Pacific Flyway Plan

A Framework for the Management of Double-crested Cormorant Depredation on Fish Resources in the Pacific Flyway

Photo by Bird Research Northwest (BRNW)

This plan is one of a series of cooperatively developed plans for managing various species of migratory birds of 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, 911 N.E. 11 Ave, Portland, Oregon 97232. Information regarding the Pacific Flyway Council and management plans can be found on the Internet at PacificFlyway.gov.

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PACIFIC FLYWAY PLAN

A FRAMEWORK FOR THE MANAGEMENT OF DOUBLE-CRESTED CORMORANT DEPREDATION ON FISH RESOURCES IN THE PACIFIC FLYWAY

Prepared for the

Pacific Flyway Council

by the

Double-crested Cormorant Subcommittee

and the

Pacific Flyway Nongame Migratory Bird Technical Committee

July 2012

Approved by: Dale Rabe
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7/31/12
Date

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This plan was prepared by the Pacific Flyway Nongame Migratory Bird Technical Committee, Double-crested Cormorant Subcommittee. This is the first Pacific Flyway plan prepared for Double-crested Cormorants. Josh Dooley served as primary author and coordinated with the Subcommittee to prepare drafts and compile plan reviews. Much appreciation and thanks go to the contributors of this plan:

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EXECUTIVE SUMMARY

The Double-crested Cormorant (*Phalacrocorax auritus*; DCCO) is the most abundant of the six cormorant species in North America and has the broadest distribution, ranging across the entire continent. DCCOs were reduced in numbers and range during the 19th and early 20th centuries due to human encroachment and persecution, and widespread use of chlorinated hydrocarbons (e.g., DDT and its metabolites). Since the 1960s, DCCO numbers have increased with better environmental regulations and protection under the Migratory Bird Treaty Act.

This plan pertains to all DCCOs within the Pacific Flyway, which includes the Alaska Population, Western Population, Mexico/Southern California Population, and portion of Montana east of the continental divide. Colony sizes and distribution of DCCOs fluctuate considerably across the Pacific Flyway. Population growth within the Pacific Flyway is largely attributed to the population increase of the East Sand Island colony in the Columbia River estuary, now the largest DCCO colony in the world. However, declines of DCCO colonies have been documented over much of southern Alaska, British Columbia, Washington, and southern California. Overall DCCO abundance in the Pacific Flyway is much smaller than it was historically.

DCCO depredation at localized areas within the Pacific Flyway is creating conflicts with federal Endangered Species Act (ESA)-listed and special status fish and supplemental fisheries. This plan was developed to address these localized conflicts while managing DCCO numbers and distributions at the Flyway scale. The goal of this plan is to maintain DCCOs as a natural part of the waterbird biodiversity of the Pacific Flyway, while minimizing substantial negative ecological, economic, and social impacts of DCCOs. This plan provides a synopsis of DCCO biology, status, resources conflicts, management options, regulatory requirements, and recommended management strategies. Three objectives were developed to achieve the overarching goal: a Population Assessment Objective, an Impact Reduction Objective, and a Flyway Coordination Objective.

The purpose of this plan is to provide agencies with information and guidance to facilitate management of DCCOs in the Pacific Flyway. This plan provides a framework for states and other entities to follow when addressing fish depredation issues involving DCCO and is not intended to dictate specific management actions or policies. Management of DCCOs will be best achieved through coordinated, collaborative, and broad-scale management efforts, as outlined in this plan. This plan is a working document and should be reviewed regularly (every 5 years) and revised as needed to incorporate new information and concerns.

INTRODUCTION

Scope

The Pacific Flyway encompasses lands and waters of Alaska, Canada, the contiguous U.S., and Mexico east of the Pacific Ocean and west of the continental divide, primarily. In Montana, the counties of Hill, Chouteau, Cascade, Meagher, and Park form the eastern edge of the Pacific Flyway. In New Mexico, the continental divide forms the boundary except at the Jicarilla Apache Indian Reservation. The Pacific Flyway includes four Double-crested Cormorant (*Phalacrocorax auritus*; herein DCCO) management units (Populations): 1) Alaska Population (*P. a. cincinnatus*), 2) the Western Population (*P. a. albociliatus*), 3) Mexico/Southern California Population (*P. a. albociliatus*), and 4) the portion of Montana within the Pacific Flyway east of the continental divide (subspecies designation is currently unknown). This plan encompasses all DCCOs breeding and wintering in the Pacific Flyway.

Purpose

The purpose of this plan is to provide agencies with information and guidance to facilitate management of DCCOs in the Pacific Flyway. The plan provides a framework for states to follow when addressing fish depredation issues involving DCCOs and is not intended to dictate management policies. Strategies are provided to aid in developing and coordinating research, monitoring, and management of DCCOs across the Pacific Flyway.

Goal

The goal of this plan is to maintain DCCOs as a natural part of the waterbird biodiversity of the Pacific Flyway, while minimizing substantial negative ecological, economic, and social impacts of DCCOs.

Guiding Principles

In 2010, the Pacific Flyway Council (Council) approved an Avian Predation Policy (see Appendix D) to guide Pacific Flyway responses to issues related to migratory bird depredation on fish resources. The Council also approved the development of a comprehensive DCCO plan to be written under the guidance of the Policy and the Guiding Principles incorporated therein:

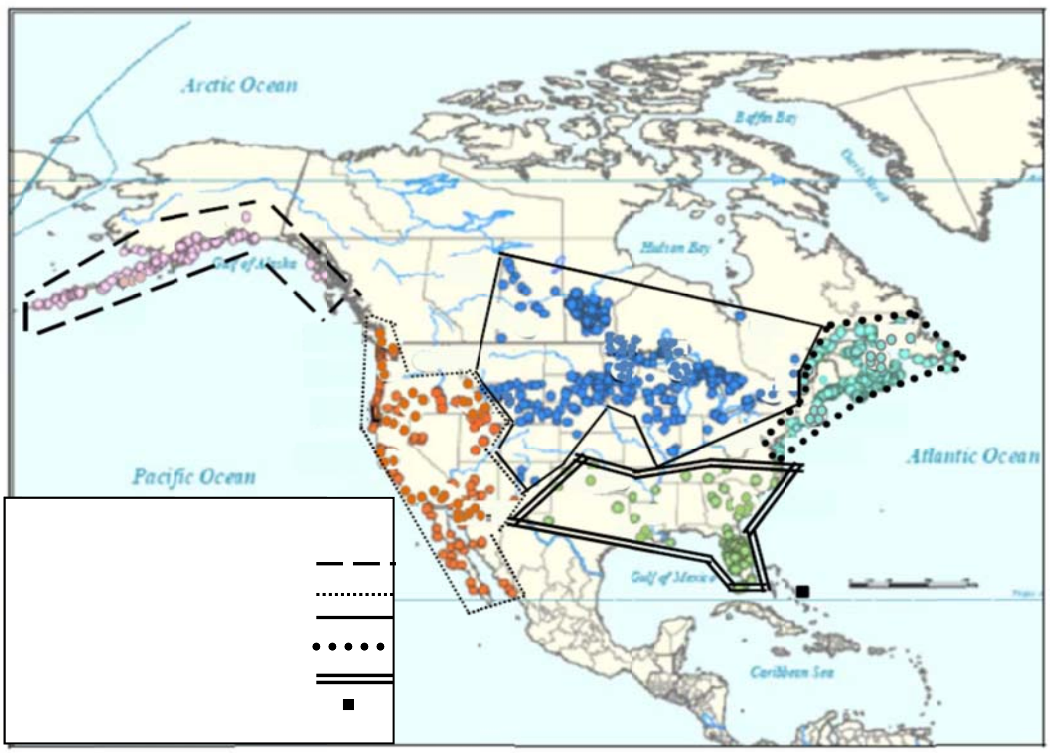
1) Vision and values are clearly and objectively defined.
2) Avian depredation issues are best addressed within the context of population and distribution objectives established for the Flyway.
3) Dialogue among states, provinces, federal, and Tribal partners is critical.
4) Responses to perceived avian depredation issues are based on sound science.
5) When evaluating the need for management action in response to avian depredation on fish resources, consideration is given to: assessment of population-level impacts for both migratory birds and fish, threatened and endangered species conflicts, native species conflicts, non-native sportfish impacts, and cost-benefit analyses for proposed management strategies.
6) Methods for reducing avian depredation on fish resources are always implemented within existing regulatory frameworks.

STATUS AND THREATS

Taxonomy and Distribution

Continental.—The DCCO is the most abundant of the six cormorant species in North America and has the broadest distribution, ranging across the entire continent (Hatch and Weseloh 1999). Five DCCO subspecies are recognized in North America: 1) *P. a. auritus* (central and northeastern North America), 2) *P. a. cincinnatus* (Alaska), 3) *P. a. albociliatus* (Pacific), 4) *P. a. floridanus* (Southeast), and 5) *P. a. heuretus* (Bahamas; Wires et al. 2001). There are two recognized breeding populations of *P.a. auritus* (i.e., Interior and Atlantic; USFWS 2003, Atlantic and Mississippi Flyway Council 2010; Fig. 1). Within the Pacific Flyway, there are two DCCO subspecies: *P. a. cincinnatus*, (Alaska, Yukon, and northern British Columbia) and *P. a. albociliatus* (southern British Columbia to Mexico and west of the continental divide; Fig. 1). Separate management of *P. a. albociliatus*, *P. a. cincinnatus*, and interior U.S. DCCO populations has been generally supported (Carter et al. 1995, USFWS 2003, Anderson et al. 2004a, Mercer 2008, Adkins and Roby 2010). This is based on geographic and demographic separation, satellite-tracking results (Adkins and Roby 2010), leg band recoveries (Dolbeer 1991, Clark et al. 2006), and population status (see Historical Trends and Population Status).

