55.4%	0.8%
2011-12	1	1,304	28	125	525	38	223	21	2,265	57.6%	1.2%
2012-13	16	1,293	17	102	526	38	264	1	2,257	57.3%	0.8%
2013-14	4	1,407	20	97	269	29	341	8	2,175	64.7%	0.9%
2014-15	16	1,579	45	138	445	23	292	14	2,552	61.9%	1.8%

Oregon-Washington Total

Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
1984-85	0	0	640	0	704	0	20	21	1,385	0.0%	46.2%
1985-86	0	19	223	373	1,269	2	162	25	2,073	0.9%	10.8%
1986-87	0	27	170	154	1,329	0	241	127	2,048	1.3%	8.3%
1987-88	0	61	163	460	3,002	7	482	36	4,211	1.4%	3.9%
1988-89	0	43	185	409	3,684	3	1,178	7	5,509	0.8%	3.4%
1989-90	0	53	131	438	3,018	14	2,014	2	5,670	0.9%	2.3%
1990-91	0	46	242	737	3,239	26	2,229	3	6,522	0.7%	3.7%
1991-92	0	81	209	673	2,962	23	1,574	15	5,537	1.5%	3.8%
1992-93	1	120	238	692	3,634	33	2,055	2	6,775	1.8%	3.5%
1993-94	0	165	278	1,047	3,643	49	2,045	8	7,235	2.3%	3.8%
1994-95	1	1,642	219	693	3,680	40	2,119	16	8,410	19.5%	2.6%
1995-96	1	2,092	142	606	2,747	22	1,134	3	6,747	31.0%	2.1%
1996-97	1	3,533	122	1,284	3,478	27	2,042	3	10,490	33.7%	1.2%
1997-98	0	4,424	170	1,245	4,636	59	2,190	16	12,740	34.7%	1.3%

APPENDIX F (cont.)

Oregon-Washington Total											
Season	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other ¹	Total	% Cackler	% Dusky
1998-99	0	7,461	173	1,057	5,143	74	2,346	15	16,269	45.9%	1.1%
1999-00	1	8,757	120	627	4,267	163	2,148	35	16,118	54.3%	0.7%
2000-01	0	6,422	102	620	4,501	123	2,006	37	13,811	46.5%	0.7%
2001-02	0	4,434	74	436	1,979	131	1,657	21	8,732	50.8%	0.8%
2002-03	0	6,404	80	378	2,628	111	1,884	63	11,548	55.5%	0.7%
2003-04	0	4,305	71	447	1,942	207	1,541	21	8,534	50.4%	0.8%
2004-05	0	7,868	59	675	2,615	148	1,711	56	13,132	59.9%	0.4%
2005-06	3	5,771	67	682	2,822	117	1,806	33	11,301	51.1%	0.6%
2006-07	9	6,709	51	490	2,536	149	1,703	52	11,699	57.3%	0.4%
2007-08	35	7,181	56	559	2,711	155	1,634	86	12,417	57.8%	0.5%
2008-09	39	7,944	88	625	3,360	242	1,887	59	14,244	55.8%	0.6%
2009-10	94	7,812	58	449	2,893	105	1,616	53	13,080	59.7%	0.4%
2010-11	63	7,152	51	579	2,223	68	1,573	53	11,762	60.8%	0.4%
2011-12	119	8,233	54	566	1,962	41	1,378	38	12,391	66.4%	0.4%
2012-13	129	7,625	32	351	1,594	41	1,500	8	11,280	67.6%	0.3%
2013-14	96	7,240	39	328	1,466	33	1,706	19	10,927	66.3%	0.4%
2014-15	114	8,770	71	334	1,402	24	1,597	33	12,345	71.0%	0.6%

¹Other includes domestic x Canada hybrids, resident dark Canada geese, and unidentified geese

APPENDIX G. Alaska dusky Canada goose harvest under Action Level 2 harvest strategies requiring a registration permit hunt with reporting requirements on the Copper River Delta (Alaska Game Management Units 6B and 6C) and in portions of eastern Prince William Sound (Hinchinbrook and Hawkins Island in Unit 6D) from 2009–2013

Year	2009	2010	2011	2012	2013
Number Permits Issued	121	73	87	67	78
Number Permittees Hunted	46	30	41	35	27
Number Permittees Did Not Hunt	72	43	45	32	49
Number Did Not Report Harvest	3	0	1	0	2
Total No. Canada Geese Harvested	20	18	25	22	15
Total No. Dusky Canada Geese Harvested	17 ²	11	14 ³	15 ⁴	14

¹Permit hunt restrictions were in place from 2009–2013 only

²1 goose not measured

³11 geese reported but not checked

⁴2 geese not measured

APPENDIX H. Geographic distribution (%) of band recoveries from dusky Canada geese

Year	N ¹	Alaska	British Columbia	Washington	Oregon	Other ²
1951	3	0.0	0.0	0.0	100.0	0.0
1952	35	17.1	2.9	5.7	74.3	0.0
1953	105	9.5	24.8	8.6	57.1	0.0
1954	192	10.4	7.3	18.2	63.5	0.5
1955	82	6.1	4.9	11.0	78.0	0.0
1956	81	3.7	27.2	9.9	58.0	1.2
1957	170	4.1	22.9	8.2	64.1	0.6
1958	132	5.3	13.6	12.1	68.9	0.0
1959	133	7.5	21.8	5.3	65.4	0.0
1960	142	4.9	21.1	15.5	58.5	0.0
1961	45	13.3	20.0	11.1	55.6	0.0
1962	105	13.3	11.4	12.4	62.9	0.0
1963	122	5.7	15.6	5.7	70.5	2.5
1964	60	6.7	8.3	18.3	66.7	0.0
1965	111	7.2	14.4	15.3	62.2	0.9
1966	94	7.4	7.4	3.2	81.9	0.0
1967	74	8.1	6.8	16.2	68.9	0.0
1968	97	9.3	17.5	9.3	63.9	0.0
1969	96	10.4	10.4	11.5	67.7	0.0
1970	157	10.8	7.6	8.9	72.6	0.0
1971	63	11.1	6.3	6.3	76.2	0.0
1972	102	8.8	0.0	8.8	81.4	1.0
1973	67	17.9	4.5	11.9	65.7	0.0
1974	182	13.2	5.5	14.8	66.5	0.0
1975	192	14.1	5.2	13.5	67.2	0.0
1976	230	10.9	10.9	13.5	64.3	0.4
1977	244	16.0	4.5	9.4	69.7	0.4
1978	244	24.6	2.0	13.9	57.0	2.5
1979	100	17.0	2.0	13.0	68.0	0.0
1980	104	3.8	2.9	9.6	82.7	1.0
1981	70	4.3	0.0	8.6	87.1	0.0
1982	32	25.0	0.0	12.5	59.4	3.1
1983	73	6.8	0.0	6.8	86.3	0.0
1984	62	21.0	8.1	8.1	62.9	0.0
Average ³	112	10.9	9.8	11.3	67.5	0.5

APPENDIX H (cont.)

Year	N ¹	Alaska	British Columbia	Washington	Oregon	Other ²
1985	50	10.0	14.0	32.0	40.0	4.0
1986	23	26.1	13.0	8.7	47.8	4.3
1987	24	37.5	12.5	8.3	41.7	0.0
1988	41	39.0	12.2	22.0	26.8	0.0
1989	26	57.7	3.8	0.0	38.5	0.0
1990	37	48.6	5.4	8.1	37.8	0.0
1991	21	52.4	0.0	14.3	33.3	0.0
1992	26	34.6	3.8	19.2	34.6	7.7
1993	13	7.7	0.0	23.1	69.2	0.0
1994	15	33.3	0.0	20.0	46.7	0.0
1995	5	0.0	20.0	0.0	80.0	0.0
1996	14	21.4	7.1	14.3	50.0	7.1
1997	18	27.8	0.0	22.2	50.0	0.0
1998	29	31.0	13.8	31.0	20.7	3.4
1999	36	30.6	11.1	13.9	44.4	0.0
2000	32	18.8	0.0	15.6	56.3	9.4
2001	25	16.0	12.0	8.0	64.0	0.0
2002	27	29.6	14.8	18.5	37.0	0.0
2003	32	12.5	9.4	15.6	62.5	0.0
2004	27	22.2	3.7	7.4	66.7	0.0
2005	26	11.5	3.8	3.8	80.8	0.0
2006	24	16.7	0.0	16.7	66.7	0.0
2007	15	26.7	0.0	0.0	73.3	0.0
2008	16	12.5	12.5	6.3	62.5	6.3
2009	9	0.0	0.0	22.2	77.8	0.0
2010	19	31.6	5.3	21.1	42.1	0.0
2011	11	18.2	0.0	9.1	72.7	0.0
2012	22	22.7	4.5	22.7	50.0	0.0
2013	13	7.7	7.7	7.7	61.5	15.4
2014	26	7.7	15.4	26.9	50.0	0.0
Average ⁴	23	25.6	7.5	15.8	49.1	1.9

¹Shot = 4,261 geese; found dead = 194 geese; band reported and no additional information = 48.