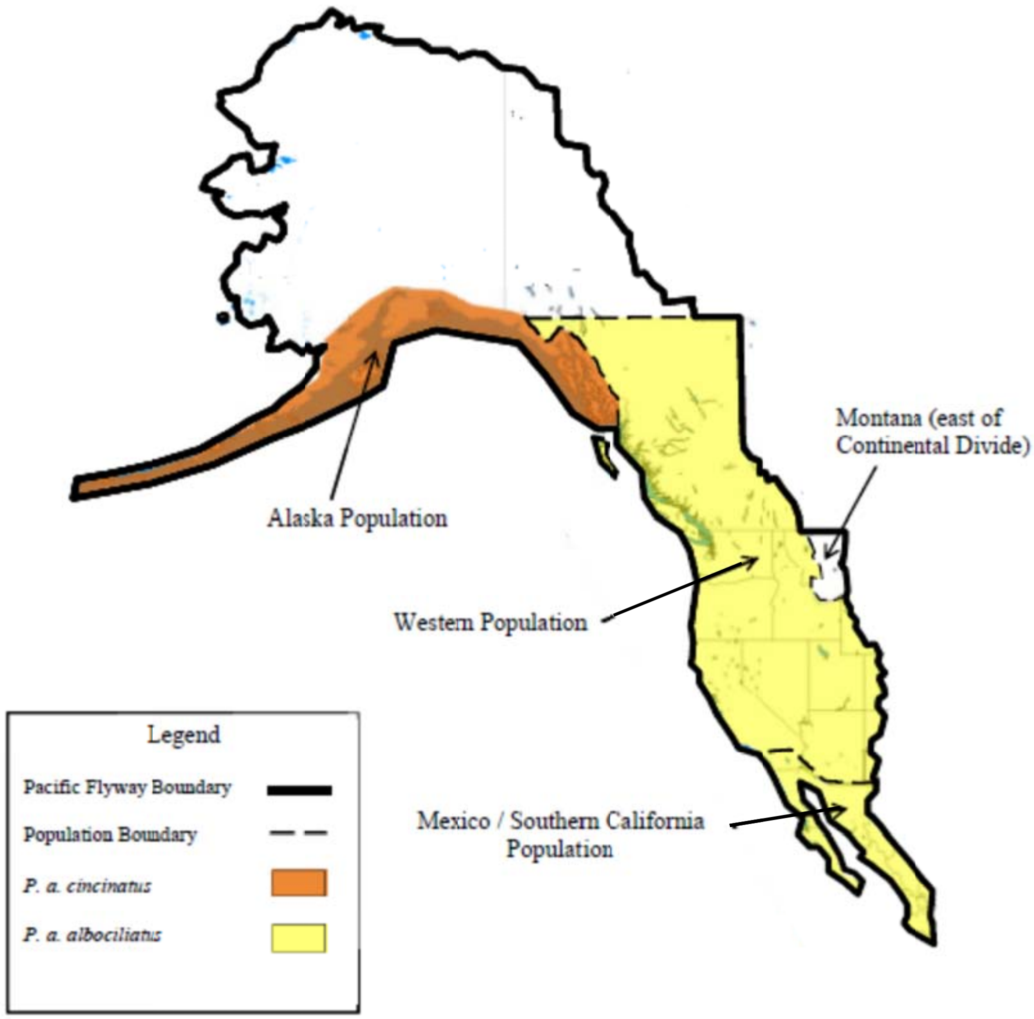
Figure 1. Breeding range of the five DCCO subspecies in North America (appended from Mercer 2008).



Pacific Flyway.—There are four management units (Populations) within the Pacific Flyway: 1) the Alaska Population (*P. a. cincinnatus)*, 2) the Western Population (*P. a. albociliatus*), 3) the Mexico/Southern California Population (*P. a. albociliatus*), and 4) the portion of Montana within the Pacific Flyway east of the continental divide (subspecies determination is currently unknown; Fig. 2). The Alaska Population includes DCCOs in Alaska, Yukon, and northern British

Columbia. The Western Population includes DCCOs from southern British Columbia to the U.S.-Mexico border, and from the Continental Divide west to the Pacific coast (Adkins and Roby 2010). Further research is required to more accurately delineate the geographic ranges and genetic subspeciation of the Mexico/Southern California Population and the portion of Montana within the Pacific Flyway east of the continental divide (Hatch and Weseloh 1999, Wires et al. 2001, Wires and Cuthbert 2006, Mercer 2008).

Figure 2. DCCO management units and subspecies within the Pacific Flyway.



Biology and Ecology

Description and life history.—DCCOs are a large, black/dark-brown, colonial-nesting, mainly fish-eating bird often found in close proximity to marine or freshwater foraging sites. Typical adult body length is 70–90 cm and body mass is 1.2–2.5 kg (Hatch and Weseloh 1999). Distinguishing plumage includes an orange-yellow skin patch on the face and throat and two rows of long feathers on the crown (i.e., the double-crest), although the latter varies among geographic regions (Palmer 1962). In British Columbia, Van der Veen (1973) found mean adult life expectancy to be 6.1 years, and the oldest recorded banded DCCO was 17 years and 9 months. Van der Veen (1973) estimated first-year survival rate of 48%, second-year survival of 74%, and subsequent annual survival of 85%.

Habitat.—During the breeding season, DCCOs use a variety of habitat types, including ponds, lakes, slow-moving rivers, lagoons, estuaries, small rock and sand islands, and open coastline. DCCOs nest on man-made structures and the ground and within trees and emergent vegetation (Hatch and Weseloh 1999, Wires et al. 2001, USFWS 2003). DCCOs require suitable nest sites free from predators and disturbance. Nesting sites are typically located proximate (i.e., <10–25 km) to foraging areas with abundant prey. Winter habitat is similar to breeding habitat. Roosting and loafing sites include exposed rocks, sandbars, shoals, coastal cliffs, offshore rocks, channel markers, pilings, wrecks, high-tension wires, utility poles, fishing piers, and trees close to foraging areas (Wires et al. 2001).

Breeding.—The timing of egg-laying within the Pacific Flyway varies by latitude, with northern DCCOs laying eggs later in the year compared to southern DCCOs (Table 1). Egg-laying begins typically two to four weeks after arrival at breeding sites (Hatch and Weseloh 1999). Mean age at first breeding is 2.74 years, with the majority of females breeding within their third year (van der Veen 1973). Continentally, Hatch and Weseloh (1999) found mean clutch size to be 2.7–4.1 eggs and fledging success to be 1.2–2.4 young/nest. Young chicks are highly altricial and require adults for sustenance, heat, shade, and protection from predators. DCCOs commonly renest if clutches fail early in the year, but only raise one brood per breeding season. See Appendix A for a list of DCCO breeding colonies by state/province.

Table 1. Timing of DCCO egg-laying at locations within the Pacific Flyway.

Time Period	Location	Reference
Late April to early May	British Columbia	Campbell et al. 1990
mid-April to early May	East Sand Island, OR	BRNW 2009
Late March to late June	South Farallon Islands and San Francisco Bay, CA	Stenzel et al. 1995
February to early March	Arizona	Corman 2005
December to January	Salton Sea, CA	Adkins and Roby 2010

Community dynamics.—DCCOs are typically communal nesters, but the number of breeding pairs at specific locations varies considerably (1 to >10,000; Wires et al. 2001, USFWS 2003, Adkins and Roby 2010). Historical accounts from Isla San Martin in Baja California during the early 20th century describe colonies exceeding 200,000–350,000 pairs, although the exact number has been contested (Wright 1913, Carter et al. 1995, Hatch 1995, Wires and Cuthbert 2006). The largest current DCCO breeding colony in North America resides on East Sand Island in the Columbia River estuary with 13,596 breeding pairs in 2010 (BRNW Real Time Research Inc., 2011). During the breeding season, nesting colonies act as the main center of activity. However, other roost areas away from colonies develop throughout the breeding season, particularly later in the year (Hatch and Weseloh 1999, USFWS 2003). It is suspected that these other roost areas consist of non-breeders and/or failed nesters (USFWS 2003). During the winter, DCCOs congregate in large numbers at nocturnal roosts, diurnal loafing sites, and feeding areas. Nesting colonies, foraging areas, winter roost sites, and DCCO abundances fluctuate spatially and temporally dependent upon disturbance levels and habitat conditions. Habitat conditions and breeding success may vary in response to inter-annual climatic conditions such as flood and drought events and large-scale climatic cycles, such as El Niño Southern Oscillation or Pacific Decadal Oscillation (Wilson 1991, Carter et al. 1995).

Movement, migration and wintering.—Migration patterns of DCCOs in the Pacific Flyway are less understood than other portions of the U.S. (Ainley and Boekelheide 1990, Campbell et al. 1990, Gilligan et al. 1994, Hatch and Weseloh 1999). DCCOs in the Pacific Flyway are thought to be less migratory compared to DCCOs within other regions (Johnsgard 1993, Hatch 1995). The Alaska Population appears to migrate little outside of Alaska and northern Canada (Wires et al. 2001). DCCOs breeding in the mountain states are thought to migrate to the West Coast, but this has not been concretely documented (Mercer 2008). Within the Western Population, satellite-tracking of DCCOs marked at East Sand Island in the Columbia River estuary and other banding data from Oregon show very little movement east of the Cascade-Sierra Nevada ranges, but show prominent north-south movement extending from the Strait of Georgia in British Columbia to the mouth of the Colorado River in Baja California Norte, Mexico (Clark et al. 2006, Adkins and Roby 2010). The predominant overwintering areas for DCCOs marked on East Sand Island were the Salish Sea region on the northern Washington coast and west of the Cascade Mountains in Oregon and Washington along the Columbia and Willamette rivers (Adkins and Roby 2010).

Feeding.—DCCOs are opportunistic, diurnal feeders. Their diet includes a wide variety of prey, including >250 species of fish from >60 families (Hatch and Weseloh 1999). Prey are predominantly small, slow-moving, or schooling fish ranging 3–40 cm, most commonly <15 cm (Hatch and Weseloh 1999). Insects, crustaceans, and amphibians are sometimes eaten (Palmer 1962). Important prey species include littoral, littoral-benthic, or estuarine fish such as shiner perch (*Cymatogaster aggregate*), sculpin (*Cottidae* spp.), gunnel (*Pholidae* spp.) and salmonids (*Oncorhynchus* spp.) along the Pacific Coast, sand lance (*Ammodytidae* spp.) in British Columbia, and clupeids (*Opisthonem* spp.) in Sonora, Mexico (Wires et al. 2001, BRNW, Real Time Research, 2011). Adult DCCOs require approximately 320 g (range 208–537 g) of fish/day, or 20–25% of their body mass/day (Hatch and Weseloh 1999). DCCOs typically feed in shallow (<8 m), near shore (<5 km) coastal areas, estuaries, and freshwater sources (Hatch and Weseloh 1999). Colonies and nighttime roosts are most often found near (i.e., <10–25 km) feeding areas, but DCCOs have been recorded foraging ≤62 km from colonies (Hatch and Weseloh 1999, Anderson et al. 2004b, Lyons et al. 2007).

Threats and Limiting Factors

Maintaining high quality, protected nesting sites and a network of wetland habitats with secure water sources is essential for sustaining viable waterbird populations (Ivey and Herziger 2006). Tremendous loss and degradation of wetlands and coastal habitats have occurred throughout North America and the Pacific Flyway (Dahl 1990, Kushlan et al. 2002, Shuford 2010), and the continued, competing demands for water and land in support of agriculture, development, and recreation are the greatest threat to regional waterbird populations (Ivey and Herziger 2006, Shuford 2010). Outlined below are specific threats and limiting factors for DCCOs.

Hatch and Weseloh (1999) found that the age of first breeding, occurrence of non-breeding, and clutch abandonment were density dependent parameters most sensitive to colony density. Abundance and availability of prey species and accessibility to high quality breeding and roosting sites determine large-scale population abundances. Predation and continued disturbance at breeding sites are the major mortality factors for DCCO eggs and hatchlings. Gulls (*Larus* spp.), crows (*Corvus* spp.), Common Ravens (*Corvus corax*), and Bald Eagles (*Haliaeetus leucocephalus*) are regularly occurring avian predators in many nesting areas (USFWS 2003). Some colony failures in Washington and British Columbia have been associated with avian predation and disturbance by Bald Eagles, Glaucous-winged Gulls (*Larus glaucescens*), and Northwestern Crows (*Corvus caurinus*; Carter et al. 1995, Moul 2000, SCCP 2010).