²California = 20 geese; 7 other states and provinces = 9 geese; Unknown location = 3 geese.

³Average prior to significant restrictive harvest regulation (1951–1984).

⁴Average after significant restrictive harvest regulations (1985–2014).

APPENDIX I. Status of tasks completed or reassessed since the 2008 Dusky Canada Goose Management Plan and not included in the 2015 revision

A. Habitat and Ecological Factors

Breeding Grounds – Action Level 1

1.3 Evaluate additional sites suitable for nest islands - **Completed**

The installation of additional artificial nest islands on the Copper River Delta was proposed in the 2008 revision of the Pacific Flyway Plan for dusky Canada geese. In 2009, the USFS conducted a GIS-based analysis to assess suitability of ponds for new nest island deployment using habitat criteria such as pond depth, pond size and vegetation composition. A total of 228 ponds were identified as potentially suitable for nest island installation.

1.4 Increase the number of artificial nest islands by 200 within ponds that meet island criteria - **Completed**

The 2008 revision of the Pacific Flyway Management Plan for the dusky Canada goose called for an increase of up to 200 islands within ponds that met nest island criteria on the Copper River Delta; in addition to the 331 nest islands currently in the artificial nest island program. In 2009, Ducks Unlimited assisted the USFS with a new nest island design that would reduce future maintenance needs. In 2012, 13 older islands were assessed and islands considered degraded were replaced. As of July 2014, a total of 169 new nest islands have been installed in 72 ponds (including 74 replacement islands and 95 new islands; the total number of artificial nest islands currently in the program is 386).

1.5 Evaluate concepts to enhance nesting habitat on barrier islands of Copper River Delta - **Completed**

A survey of Egg Island in 2013 indicated that dusky Canada geese had re-established nesting on the island, despite no effort to enhance nesting habitat. Dusky Canada goose broods continue to use a few of the barrier islands, including Egg Island, for brood rearing. The USFS is planning to complete an evaluation of concepts to enhance nesting habitat, including proposed water control structures for two ponds on Egg Island, by 2016. Thus, this task can be re-inserted in the future if deemed necessary.

1.8 Establish the Copper River Delta as an eagle donor site for restoration programs; implement capture and relocation - **Completed**

The Copper River Delta as an eagle donor site was evaluated by the USFWS and determined to be infeasible. Restoration programs in the lower 48 states of the U.S. do not have a need for donor eagles.

1.9 Develop an options paper for a comprehensive predator management program based on best available information, including a program of evaluation and testing of specific strategies - **Completed**

A comprehensive predator management program was developed by ADFG. Details of the proposed program can be found in an ADFG published report:

Crowley, D.W. 2011. Management of mammalian predators of dusky Canada geese on the Copper River Delta, Alaska. Wildlife Management Report, ADF&G/DWC/WMR-2001-1. Alaska Department of Fish and Game, Division of Wildlife Conservation. Cordova, Alaska.

- 1.10 Test and evaluate deterrence and redistribution of coyotes and other mammalian predators on defendable areas to increase dusky Canada goose production, based on patterns of nest/gosling predation and area evaluations. Includes experimental feeding at lure sites - **Completed**

Dave Crowley (2011) tested the feasibility of diversionary feeding of mammalian predators during a period prior to the arrival of eulachon to reduce nest predation. The objectives were to evaluate the logistics and efficacy of deploying bait blocks as a diversion from dusky Canada goose nests. Two 130 kg bait blocks of thawing fish carcasses were anchored along the lower Alaganik Slough area of the Copper River Delta. Bait blocks were visually monitored during the day and bait was checked daily for animal tracks to determine if bait was visited at night.

- 1.11 Test and evaluate the use of avian predator deterrence and redistribution, based on predation patterns and area evaluations. Includes experimental feeding at lure sites – **Completed**

USGS Alaska Science Center conducted a preliminary study to test conditioned taste aversion (CTA) as a method of reducing bald eagle predation of dusky Canada goose nests on their primary breeding area, the Copper River Delta in 2009. CTA is the process of training an animal (i.e. predator) to avoid certain food items as a result of becoming ill. As a first step in testing CTA, USGS assessed whether eagles would exploit goose eggs in artificial nests to evaluate the potential for delivery of emetics to eagles via artificial nests.

The methods and results of the study can be found in a USGS published report:

Fondell, T.F. and J. Hupp. 2009. Conditioned taste aversion to reduce bald eagle predation of Dusky Canada goose nests on the Copper River Delta, Alaska. U.S. Geological Survey Final Report. Anchorage, AK.

Crowley (2011) tested the feasibility of diversionary feeding of avian predators (in concert with diversionary feeding of mammalian predators) during a period prior to the arrival of eulachon to reduce nest predation. The objectives were to evaluate the logistics and efficacy of deploying bait blocks as a diversion from dusky Canada goose nests.

Breeding Grounds - Action Level 2

- 2.3 Develop brown bear guided hunt areas on the Copper River Delta to increase bear harvest. Most of the western Copper River Delta is closed to guides under “home rule” provisions of

the Chugach NF plan, but some other areas can be opened without amending the plan -
Completed

The Chugach National Forest is currently in the process of a Forest Plan revision and this task is being considered in the revision process. However, even if guided hunt areas can be established, the harvest opportunity for brown bears will be limited, and therefore, likely will not be meaningfully beneficial to dusky Canada geese.

- 2.4 Implement deterrence, redistribution, and further liberalized hunting and trapping of coyotes and other mammalian predators on defendable areas to increase goose production. Requires action by the Alaska Board of Game - **Removed**

This task was deemed infeasible following the evaluation by Crowley (2011), and therefore, removed from the Management Plan.

The diversionary feeding of predators prior to the arrival of eulachon was deemed infeasible because of the unpredictable timing of eulachon runs and the required geographic scale of implementing such a project.

Harvest regulations for brown bear and wolves have been liberalized to the extent that human harvest is limiting their populations. With the exception of carefully directed and guided brown bear hunts, ADFG will not support further liberalizations of regulations.

Coyotes can be harvested year-round with no bag limit on the Copper River Delta. Further liberalization of trapping regulations is not feasible because of the potential for incidental take of other species. Coyotes are not a significant predator of dusky Canada goose nests or goslings, and therefore, a large-scale predator control effort would not be supported and would be difficult and costly to implement. However, Crowley (2011) suggested that monitoring and maintaining Egg Island as a coyote-free zone may benefit dusky Canada geese.

Further extension of the mink trapping season is not feasible because pelts singe, and therefore, are of little value.

- 2.5 Implement avian predator deterrence and redistribution, based on previous research and experimental tests in Level 1 - **Removed**

USGS concluded that conditioned taste aversion (CTA) is likely not a practical method of reducing bald eagle predation of dusky Canada goose nests on the Copper River Delta. Eagles did not sufficiently exploit artificial nests such that emetics could be delivered via that approach, and ravens predated artificial nests so swiftly that eagles have little opportunity to locate them. Although it may be possible to place eggs treated with emetics in dusky Canada goose nests, we suggest that is likely also impractical. Locating nests for placement of treated eggs would require considerable effort. Also, an important component of CTA is that predators be exposed to the emetic before the preferred food source becomes available.

A detailed assessment can be found at:

Fondell, T.F. and J. Hupp. 2009. Conditioned taste aversion to reduce bald eagle predation of dusky Canada goose nests on the Copper River Delta, Alaska. U.S. Geological Survey Final Report. Anchorage, AK.

2.7 Develop an assessment of the feasibility and costs of captive-rearing dusky Canada geese on the Copper River Delta - **Completed**

In 2010, the USFWS evaluated the costs and feasibility of captive-rearing goslings on the Copper River Delta. A detailed list of the logistics and associated costs can be provided by Region 7 MBM, USFWS. A brief summary of the logistical cost projections is listed below:

Egg Collection – transportation, salary, food, and field camp supplies: Subtotal=\$12,731
Egg Incubation and Confinement – technician costs, incubation costs, technician transportation, fuel, confinement pens and shelters, goose feed, material transport: Subtotal=\$195,532.39
Miscellaneous – fuel, electronics, permanent field camp supplies, wading pools, astro-turf, egg collecting field supplies, etc: Subtotal=\$25,000

Grand total=\$233,263.39

Breeding Grounds - Action Level 3

3.2 Implement a program of captive brood-rearing to enhance survival of goslings to fledging - **Removed**

This task was removed from the Management Plan because the cost projections of a captive brood-rearing program provided by the USFWS indicated that the program was logistically difficult to implement and cost prohibitive.