Pesticides and contaminants, particularly dichlorodiphenyltrichloroethane (DDT) and its metabolites, contributed substantially to the decrease in DCCO numbers during the mid-20th century (see Historical Trends and Population Status). Contaminants continue to pose threats to DCCOs and other waterbirds (Kushlan et al. 2002, Ivey and Herziger 2006). Direct killing by humans and human disturbance at nesting sites were cited as common threats (Hatch and Weseloh 1999). Water conditions, such as drought and flooding, particularly within interior states of the Pacific Flyway, affect DCCO numbers and distribution by changing habitat conditions and the abundance and availability of prey species (Ivey and Herziger 2006, Shuford 2010). Entanglement with fishing gear is another cause of mortality, but this has not been well quantified.

Disease transmission.—Newcastle disease is the most prevalent disease of DCCOs, and transmission among individuals at colonies can be widespread. Glaser et al. (1999) documented die-offs >20,000 individuals in the Great Lakes and Interior U.S. regions. Transmission of Newcastle disease from DCCOs to poultry has been shown, and transmission to other bird species is likely but has not been formally documented (Heckert et al. 1996, Kuiken 1999). Newcastle disease was first documented in the Atlantic Population in the 1970s, the Interior Population in the 1990s, and the first cases of Newcastle disease infection west of the continental divide occurred in 1997 at the Salton Sea, Columbia River estuary, and Great Salt Lake (Kuiken 1999). Since 2003, the disease has been commonly found in DCCO fledglings from East Sand Island, but no large-scale outbreaks of the disease have occurred there or elsewhere in the Pacific Flyway (Adkins and Roby 2010). Instances of other diseases in DCCOs have been documented to a lesser extent, such as avian cholera in Saskatchewan (Wildlife Health Centre Newsletter 2005), West Nile virus in Florida (Allison et al. 2005), and botulism at the Salton Sea in California (Shuford 2010)

Historical Trends and Population Status

Continental.—DCCOs were observed in New England during the 17th century, and in the Pacific Flyway at the mouth of the Columbia River by Lewis and Clark in 1805 (Wires et al. 2001). While precise counts are not available for most colonies prior to the 20th century, records suggest historic populations were much larger than they are presently (Wiers and Cuthbert 2006). For example, in the early 20th century the DCCO colony at Isla San Martin, Baja California was estimated at 200,000–350,000 breeding pairs, nearly as large as the current continental population (Wright 1913, Hatch 1995, Carter et al. 1995, Wires and Cuthbert 2006). Substantial reduction in numbers and range occurred in the 19th and early 20th centuries due to large-scale human encroachment and persecution (Hatch and Weseloh 1999). More serious declines occurred in the 1950s and 1960s as a result of continued environmental degradation and the widespread use of chlorinated hydrocarbons (e.g., DDT and its metabolites). Since the 1960s and 1970s, numbers have increased significantly with better environmental regulations and protection under the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703 et seq.; 40 Stat. 755) in

1972. DCCO populations in the Great Plains, Great Lakes, and Atlantic Coast areas have experienced the most rapid growth due to advantageous changes in fish assemblages (i.e., high proportions of smaller fish species in the Great Lakes) and increased numbers of aquaculture facilities, particularly in the south and southeast U.S. (Hatch and Weseloh 1999, USFWS 2003). Continentally, from 1999–2009, DCCOs increased at a rate of approximately 8.7% per year (95% CI = 3.1 to 16.3), largely resulting from the growth of the Interior and Atlantic populations (Sauer et al. 2011).

During 1989–1995, the total continental population of DCCOs, including all five subspecies was 1–2 million, with an estimated 372,410 breeding pairs (Tyson et. al. 1997, USFWS 2003; Table 2). There is uncertainty, however, in the exact correlation between the number of breeding pairs and the total continental population (see Hatch and Weseloh 1999, USFWS 2003). Published estimates range from 1–4 nonbreeders per breeder (USFWS 2003), therefore overall population totals may be much larger than the breeding pair estimates provided. During 1989–1995, 91% of all breeding DCCOs resided in the Atlantic and Interior regions, 4% in the Southeast, and 5% in the West Coast-Alaska region (Table 2).

Table 2. DCCO breeding population estimates for North America, 1989–1995 (Tyson et al. 1997).

Region	Estimated # of breeding pairs	Percent of continental population
Atlantic	85,510	23%
Interior	256,212	68%
Southeast	13,604	4%
West Coast-Alaska[a]	17,084	5%
TOTAL	≥ 372,410	100%

[a] includes AK, B.C., WA, OR, ID, CA, NV, UT, AZ

Pacific Flyway.—DCCO abundance in the Pacific Flyway is at least an order of magnitude smaller than it was historically (Wires and Cuthbert 2006). During the past two decades, DCCO colonies within the Pacific Flyway have fluctuated. The flyway experienced a large-scale redistribution of DCCOs, with documented colony declines in many areas and a large population increase at East Sand Island in the Columbia River estuary. The Western Population increased during the past two decades, largely due to growth at the East Sand Island colony. Colony declines were documented over much of southern Alaska, British Columbia, Washington, and southern California (Carter et al. 1995, Hatch and Weseloh 1999, Wires et al. 2001, Anderson et al. 2004a, Wires and Cuthbert 2006). The DCCO colony at Mullet Island in the Salton Sea and other areas in Southern California exhibited growth during the late 1990s, likely due to influxes of DCCOs from Mexico (Carter et al. 1995, Wires and Cuthbert 2006, Mercer 2008). DCCO abundances decreased to zero at Mullet Island,in the early 2000s (Molina and Sturm 2004) and then increased throughout the late 2000s (Adkins and Roby 2010).

DCCO population estimates relevant to the Pacific Flyway are provided in Table 4. Comparisons across studies are difficult because colonies are typically not estimated during the same years, different population parameters are measured (e.g., breeding pairs, number of individuals, number of nests, etc.), geographic delineations are different, and important areas supporting large numbers of DCCOs are not regularly monitored (e.g., Mexico). DCCO populations within the Pacific Flyway are discussed below in more detail.

Western Population.—The Western Population was estimated at 29,240 breeding pairs in 2009 (Adkins and Roby 2010; Table 4). Ninety percent of the Western Population resided within the provinces/states of British Columbia, Washington, Oregon, and California (Table 3; Fig. 3). Seventy-one percent of DCCOs bred at coastal sites and 29% bred at inland sites (Adkins and Roby 2010).

During the past two decades, the Western Population increased nearly 60%, or approximately 10,000 breeding pairs, and large-scale distributional changes occurred (Adkins and Roby 2010). The average annual growth rate was 3% during the past two decades, although the growth rate has slowed in recent years (Adkins and Roby 2010). Growth of the Western Population was largely attributed to the growth of the DCCO colony at East Sand Island. During 1989–2010, this colony grew from 90 to 13,596 breeding pairs (BRNW Real Time Research Inc., 2011). The colony at East Sand Island currently has the largest concentration of DCCOs in the world, accounting for 41% of the Western Population (Adkins and Roby 2010). Growth has largely been attributed to immigration from other colonies (Carter et. al. 1995, Moul 2000, Anderson et al. 2004a, Adkins and Roby 2010). Anderson et al. (2004a) speculated that the increase in DCCO abundance at East Sand Island resulted from more stable and predictable food resources in the Columbia River estuary compared to coastal and interior nesting areas throughout the Flyway that are influenced to a greater extent by fluctuating oceanic and climatic conditions.

A number of DCCO colonies within the Western Population experienced declines of nesting pairs during the late 1990s and early 2000s (e.g., the Chain Islets in the Gulf Islands, Five Finger Islands, and Mandarte Island, British Columbia; Juan de Fuca Strait Islands, Washington; Sheepy Lake, Lower Klamath Lake National Wildlife Refuge (NWR), and Rice Island, Oregon; South Farallon Island, and Mullet Island, California) and few new colonies were established (Wires et al. 2001, Chatwin et al. 2002, Anderson et al. 2004a, Wires and Cuthbert 2006, SCCP 2010). Declines at some of these colonies have been attributed primarily to immigration to East Sand Island (Carter et. al. 1995, Moul 2000, Anderson et al. 2004a, Adkins and Roby 2010). Declines and changes in distribution have also been attributed to depredation and human disturbance (Moul 2000, SCCP 2010) and El Niño events (Wilson 1991).

Table 3. DCCO breeding pair abundance for states within the Western Population, 1987-1992 and 1998-2011.

Location	# of colonies	1987-92	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Interior States[a] (Pacific flyway portions only)																
Idaho	13	-	-	-	-	-	-	-	-	-	1,008	(1,180)	(1,418)	1,613		
Montana	4	-	-	-	-	-	-	-	-	-	(17)	-	-	(32)	108[a]	158[b]
Nevada	11	-	911	1,677	-	-	-	-	-	269	(720)	(872)	(165)	660		>1,030[c]
Utah	5	-	-	-	-	-	-	-	-	-	-	-	-	177		
Colorado	1	-	-	-	-	-	-	-	-	21	18	19	29	41		
Arizona	10	-	-	-	-	-	-	-	-	-	-	-	-	325		600[d]
Coastal States																
British Columbia	10															
Coastal		1,981	(586)	(332)	617	-	-	-	-	-	-	-	-	403		
Interior		4	9	10	11	12	23	25	-	59	117	99	123	-		
Washington	15															
Coastal		1,564	496	283	-	-	-	(954)	-	-	-	-	-	788		
Interior		(425)	-	-	-	-	-	(250)	(300)	1,218	1,554	1,367	1,428	1,196		
Oregon	34															
Coastal		6,303	-	-	-	-	-	13,256	-	-	15,886	-	-	14,730		
Interior		(725)	-	913	-	-	-	(883)	(1,043)	-	-	-	-	1,041		
California	91															
Coastal		4,405	-	-	-	-	-	6,575	-	-	-	-	4,994	-		
Interior		(1,059)	(4,140)	6,865[e]	-	-	-	-	-	-	-	-	-	(2,287)		

The number of colonies and breeding pair estimates from 1987–1992 and 1998–2009 were taken from Adkins and Roby (2010). Estimates from 2010 and 2011 were provided by state committee representatives. Years with few or no data were omitted. A dash indicates that no data were recorded for that year. Totals in parentheses are incomplete due to missing data because of either (1) a lack of estimates for a large number of sites, (2) no estimate for a site likely to represent a large portion of breeding pairs for the area, or (3) only a visual approximation of breeding pairs was available for a given site(s) rather than a precise count.

[a] one documented case of DCCO breeding was observed in the Pacific Flyway portion of New Mexico (see Appendix A)

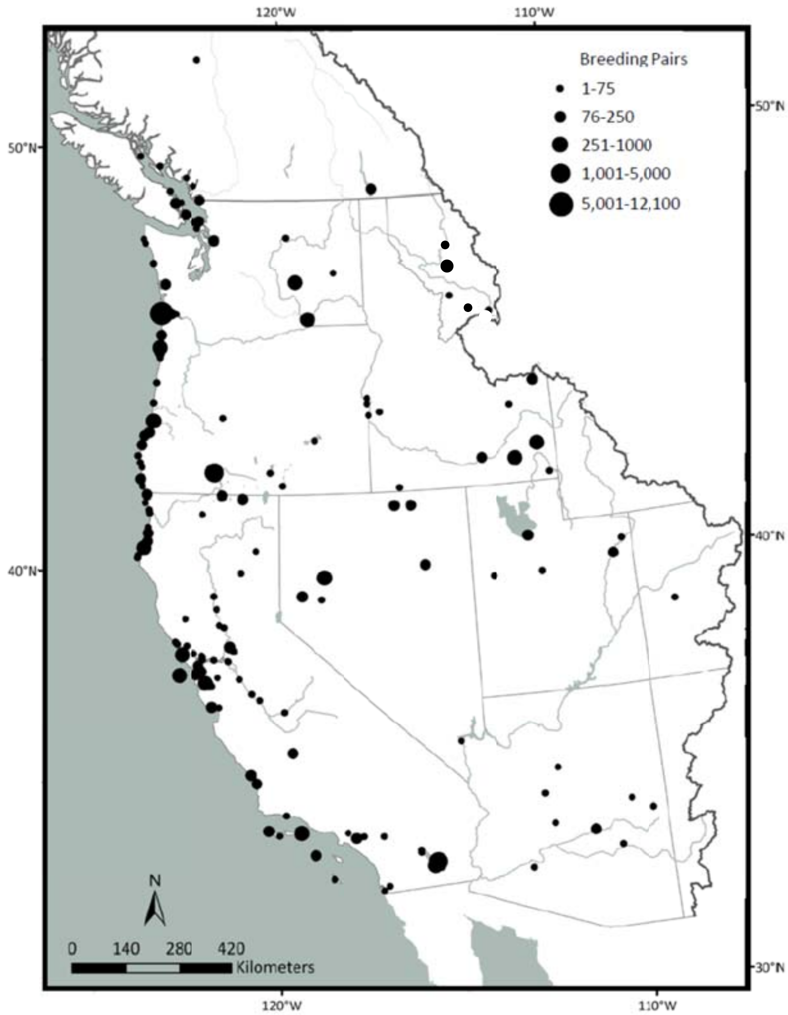
[b] estimates from MFWP, unpubl. data.

[c] estimate from NDOW, unpubl. data.

[d] estimate from ADFG, unpubl. data.

e Shuford (2010) reports 7,303–11,261 breeding pairs during 1997–1999.

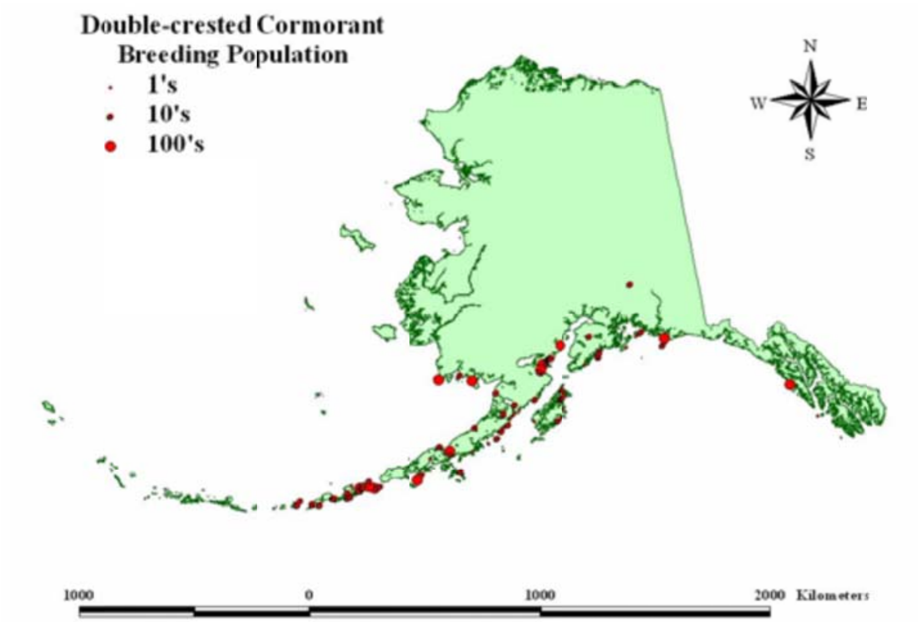
Figure 3. Distribution and relative size of DCCO breeding colonies in the Western Population, 1998–2009 (modified from Adkins and Roby 2010*).



* Montana estimates from MFWP, unpubl. data
See Table 3 and Appendix A for estimates after 2009.

Alaska Population.—*P. a. cincinnatus* is the only DCCO subspecies known to inhabit Alaska. Carter et al. (1995) estimated a total population of 5,848 individuals, and Wires and Cuthbert (2006) estimated 3,029 breeding pairs (Table 4). Between 1970 and 2000, DCCOs bred at 106 different colonies in the south coastal and southwestern part of the state. The vast majority of these colonies were small, with 93% having <100 breeding pairs (Fig. 4). The breeding population of DCCOs in Alaska is thought to have declined from historical estimates and may still be declining, and breeding distribution appears more restricted than it was historically (Wires et al. 2001, Wires and Cuthbert 2006). Declines are possibly due to climate change and introduction of predators (Wires et al. 2001, Wires and Cuthbert 2006). Area-wide surveys, particularly of the interior portion of Alaska, are lacking, so population estimates and trends are more speculative. Alaska is the only state in the Pacific Flyway that allows harvest of cormorants under subsistence hunting and small game regulations. During 1995–2000, 1,753 individuals and 22 eggs of Pelagic Cormorants (*Phalacrocorax pelagicus*) and DCCOs combined were harvested per year on average (ADFG, unpubl. data). *P. a. cincinnatus* breeds only in Alaska but winters as far south as British Columbia (Hatch and Weseloh 1999). Exact wintering and migratory abundances of *P. a. cincinnatus* in British Columbia and Yukon are unknown.

Figure 4. Distribution and relative size of DCCO breeding colonies in Alaska (Bering Seabird Colony Catalog Database 2010).



Mexico/Southern California Population.—Information of DCCO breeding abundance, distribution, and population trends within Mexico are largely lacking. Tyson et al. (1997) and Adkins and Roby (2010) both excluded this area from their population assessment due to lack of available data. DCCOs are commonly found along both coasts of Baja Sur, and along the Gulf Coast of Tamaulipas and Campeche (Wires et al. 2001). Carter et al. (1995) estimated 6,788 total individuals in Baja California and 7,150 total individuals in Sonora and Sinaloa, Mexico (Table 4). Historical abundances on Isla San Martin, Baja California (200,000–350,000 breeding pairs) dwarfed any present day colony by an order of magnitude (Wright 1913, Hatch 1995, Carter et al. 1995, Wires and Cuthbert 2006). The colony at Isla San Martin decreased dramatically due to human disturbance and introduced predators, disappearing entirely in the late 1970s (Everett and Anderson 1991). Re-establishment took place in the late 1980s or early 1990s, and six hundred breeding pairs were observed in the late 1990s (Palacios and Mellink 2000). Current estimates of breeding pairs on Isla San Martin are unknown. Censuses during the 1970s suggested that Isla Alcatraz was one of the largest DCCO nesting colonies in the Gulf of California. In 2002–2003, there were 1,683 active nests, which represented 30–40% of coastal nesting DCCOs in the Gulf of California (Pfister et al. 2005). In southern California, breeding DCCOs increased from 416 birds in 1975–1977 to 2,528 birds in 1991, including dramatic increases at the Salton Sea (Carter et al. 1995). In 1999, there were 5,425 DCCO breeding pairs at Mullet Island in the Salton Sea (Shuford et al. 2000). The rate of DCCO increase in southern California could not be explained by local productivity alone and was attributed to immigration from Mexico (Carter et al. 1995, Wires and Cuthbert 2006, Mercer 2008). DCCO abundances at the Salton Sea declined in the 2000s (e.g., zero breeding pairs in 2000 and 2001; Molina and Sturm 2004). In 2009, there were

2,000 breeding pairs (Adkins and Roby 2010). The boom and bust pattern of DCCO abundances at the Salton Sea have been linked to prey abundance and El Niño cycles (Molina and Sturm 2004).

Montana - east of the Continental Divide.—During 2009–2011, 712–757 DCCO breeding pairs resided within the Pacific Flyway portion of Montana east of the continental divide. There are four DCCO colonies in this portion of the state: Arod Lake, Canyon Ferry Wildlife Management Area (WMA), Freezout WMA, and Red Rock Lakes NWR (see Appendix A for colony abundances).

Table 4. Published DCCO estimates in the Pacific Flyway, 1970–2009.

Region	Estimated Number	Description	Survey Years	Source
Pacific Flyway				
British Columbia, Washington, Oregon, California, Baja Mexico, and Sonora and Sinaloa, Mexico	49,094	total individuals (43,358 individuals at 126 coastal colonies and 5,736 individuals at 22 interior colonies)	1970-1992	Carter et al. 1995
West Coast-Alaska (AK, B.C., WA, OR, ID, CA, NV, UT, AZ)	17,084	breeding pairs	1990-1997	Tyson et al. 1997
West Coast (B.C., WA, OR, ID, CA, NV, UT, AZ)	22,000	breeding pairs	1990-1998	Hatch and Weseloh 1999
P.a. albociliatus	33,000	breeding pairs (248 colonies)	1970-1999	Wires and Cuthbert 2006
Western Population				
	29,240	breeding pairs	1987-1992 and 1998-2009	Adkins and Roby 2010
Alaska				
	5,848	total individuals (5,622 individuals at 90 coastal colonies and 226 individuals at 5 interior colonies)	1970-1992	Carter et al. 1995
	3,029	breeding pairs	1970-1999	Wires and Cuthbert 2006
Mexico				
	6,788 (Baja Mexico); 7,150 (Sonora and Sinaloa)	total individuals	1970-1992	Carter et al. 1995

Other Existing Management Plans

In the Pacific Flyway, the U.S. Army Corps of Engineers is currently developing a management plan to reduce avian depredation to federal Endangered Species Act (ESA)-listed salmonids in the Columbia River estuary by DCCOs and the Columbia Plateau by DCCOs and Caspian Terns. Management actions on East Sand Island, which harbors 41% of the Western Population of DCCOs, could have major impacts on the distribution and abundance of the species in the Pacific Flyway. In 2010, Montana Department of Fish, Wildlife, and Parks (MFWP) Commission approved the Upper Missouri River management plan concerning sport fisheries in this area, which included control of DCCOs as a management option (MFWP 2010). Idaho developed a management plan in 2009 for American White Pelicans (*Pelecanus erythrorhynchos*) in the southeast portion of the state, which includes information concerning DCCOs (IDFG 2009). A DCCO management plan was created jointly for the Atlantic and Mississippi flyways in 2010 (Atlantic and Mississippi Flyway Council 2010) and one is currently being drafted for the Central Flyway. The USFWS prepared a continental Environmental Impact Statement (EIS) for DCCOs in 2003 (USFWS 2003) and an Environmental Assessment (EA) in 2009 (USFWS 2009), which evaluated impacts associated with the depredation order (see Regulations for Take of Migratory Birds). This did not include states within the Pacific Flyway. Regulations stemming from these documents are under review as part of a reopened National Environmental Policy Act (NEPA) process. Determination of a national management strategy for DCCOs, and any regulatory changes, if warranted, will be finalized by June 30th, 2014. DCCOs were also included in the North American Waterbird Conservation Plan (Kushlan et al. 2002) as well as regional waterbird conservation plans, such as the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006).