B. Harvest Management

2.2 In Washington and Oregon, all Canada goose hunting in the Northwest Oregon/Southwest Washington Quota Zones would be targeted to optimize depredation control - **Completed**

This task was removed from the plan because this portion of harvest management is in place throughout western Oregon and Washington with respect to areas open to hunting (primarily private lands) and to timing of harvest which maximizes temporal goose seasons. Thus, to some degree this action can be considered complete.

C. Crop Depredation Control

No completed tasks or deletions

D. Inventories

Breeding Grounds

6. Conduct a winter survey of Canada geese in Prince William Sound - **Removed**

The number of Canada geese that winter in Prince William Sound represents a small fraction of the total PWS nesting population.

8. Conduct spring and fall distribution surveys of Canada geese on the Copper River Delta to identify staging areas and assess harvest vulnerability of dark goose aggregations - **Removed**

Ongoing satellite telemetry studies will address these issues in the future.

Wintering Grounds

1. Conduct the annual midwinter waterfowl inventory - **Removed**

Using the midwinter waterfowl survey (MWS) to estimate relative abundance of dusky Canada geese provides several challenges to management. First, the midwinter survey is unlikely to provide complete coverage of dusky Canada geese wintering habitats due to the geographic scope of survey areas, incomplete detectability of birds, and limits to survey time and effort due to vagaries of weather during the survey period. Additionally, dusky Canada geese often mix with other subspecies of geese making differentiation difficult for aerial observers. Given the challenges and inefficiencies of using the MWS to estimate dusky Canada goose abundance, the subcommittee recommended removing this from the list of tasks.

E. Research

5. Examine methods of improving production surveys on the Copper River Delta to better reflect observed annual variation in nest success and gosling survival (e.g., replicate surveys, detection of markers in relation to visibility in the range of habitat types) - **Completed**

Replicate surveys were conducted in 2010 with little variation in results. The survey design and methodology was deemed sufficient for generating an index to annual productivity representing a minimum count.

6. Investigate the ecology and productivity of Canada geese breeding in Prince William Sound (PWS) including Green, Hinchinbrook, and Montague Islands - **Removed**

Canada geese nest in low densities throughout PWS. Nesting and productivity studies would be logistically difficult to conduct, extremely expensive, and would most likely result in small samples and equivocal conclusions.

7. As an alternative to other methods, estimate recruitment on the Copper River Delta and elsewhere using DNA isolated from eggshell membranes - **Removed**

This task was removed from the plan because we have no method to estimate emigration from natal areas (i.e. area from which the goose hatched); thus, using DNA isolated from eggshells was deemed impractical.

8. Evaluate factors involved in the loss of goose nesting on Egg Island - **Removed**

A limited search conducted during May 2013 revealed that Canada geese were again nesting on Egg Island. The number of nesting geese on the island is not known, but the large numbers of goslings observed there during the brood rearing period for the last 8 years (Petrula and Smith 2014) suggests that nest densities could be high.

Petrula, M. P. and K. R. Smith. 2014. Dusky Canada goose production survey and banding efforts 2014. Unpubl. rep. 8pp. Alaska Department of Fish and Game, Division of Wildlife Conservation, Waterfowl Program. Anchorage, Alaska.

14. Re-examine the genetic composition of hunter-killed Canada geese submitted at check stations and classified as dusky Canada geese (after Pearce et al. 2000) to identify source populations - **Completed**

In 2007 genetic samples were collected from hunter shot geese at Oregon check stations, and samples from Tillamook County were analyzed by the USGS to examine the genetic characteristics of these geese with an emphasis on Aleutian geese. Because of the small sample size involved (10 birds classified as dusky Canada geese in the sample of 123 large type Canada geese) and the fact that the samples contained many previously unknown Canada goose haplotypes, no statement about the accuracy of check station's classification of dusky Canada geese can reliably be made.

Additionally, 604 genetic samples from all areas except Tillamook County were analyzed by Wildlife Genetics International in Nelson, BC. Unfortunately, these samples were not analyzed in such a way as to determine accuracy of classification at check stations. Results did suggest the samples, minus presumed hybrid individuals, originated from five populations of Canada geese.

Further genetic evaluation of hunter shot dusky and dusky-like geese is unlikely to inform dusky Canada goose management. Previous work suggests check stations correctly classify most dusky geese, though some non-dusky geese are inadvertently also classified as dusky Canada geese. Additionally, the work conducted with the Tillamook harvest samples suggested breeding ground reference material for Pacific Flyway Canada geese is insufficient to allow identification of source populations of harvested geese.