Legal Status

International migratory bird conventions and the Migratory Bird Treaty Act.—The Migratory Bird Treaty with Canada in 1916 and later conventions with Mexico (1936), Japan (1972) and the Soviet Union (1976) established international protection for shared migratory birds. The MBTA (16 U.S.C. 703 et seq.; 40 Stat. 755) is the primary domestic legislation which implements the provisions of the four international migratory bird treaties within the U.S. The MBTA mandates the following responsibilities and authorizes the Secretary of the Interior to adopt regulations that: 1) conserve and manage migratory birds internationally; 2) sustain healthy migratory bird populations for consumptive and non-consumptive uses; and 3) restore depleted populations of migratory birds. In 1972, under the terms of the amended convention with Mexico, the cormorant taxonomic family, *Phalacrocoracidae*, was added to the list of migratory birds federally protected under the MBTA (50 CFR 10.13). Therefore, take (any attempt to hunt, pursue, wound, kill, possess, or transport) of DCCOs, or any part, nest, or egg thereof, is prohibited except as authorized by MBTA regulations (50 CFR 21). MBTA regulations (50 CFR SubPart D; Control of Depredating Birds) allow for control of migratory bird depredation under certain conditions (see Management Alternatives).

Special status designations.—In the U.S., DCCOs currently are not listed as threatened, endangered, or a species of concern at the state or federal level. DCCOs have a status of “least concern”, the lowest designation under the International Union for Conservation of Nature (IUCN) ranking system (IUCN 2011) and were designated “currently not at risk” in the USFWS’s Seabird Conservation Plan for the Pacific region (USFWS 2005a). DCCOs were listed as a California Bird Species of Special Concern (BSSC) in 1978 and 1992 and are currently on the “Watch List” because of the previous designation (Shuford and Gardali 2008).

In Canada DCCOs are protected at the provincial level under Section 34 of the British Columbia Wildlife Act and the provisions prescribed by the Migratory Bird Treaty of 1916. DCCOs are a “blue-listed species” (i.e., species of special concern) in British Columbia (B.C. Conservation Data Centre 2011) and a “conservation concern” in the Yukon (Yukon Conservation Data Centre

2011). These designations result from the observed decline in DCCO numbers within these provinces during the past decades (see Western Population). In Mexico, DCCOs do not have any specific legal status, designations, or listings at the state or national level other than those prescribed in the Migratory Bird Convention (1936).

RESOURCE CONFLICTS

DCCOs are known to consume fish resources that are of conservation significance or have economic or social value. The impacts of DCCOs on fish resources range from minor to substantial, and are often characterized by a lack of information. The section below outlines DCCO resource conflicts in the Pacific Flyway.

Fish

Persecution of DCCOs by anglers and other entities because of suspected impacts to fisheries dates back to the early 1900s (Gabrielson and Jewett 1940, Bayer 1989, Carter et al. 1995). Effects of DCCOs foraging on fisheries can be difficult to quantify, particularly with incomplete data on total DCCO population sizes, including nonbreeders. A multitude of predator and prey species and environmental conditions contribute to fish population dynamics. Based on energetic models and estimated fish take on large waterbodies, such as Lake Erie, Lake Ontario, and the Columbia River, DCCOs contribute to mortality but typically are not the primary or sole cause of decline of a particular fish species (Weseloh and Casselman 1992, Madenjian and Gabrey 1995, Lyons and Roby 2011). However, localized impacts of DCCOs on fisheries or aquaculture facilities can be substantial (Glahn et al. 2002, Teuscher 2004, Teuscher et al. 2005, Skiles 2008).

ESA-listed and special status fish.—In the Pacific Flyway, the impact of DCCOs, as well as other fish-eating birds, on federal ESA-listed Pacific salmonids has been a long-debated and contentious issue (Roby et al. 1998, Collis et al. 2000, Collis et al. 2001, Roby et al. 2003, USFWS 2005b). DCCO consumption of juvenile salmonids shows great spatial and temporal variation, ranging from 0.0–95.3% of their diet and peaking at the height of juvenile salmon migrations (Robertson 1974, Roby et al. 1998, BRNW 2009). The proportion of salmonids in DCCO diet by biomass averaged approximately 10% (range: 2–25%) at East Sand Island during 1999–2010 (Fig. 5). During 2003–2010, estimated salmonid smolt consumption by DCCOs on East Sand Island averaged approximately 7.5 million and has increased within this time period, peaking at 19.3 million smolts in 2010 (Fig. 6).

With 13 federal ESA-listed salmonid Evolutionary Significant Units (ESU) in the Columbia River Basin, DCCO depredation along the Columbia River is a significant concern in Oregon and Washington. Potential impacts to federal and state-listed species along the Oregon coast outside of the Columbia River estuary are also a concern. Approximately 2,384 DCCO pairs breed in roughly 22 colonies along the Oregon coast (Adkins and Roby 2010), generating concern for potential impacts to the two federally ESA-listed and seven state-listed sensitive salmonid Significant Management Units (SMU) found along the Oregon coast. Federally ESA-listed salmonids include the Oregon Coast ESU Coho salmon (*O. kisutch*) and the Southern Oregon/Northern California Coast ESU Coho salmon. Coastal cutthroat trout (*O. clarki ssp*) are listed federally as a Species of Concern. State-listed Sensitive Salmonids include: Pacific Coast

ESU Chum Salmon (O. keta); Coastal Spring Chinook SMU (O. tshawytscha); Oregon Coast ESU Coho Salmon; Southern Oregon/Northern California Coast ESU Coho salmon; Oregon Coast ESU summer run/Coastal Summer Steelhead SMU (O. mykiss); Oregon Coast ESU winter run/Coastal Winter Steelhead SMU; and Southern Oregon/Northern California Coast ESU Chinook salmon.

Figure 5. The annual proportion by biomass of salmonids in the diet of DCCOs at East Sand Island (from BRNW, Real Time Research, 2011).

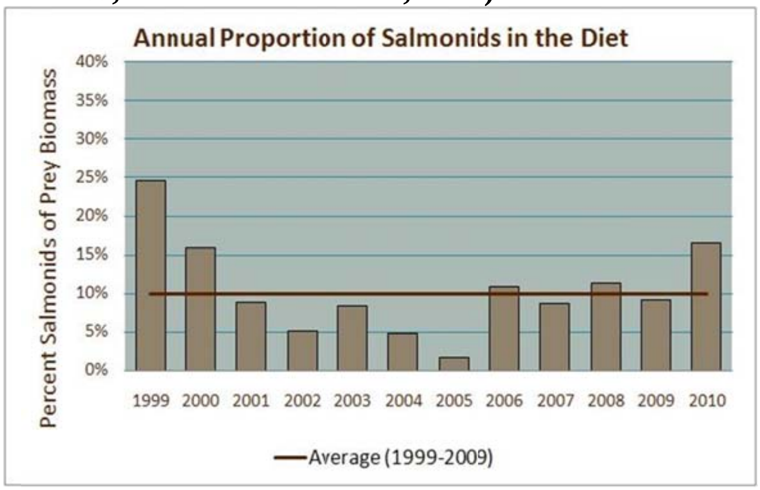
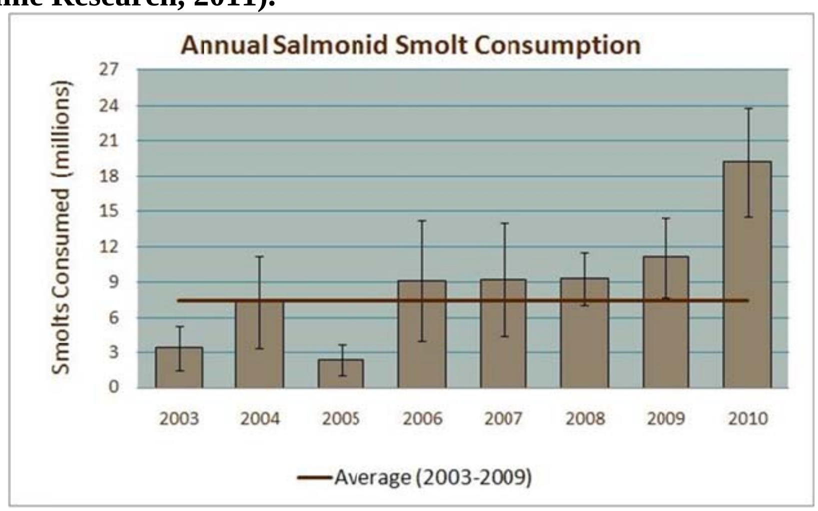


Figure 6. The annual number of salmonids consumed by DCCOs at East Sand Island (from BRNW, Real Time Research, 2011).



Although DCCOs contribute to overall mortality of ESA-listed salmonids, the USFWS (2000) stated that DCCOs (and avian depredation in general) were neither the primary cause of population declines, nor would reducing DCCO depredation or overall avian depredation alone result in the recovery of ESA-listed salmonids. Lyons and Roby (2011) stated that reduction of avian depredation in the Columbia Plateau, by itself, will not recover ESA-listed salmonids, although reductions may increase salmonid population growth rates to some extent. However, modeling exercises indicated that increases in lambda from managing avian predation could only be achieved with the assumption that avian predation was at least partially additive (i.e., smolt mortality due to other factors would not increase and completely compensate for reductions in avian predation; Lyons and Roby 2011). There are many confounding factors influencing salmonid populations, and addressing avian depredation should be considered in the context of other recovery actions for ESA-listed salmonids.

In southern Idaho, trout depredation, particularly Yellowstone cutthroat trout (*O. c. bouvieri*) and Bonneville cutthroat trout (*O. c. utah*) by American White Pelicans and DCCOs has been an on-going conflict. Yellowstone and Bonneville cutthroat trout are listed as both a state species of special concern (SSC) and a species of greatest conservation need (SGCN) in Idaho. In certain focal areas of Nevada, there are concerns of DCCO depredation of federally-listed endemic spinedace (*Lepidomeda* spp.), which are found primarily in isolated springs in the southeastern portion of the state (C. Tomlinson, NDOW, pers. comm.).

Supplemental fisheries.—The role that hatchery programs play in regard to fish numbers, environmental and socio-economic impacts, and recreational opportunities cannot be understated. Depredation by DCCOs on hatchery stocks can result in economic loss due to loss of both hatchery production and the economic contribution of angling to local economies (IDFG 2009). Hatchery programs require extensive resources and funding to implement. The Oregon Department of Fish and Wildlife (ODFW) invests >30 million dollars annually in hatchery and habitat restoration programs to fuel healthy, sustainable wild and hatchery fish populations capable of supporting fisheries in Oregon. ODFW hatcheries raise and release >50 million fish per year (ODFW 2011). Eighty percent of all trout harvested in Oregon during 1999 were reared in hatcheries (USFWS 2003). The contribution of coastal freshwater recreational salmon and steelhead fishing to the Oregon economy was nearly $15 million in 2007 (The Research Group 2009). In addition, ocean salmon commercial and recreational fisheries contributed an additional $3.8 and $4.3 million, respectively, in 2007 (The Research Group 2009). In 2011, California Department of Fish and Game (CDFG) statewide production of both anadromous fish and trout was 47 million fish (CDFG, unpubl. data). Nevada's four fish culture facilities produce approximately 430,000 pounds of trout per year and stocking programs supplement the majority of areas used for recreational angling (NDOW 2011). The Nevada Department of Wildlife (NDOW) estimated that 50% of the total fisheries program budget was allocated to its stocking program (NDOW 2011) Estimated production costs per pound of fish produced were $2.85 in Nevada (all trout; NDOW 2011), $3.30 in Idaho (fingerling rainbow trout; IDFG 2009), and $3.57 in California (all trout; CDFG, unpubl. data).

In some areas of the Pacific Flyway, DCCOs are or appear to be affecting large-scale hatchery releases and site-specific trout stocking programs. In the Blackfoot Reservoir, Idaho, Teuscher (2004) estimated that DCCOs and American White Pelicans consumed 7.6 tons of rainbow trout. Additionally, 27% of newly-stocked trout were lost to avian depredation within the first week after stocking, and trout composed 66% of DCCO diet immediately following stocking (Teuscher et al. 2005). At Springfield Reservoir, Idaho, a stocking program of <9-inch trout in 1994 was stopped due to DCCO depredation (USFWS 2003). Predation on hatchery released juvenile salmonids has also been documented in Oregon's coastal estuaries, although data is limited (Stahl et al. 2000, Clements et al. 2011). In a study conducted in the Nehalem estuary, Oregon, researchers found that 40% of radio-tags from juvenile hatchery-raised Coho were deposited at the nearest DCCO colony (Clements et al. 2011). In California, DCCOs have been observed foraging on released Chinook and state and federally listed Coho salmon smolts and yearling steelhead near Trinity River Hatchery and Warm Springs Hatchery, but a formal assessment documenting impacts has not been conducted (CDFG, unpubl. data). In Nevada, >90% trout depredation rates were observed at Virginia Lake near Reno, and DCCOs were primarily suspected of the depredation (Skiles 2008). A fall stocking program was initiated to maintain trout numbers at Ruby Lakes NWR, Nevada, to avoid DCCO depredation during the spring (NDOW, unpubl. data). In Arizona, numbers of DCCOs increased during the last decade in the greater Phoenix area, and DCCOs are suspected of having an impact on stocked trout. However, no formal assessment or documentation of impacts exist (J. Driscoll, AGFD, pers. comm.). In Montana, DCCO depredation has been documented at a stocked pond near Ninepipe NWR (C. Wightman, MFWP, pers. comm.). Additionally, in Montana, fish survival has been an ongoing concern in the Upper Missouri River. DCCO control was included as an option in an approved management plan by MFWP Commission in 2010 for this area, but additional research on depredation by DCCOs is needed prior to implementing controls (MFWP 2010).

Fish hatchery facilities.—DCCOs forage on concentrations of easily accessible fish; thus, fish reared at hatchery facilities can be particularly vulnerable to depredation. Fish reared at hatcheries also experience loss attributed to DCCOs due to stress on fish, which can make fish more vulnerable to disease (Wires et al. 2001). In the Pacific Flyway, there are no long-standing or pervasive DCCO conflicts at fish hatchery facilities. In 2001, 20 DCCOs were authorized for take at Wah Weah State Fish Hatchery in Arizona, but none were actually taken.

Aquaculture facilities.—The Pacific Flyway has not documented the prevalence of aquaculture related conflicts as southern and southeastern U.S. states, predominantly with catfish facilities (Glahn et al. 2002, USFWS 2003, USFWS 2009). USFWS depredation permitting data from the Pacific Flyway during 2005–2010 show that essentially all (1,812 of 1,859 individuals; 97.5%) DCCOs killed at aquaculture facilities occurred within 3 areas of California: 1) Salton Sea area (Imperial, Kern, Riverside, and San Bernardino counties; 52%); 2) San Francisco Bay area (Contra Costa, Sacramento, and San Joaquin counties; 35%); and 3) Fresno County (13%). In California, the aquaculture industry has voiced concerns over increasing conflicts with piscivorous birds, including DCCOs, and are advocating for future research to better quantify depredation impacts. In Washington, 47 DCCOs were killed at aquaculture facilities during 2005–2010, which composed 4% (i.e., 47 of 1,148 individuals) of the total number of DCCOs lethally taken in the state during that time period.

Habitat Degradation and Other Bird Species

In the Pacific Flyway, there are no long-standing, pervasive, or current issues related to DCCO habitat degradation or risk to endangered plant or bird species. An isolated instance was reported on a small island in Coos Bay, Oregon, where 50% of the trees were found dead in 2003 after a DCCO colony began nesting in 1999 (Pacific Seabird Group 2004). High concentrations of DCCOs can degrade habitat by defecation and denuding trees of twigs and leaves for nest material (Hatch and Weseloh 1999, USFWS 1999). The excessive ammonium nitrogen levels from accumulated feces can kill trees, shrubs, and plants within a few years and denuded trees die within 3–10 years (Hatch and Weseloh 1999). These effects are not unique to DCCOs and occur in other tree-nesting colonial waterbird species (e.g., herons). Changes in the plant community or vegetation structure can affect bird species which nest in association with DCCOs, such as gulls and terns (*Laridae* spp.), herons and egrets (*Ardeidae* spp.), and pelicans (*Pelecanus* spp.). DCCOs naturally compete with other bird species for nesting sites and food resources, although information on the nature of such competitive interactions (e.g., dominance status of DCCOs and other species) is lacking (Wires et al. 2001).

MANAGEMENT

The intention of this document is to provide information relevant to DCCO management in the Pacific Flyway, with emphasis on how to maintain viable DCCO populations, ameliorate site-specific and local conflicts, and do both within a larger and more unified Flyway context. The sections below outline the regulations and management alternatives relevant to DCCO conflicts and recommended management strategies for the Pacific Flyway.

Regulations for Take of Migratory Birds

Wildlife managers can use non-lethal harassment or deterrents (see Management Alternatives) to minimize DCCO depredation impacts without obtaining a USFWS permit, provided the harassment does not result in injury or death of adults, chicks, or eggs directly or indirectly through nest abandonment as stipulated in 50 CFR 21.41. Lethal take of migratory bird species, including nests and eggs, for depredation control purposes or to alleviate other conflicts may be authorized by the USFWS in the form of: 1) depredation permits, 2) depredation orders, 3) control orders, and 4) conservation orders. Depredation permits and depredation orders allow for the take of migratory birds that commit or are about to commit depredation on trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner that they are a health hazard or other nuisance. Control orders are issued for take of migratory birds where they are non-native in a specific location or non-native for a particular season and are concentrated in a manner that causes depredation or a nuisance (e.g., removal of Muscovy Ducks [*Cairina moschata]*). Control Orders may also address wide-spread population reduction of a species for reasons other than agricultural or wildlife associated depredation (e.g., resident Canada Geese (*Branta canadensis*). Conservation orders are issued for the widespread population reduction of overabundant migratory birds, when populations cannot be controlled through traditional management programs and practices, such as standard hunting seasons. Only one conservation order exists for light geese (*Chen* spp.). All of the above actions are federal actions that require compliance with NEPA. The DCCO is not a non-native species (options 3) and is less common in the Pacific Flyway than historical estimates of abundance (option 4). Therefore, options 3 and 4 are not appropriate tools for the management of DCCOs in the Pacific Flyway and will not be discussed further in this document.

Depredation permits.—Under 50 CFR 21.41, the USFWS can issue permits for the lethal removal of migratory birds, including adults, nests, and eggs, to reduce migratory bird depredation. Depredation permits are issued for the removal of a permitted number of individuals from a specific site by authorized individuals. Depredation permits are issued by the appropriate Regional Migratory Bird Permit Office provided that a complete application is submitted, with a valid justification and showing of responsibility, and the requested take does not threaten or pose a significant risk to the migratory bird population (50 CFR § 13.2150; Service Manual Chapter 724 FW 6). Depredation permits are typically issued under a NEPA Categorical Exclusion, although some require additional NEPA review (e.g., an EA or EIS). A depredation permit application form includes the minimum information required for the USFWS to consider and assess such requests (see Appendix C).

In 1990, USFWS Director's Order No. 27 authorized the issuance of depredation permits to lethally take depredating migratory birds at aquaculture facilities and public hatcheries to address emergency situations. In 2005, this Director's Order was updated and incorporated into the USFWS Manual (Service Manual Chapter 724 FW 6). Depredation permits at fish culture facilities only apply to the premises of the facility. Public hatcheries may obtain a depredation permit to protect endangered or threatened species and for short term relief after a natural disaster. Public agencies are encouraged to set an example for the public by implementing non-lethal measures at fish culture facilities to minimize losses to avian depredation whenever possible.

Depredation permits for take of migratory birds in open waters are rarely issued because natural foraging events in open waters do not constitute depredation, and native species of fish and migratory birds are both public resources. Depredation permits for the take of fish-eating birds over open waters may be issued to protect 1) human health and safety; 2) federally or state-listed species; and 3) personal property, agricultural resources, or other resource interests, particularly when private loss affects a principal means of livelihood or income. These criteria can be difficult to demonstrate in open water situations.

Within the Pacific Flyway, an average of 494 DCCOs per year were lethally taken under depredation permits in the years 2005–2010 (Table 5). The number of DCCOs killed within Washington and California accounted for essentially all lethal take within the Pacific Flyway (Table 5). In Washington, 96% of lethal take occurred at dams on the Columbia River to alleviate depredation of ESA-listed salmonids, and the remaining 4% occurred at aquaculture facilities. Nearly all (>99%) lethal take in California occurred at aquaculture facilities, and lethal take of DCCOs declined from a high of 611 in 2005 to a low of 49 in 2010. No permits were issued in Alaska, Colorado, Montana, New Mexico, Oregon, or Wyoming. Information was not available for British Columbia, Yukon, or Mexico.

Table 5. The number of DCCOs authorized for take and the number actually taken under the authority of MBTA depredation permits in the Pacific Flyway by state, 2005–2010.

State	Total # authorized to take	Total # actually taken	Percentage of take within Pacific Flyway
Arizona	140	1	<0.1%
California	4,045	1,812	61.1%
Idaho	15	0	0.0%
Nevada	NA	1	<0.1%
Utah	NA	2	0.1%
Washington[a]	2,280	1,148	38.7%
TOTAL	6,480	2,964	100%
AVERAGE #/YEAR	1,080	494	-

Data were collected from USFWS Regional Permitting Officers.
[a] Permits were issued to the state of Washington but 96% of take occurred on the Columbia River, which divides Washington and Oregon.