15. Compare habitat requirements among subspecies of geese wintering in the Willamette Valley and Lower Columbia River region to evaluate how management options designed to reduce crop depredation will impact individual subspecies - **Completed**

Anne Mini (2012) indicated that Cackling (Cacklers) and dusky Canada geese used the landscape quite differently. Cacklers, exhibited less site fidelity and greater commuting distances to foraging areas than dusky Canada geese. Cacklers showed a clear preference for young grass during all periods of the winter (Mini 2010), whereas dusky Canada geese preferred young grass and pasture. Management actions designed to reduce crop depredations could theoretically focus on fields exploited primarily by cacklers and reduce impacts to dusky Canada geese that do not specialize grazing preferences solely on short green forage. Additionally, Cacklers were less faithful to roost sites, used more fields, and commuted nearly twice as far (5.2 ± 0.3 km vs. 3.0 ± 0.4 km) to foraging sites as dusky Canada geese (Mini 2012). Management actions that account for movement patterns and habitat preferences of over-wintering geese have the potential to reduce crop depredation while minimizing impacts to dusky Canada geese.

16. Develop methods to determine the amount and type of winter habitat needed to support the dusky population and the growing aggregation of other Canada geese - **Completed**

Anne Mini (2012) estimated carrying capacity of federal lands for dusky Canada geese and Cacklers using a daily ration approach during three winter periods (early, mid-, and late winter). Data collected included forage supply (available habitat acreages and available forage biomass per habitat) and daily food requirement (based on predictions of allometric equations and target population size per goose species). The estimated carrying capacity for geese declined by almost one-half during mid-winter (mid-December to mid-February) compared to early or late winter periods. During mid-winter, the fewest geese (16,164 Cacklers; 11,066 dusky Canada geese) could be supported on currently-available public lands; during late winter, the greatest number of geese could be supported (34,509 Cacklers; 27,654 dusky Canada geese). Although Cacklers had lower individual energy requirements compared to dusky Canada geese, Cacklers required 89% more foraging habitat than dusky Canada geese because of a much larger population size (Mini 2012). Given current Pacific Flyway population goals for geese, approximately 18,000 ha of total grazing habitat in young and mature grass is needed in the Willamette Valley to support a total over-wintering population composed of 340,000 geese belonging to four subspecies (Mini 2012); suggesting additional public lands (14,691 ha) are required. Although the forage to support all these geese on public lands in the Willamette Valley is far from attainable, total availability of food energy in the Willamette Valley (on public and private lands) is not limiting.

17. Compare nutritional quality among major forage types used by geese in SW Washington and NW Oregon and assess energetic carrying capacity of public lands - **Completed**

Available foraging habitat types for geese in the Willamette Valley differ in the timing of seeding and their growth structure. Forage requirements encountered a bottleneck during

mid-winter, when grass re-growth rates were low and day length was short. Commensurate with this pattern, goose body condition declined during the mid-winter period (Mini 2012). The primary foraging habitats that geese use are annual ryegrass (*Lolium multiflorum*), perennial ryegrass (*L. perenne*), and perennial tall fescue (*Festuca arundinacea*). Mini (2012) measured standing stock biomass (SSB) and re-growth rates of young and mature grass during winter in 2005–2006 and 2008–2009. SSB was greater in mature grass fields than young grass fields and was highest in the late winter period, but similar between early and mid-winter periods. Mature and young grass fields were similar in overall re-growth rates with similar patterns (declining from early winter to mid-winter and increasing in late winter) across winter periods. Accounting for re-growth increased total forage biomass in early and late winter periods and habitat composition influences energetic carrying capacity in the WV. For example, converting farmed areas at Finley NWR entirely as young grass would result in a reduced carrying capacity by an average of 51% for Cacklers and 49% for dusky Canada geese. The greatest reduction in carrying capacity occurs during mid-winter when only 9,976 Cacklers (62% reduction) or 6,402 dusky Canada geese (58% reduction) could be supported. Availability of resources during critical periods in winter may affect small and large bodied geese differently (Mini 2012).

Literature Cited in tasks 15, 16, and 17 above:

Mini, A. E. 2012. The Role of Body Size in the Foraging Strategies and Management of Avian Herbivores: A Comparison of Dusky Canada Geese (*Branta canadensis occidentalis*) and Cackling Geese (*B. hutchinsii minima*) Wintering in the Willamette Valley of Oregon. Dissertation, Oregon State University, Corvallis. 92pp.