Depredation orders.—Depredation orders are issued for large geographic areas when the need and number of requested depredation permits are too great for the traditional depredation permitting process and significant reductions in administrative costs and processing times of permit requests can be achieved. Depredation orders are typically intended to address economic loss or human health and safety concerns. Development of a depredation order is a federal rule making process, requiring review under NEPA and issuance of an EA or EIS. Seven depredation orders currently exist for the control of various bird species.

For DCCOs, there are two separate depredation orders currently in effect, which pertain to states outside of the Pacific Flyway. These are the 1998 Aquaculture Depredation Order (Aquaculture DO; 50 CFR 21.47), which was later amended in 2003, and the 2003 Public Resource Depredation Order (Public Resource DO; 50 CFR 21.48). The Aquaculture DO allows for the take of DCCOs in 13 eastern states without a Federal permit when DCCOs were found committing or about to commit depredation to fish culture stocks on the premises of freshwater commercial aquaculture facilities and State-operated hatcheries. The Public Resource DO authorized state fish and wildlife agencies, federally recognized tribes, and state directors of APHIS in 24 eastern states to prevent depredations on the public resources of fish (including hatchery stock at Federal, State, and Tribal facilities), wildlife, plants, and their habitats by taking, without a permit, DCCOs found committing or about to commit such depredation. Lethal take could occur by more liberal measures (e.g., egg oiling, killing birds at roosts) than the Aquaculture DO.

Scientific collecting and airport depredation permits.—Lethal take of DCCOs can also be authorized with a USFWS Scientific Collecting permit (see Appendix C) or Airport Depredation permit. Scientific collecting permits are issued for legitimate scientific research and museum collection where lethal take does not have a population impact on the bird species. Airport Depredation permits are issued to minimize and prevent aircraft collisions with birds. In the Pacific Flyway during 2005–2009, 240 DCCOs were taken under airport depredation permits. During this same period, 855 DCCOs were taken under Scientific Collecting permits, including take to assess the significance of depredation on ESA-listed salmonids in the Columbia River.

Management Alternatives

Non-lethal and lethal methods are available to manage DCCOs impacting fisheries resources in the Pacific Flyway. All management actions must comply with local, state, and federal regulations. Any lethal method requires a USFWS permit for take of a migratory bird (50 CFR §21.41). Methods that do not result in bird mortality but include the possession or transport of a bird, eggs or parts thereof also require an MBTA permit from the USFWS (50 CFR §21). State permitting requirements for non-lethal and lethal methods vary by state. The development of comprehensive management plans to document and coordinate lethal and non-lethal actions to reduce bird depredation is strongly recommended to implement actions efficiently and to assess the effectiveness of such actions on reducing depredation.

Non-lethal and lethal management alternatives are described below (also see Appendix B and Sullivan et al. 2006). Non-lethal measures must be implemented first and the results assessed prior to requesting USFWS permits for lethal measures. If all practicable non-lethal management actions are ineffective, managers may apply to the USFWS Regional Migratory Bird Permit Office to lethally take DCCOs through depredation permits (see Appendix C).

Non-lethal—Non-lethal management is categorized into: 1) hazing; 2) barriers and obstruction devices; 3) habitat modification to discourage nesting, roosting, and foraging; and 4) altering fisheries management practices to alleviate avian depredation. Non-lethal management is most effective when multiple non-lethal measures are used in conjunction.

1) In general, frightening devices, such as decoys, scarecrows, visual or auditory deterrents, human disturbance, dogs, lights, and water cannons, usually have short-term and/or small-spatial scale effects, if any, on roosting or foraging DCCOs, which typically habituate to these measures (Matteson et al. 1983, Craven and Lev 1987, Parkhurst et al. 1987). When used in combination and with continued persistence, the methods can achieve greater and more lasting effects. These hazing methods may have long-term effects on colony size when applied strategically early in the breeding season. However, once egg laying has commenced, use of any of these methods can result in lethal take as described in the MBTA.

2) Obstruction devices and barriers (e.g., nets, fences, wires, floating rope, line, screen, etc.) are typically very effective at reducing DCCO depredation at aquaculture facilities, hatcheries, and man-made structures (Wires et al. 2001, USFWS 2003). However, the cost of obstruction devices and barriers can be great at large scales and are not applicable in many open water scenarios. Obstruction devices can effectively dissuade DCCOs from nesting. However, similar to hazing methods, these measures must be applied before egg laying has commenced.

3) Habitat modifications can be undertaken to reduce DCCO accessibility to roosting and foraging areas by decreasing available perches and foraging platforms through direct removal or making them unsuitable for use (Craven and Lev 1987). To reduce DCCOs nesting at an area, nest sites can be made less desirable by altering habitat (e.g., removing trees, increasing ground cover, flooding, fire, etc.).

4) Alteration of fisheries management practices can reduce DCCO depredation. Effective management actions pertaining to released fish include: 1) releasing fish away from areas of DCCO concentrations; 2) changing the time of release during the year so as to avoid peak DCCO concentrations; 3) releasing fish at night to avoid peak foraging activity of DCCOs; 4) randomly changing locations of fish release; 5) dispersing fish upon release; 6) releasing fish during high water levels or controlling for high water levels to reduce DCCO foraging efficiency; and 7) modifying habitat to provide fish refuge from DCCO depredation (Wires et al. 2001, USFWS 2003, IDFG 2009). DCCOs also feed on fish caught in nets and weirs (Matteson et al. 1983, Wires et al. 2001). Actions to reduce depredation in nets include: 1) reducing time fish spend in nets; 2) covering nets with wire or more netting; and 3) removing or decreasing usability of nearby perches (e.g., by spikes or electric wire).

Lethal—Lethal management is categorized into: 1) direct killing of adults, subadults, or young; 2) destroying nests and eggs; and 3) altering predation levels and habitat to increase mortality of DCCOs.

1) Direct shooting of DCCOs, particularly when conducted in conjunction with other harassment techniques, can be effective at ameliorating DCCO conflicts at local scales and in isolated populations. However, the effectiveness diminishes in large or migratory populations because killed individuals are quickly replaced and birds become educated to shooting pressure (Keller 1999, Wires et al. 2001, Bishop et al. 2003). DCCOs are rather cautious, and shooting can become very ineffective or impossible as birds become educated to shooting pressure (Bishop et al. 2003, Glahn et al. 2000). Typically DCCOs disperse to nearby areas, which may result in conflicts at new localities. In the 24 states operating under the Public Resource DO, 160,374 total (i.e., 40,094 average/year) DCCOs were taken during 2004–2007, and this level of take (i.e., approximately 2.2% of the population) did not appear to affect the overall population of DCCOs (USFWS 2009). Poison (e.g., DRC-1339) has been used to kill other colonial nesting bird species (Blodget and Henze 1991, USFWS 1990), but there is no documentation of such use on DCCOs.

2) Nest and egg destruction (i.e., such as addling with corn oil) have variable results at reducing DCCO populations. For example, large-scale programs (i.e., >180,000 eggs sprayed in New England during 1944–1952; >25,000 nest sprayed in Quebec during 1989–1993) had little measurable effect on the DCCO population in New England, whereas, in Quebec, the population was reduced from >17,000 breeding pairs to the management goal of 10,000 breeding pairs in less than 5 years (Hatch and Weseloh 1999). Egg-oiling in conjunction with culling can be quite effective at reducing localized DCCO populations. On Young Island, Vermont, DCCOs nesting numbers were reduced to zero in four years by egg-oiling all nests and culling 20% of adults (Strickland et al. 2011). DCCOs commonly renest if a clutch is lost early in the season, or disperse to other nearby areas if nests are destroyed or continually harassed. Thus, nest and egg destruction programs conducted throughout or late in the breeding season are more effective at reducing populations than those conducted early in the breeding season (Wires et al. 2001).

3) Indirect lethal management actions include introducing predators to predator-free nesting areas and altering habitat to enhance predator abundances. These actions have more unexpected and unintended consequences, including effects on non-target species. Once established, though, these methods can be very cost-effective because continued management efforts are not needed. However, predicting whether these actions will result in take as defined by the MBTA is difficult. Project proponents should fully consider the potential for, and the consequences of, migratory bird mortality, and the effects on non-target natural resources resulting from the implementation of such measures.

Recommended Management Strategies

This plan establishes three objectives and associated strategies to facilitate DCCO management in the Pacific Flyway, including lethal control in a manner consistent with the stated goal of this plan and the Pacific Flyway Council's policy on avian predation. The strategies outlined below will facilitate a science-based approach to develop and evaluate management actions, ongoing population assessments, and guidance on the MBTA permitting processes. Implementation of recommended strategies should proceed at the appropriate local, regional, or flyway scale as needed. The Population Assessment and Coordination Objectives will serve to build a foundation for the development of a more comprehensive Pacific Flyway DCCO Management Plan in the future.

A. Population Assessment Objective
Identify, develop, and implement monitoring protocols necessary to determine DCCO population demographics and distribution at the flyway scale to guide and assess management actions.

Flyway-level coordinated monitoring will help to better determine the status of DCCOs by filling data gaps relative to population estimates, trends, and distribution. Without Flyway-level coordinated monitoring, it is difficult to interpret changes in localized occurrences from actual changes in broader population demographics. Coordinated monitoring efforts will result in greater comprehensive understanding of population demographics, distribution, and movement which allows for less uncertainty in management decision-making. A comprehensive monitoring protocol implemented throughout the Pacific Flyway in a coordinated manner will allow the USFWS and states to better assess the potential effects of management actions.

<u>Strategy 1:</u> Develop and implement standard monitoring protocols during breeding and wintering seasons to help determine DCCO (1) population numbers at the local and flyway scale, (2) population trends and seasonal distribution throughout the Pacific Flyway, and (3) factors that may influence local and flyway-level populations.

Adequate baseline knowledge of breeding and wintering population levels, trends, distributions, and the factors that influence populations are essential for proper management of DCCOs at the local, regional, and flyway scale. Monitoring efforts should be focused in areas where data are insufficient and should complement ongoing surveys. Survey efforts should be standardized to the extent possible to ensure consistency of data. Knowledge of the distribution of DCCOs is important to better elucidate population shifts and movements through time and to aid in addressing resource conflicts at the local and flyway scale.

<u>Strategy 2:</u> Develop and implement demographic, genetic, and movement studies aimed at specific gaps in our knowledge of population dynamics and habitat use.

More knowledge is needed regarding basic demographic information, movement patterns, and population structure within the Pacific Flyway. Age- and sex-specific life history parameters are needed to better understand population dynamics. Genetic samples should be collected as needed to determine accurate population boundaries. Radio-telemetry and banding data should be used to understand movement patterns and interconnectivity of DCCOs among colonies, foraging areas, and populations. Gathering this information will provide the data necessary to understand relationships within and among DCCO populations within the Pacific Flyway and more accurately delineate management units.

B. Impact Reduction Objective
State wildlife agencies may address local impacts of DCCOs on fish resources of concern using non-lethal management options, existing regulatory framework for lethal control, and the guiding principles contained within the Pacific Flyway Council Avian Predation Policy (Appendix D).

This document provides an impact reduction objective to emphasize management at the local level, not a population reduction objective at the Flyway scale. Impacts of DCCOs on fish resources are typically localized in nature and management options to reduce these impacts are currently available with existing management tools and regulatory frameworks. Perhaps most importantly, establishing a population reduction objective does not change the regulatory process or requirements for take under the MBTA.

Strategies 1-3 below address key steps toward establishing and implementing impact reduction at the local scale within the flyway context. When utilizing non-lethal methods only, the degree to which these strategies are implemented may be dependent upon the severity of impact to DCCOs. Strategy 4 addresses the broader issue of sustainable level of take.

Strategy 1: Using the Pacific Flyway Council's Avian Predation Policy and guiding principles incorporated therein, conduct site-specific assessments to quantify DCCO depredation impacts on fish resources of concern.

Impacts of DCCO depredation on fish resources should be clearly documented with empirical evidence. An assessment and quantification of the effects of DCCO depredation will determine the need for management and will inform the development of explicit objectives and strategies to address management concerns. This information will also support federal requirements under the MBTA permitting process, should lethal control measures be necessary.

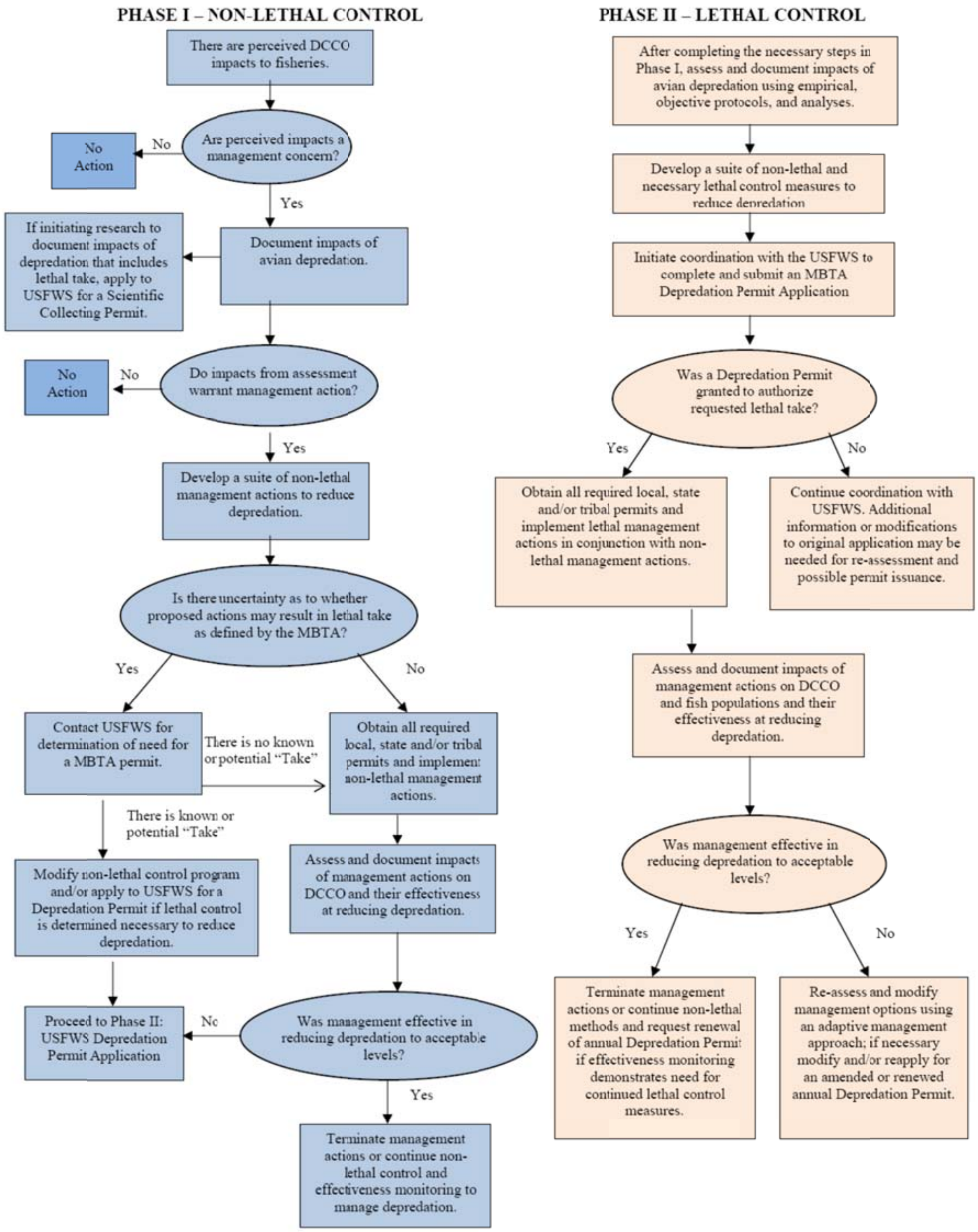
Strategy 2: Develop explicit management objectives and implement measures to achieve stated objectives using available tools and regulatory frameworks.

Expectations of how management actions will reduce impacts to fish populations should be explicitly addressed and expected outcomes on affected fish and DCCO populations should be clearly stated. Non-lethal and lethal methods currently exist to manage fishery related DCCO conflicts in the Pacific Flyway. All management actions must comply with local, state, and federal regulations. Non-lethal measures should be implemented first and the effects of these actions assessed. Non-lethal measures can include hazing, barriers and obstruction devices, habitat manipulations, and altering fisheries management practices. If use of practicable non-lethal management actions alone is determined to be ineffective or insufficient, states may apply to the USFWS Regional Migratory Bird Permit Office for the appropriate MBTA permit to authorize lethal take (Fig. 7).

Strategy 3: Implement effectiveness monitoring.

Effectiveness monitoring will determine the need for continuation or modification of actions and is necessary to assess whether objectives were achieved.

Figure 7. Process for responding to concerns regarding avian depredation on fish resources: non-lethal and lethal control options.



* This chart provides a basic sequence of events, including actions that may or may not require Federal or other permits. Note that although lethal take may be authorized on a one-year basis by USFWS, permitting of lethal control of migratory birds is not intended to be a long-term solution to a depredation problem. See the application form in Appendix D, and contact USFWS for specific information and guidance regarding Depredation Permits and Scientific Collecting Permits.

Strategy 4: Coordinate with the USFWS to explore population modeling options to assess sustainable levels of take while ensuring the conservation of DCCOs.

Modeling options should be explored to assess the impact of take on DCCOs at the local, regional, and flyway scale. Methods to assess implications of take from non-game populations using the principles of the Potential Biological Removal (PBR) model are available (Runge et al. 2004, 2009). For example, the PBR model was used to determine a potential maximum threshold of take that could occur to address Black Vulture depredation issues in Virginia while ensuring the conservation of the species (Runge et al. 2009). Model outputs will support the decision making process for the issuance of permits for lethal take and are not intended to establish DCCO population reduction objectives.

C. Flyway Coordination Objective
Monitoring and management actions are communicated, assessed, and coordinated at the Flyway scale.

Population information and DCCO depredation issues are best addressed at the Flyway scale through collaboration among member states and the USFWS. The benefit of this approach is that the cumulative effects of individual actions may be assessed at the broader geographic and population scale. Moreover, local management actions may have consequences elsewhere that can only be identified through inter-state communication. The efficiency and effectiveness of various impact reduction measures can be shared to inform and improve adaptive management strategies. This approach also provides opportunity for collaborative cost sharing to address future management, monitoring, and coordination needs.

Strategy 1: Establish a procedure for states to report the results of DCCO surveys, population estimates, trends and demographic parameters from coordinated monitoring efforts to the NTC and the USFWS.

Member agencies can use this information to evaluate management actions and implement management recommendations. This data can also be used to develop population models for the Pacific Flyway. A comprehensive reporting system will enable agencies to make informed data-driven decisions on managing DCCOs throughout the Pacific Flyway. Sharing survey results on population estimates, trends, distribution, demographic parameters and other environmental factors will enhance our understanding of the effectiveness and impact of management actions.

Strategy 2: Develop a reporting process for DCCO management actions in Pacific Flyway.

Annual reports from the USFWS that summarize take of DCCOs within the Pacific Flyway will be presented to the NTC. Within this same forum, states will provide annual reports of non-lethal and lethal management activities. This information, in addition to population monitoring data (see Flyway Coordination Objective, Strategy 1) will enable federal and state agencies to assess cumulative impacts and more effectively manage DCCOs in the Pacific Flyway.

Strategy 3: Store, maintain, manage and analyze data for purposes of meeting plan objectives.

Establishment and maintenance of a centralized database is necessary to store monitoring data and support assessments of population size, demographics, and the spatial and temporal distribution of DCCOs including conflict locations. It will be important to develop procedures for data collection and management (e.g., consistent terminology, data dictionary, metadata, etc.). These data can be used by the USFWS and member states to evaluate flyway-level effects of take and ongoing population assessments. Development and hosting of such a database will require a long-term fiscal commitment to support database management and necessary analyses.

Strategy 4: Establish multi-agency agreements to fund research and monitoring.

The increasing cost of conducting research and monitoring limit individual agencies from pursuing projects. Hence, pooling resources to implement multi-agency projects would be more efficient and provide a more comprehensive approach to DCCO research and management. A variety of options should be explored, including multi-agency agreements and public-private partnerships.

Strategy 5: Continue involvement with federal review actions, associated NEPA processes, and forth-coming strategies for management of DCCOs at the population, flyway, and continental scales.

Regulations that determine DCCO management in the U.S. are periodically updated. Currently, regulations that pertain to the PRDO and AQDO and are actively under review, and regulatory changes, if warranted, will be finalized by June 30th, 2014. It is important that the Pacific Flyway remain active in this process, and future processes, so that positions of states within the Pacific Flyway are properly voiced and members of Pacific Flyway states are well-informed as changes to regulations are being considered. It is also important that the Pacific Flyway stay current to new and evolving ways to manage DCCOs, with member states and USFWS working collaboratively to find the most effective and applicable management method(s) for the Pacific Flyway.

REVIEW

To improve effective management and ensure that the goal of this plan is met, this plan shall be reviewed periodically, ideally every five years. The NTC shall appoint a DCCO subcommittee to lead and coordinate the review process. An appointed member(s) of the NTC and/or subcommittee shall report information pertaining to, and future revisions of, this plan to Council upon request.

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APPENDICES

APPENDIX A: Breeding Colonies

i) Colony name, year of census, number of nests (i.e., breeding pairs), and locality coordinates for the Western Population of DCCOs from surveys through 2009 (from Adkins and Roby 2010) and more recent estimates. B = breeding known but not assessed. PB = possibly breeding.

	Adkins and Roby 2010				Most Recent Estimates		
Colony	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
BRITISH COLUMBIA							
Northern Strait of Georgia							
Mitlenatch Island	2009	20	49.95	-125			
McRae Islets	2000	1	49.7395	-124.288833			
Christie Islet	2009	0	49.492667	-123.301			
Pam Rock	2009	4	49.486	-123.292333			
Franklin Rock/Merry Island	2000	0	49.466667	-123.916667			
Gulf Islands							
Five Fingers Island	2009	0	49.225667	-123.909			
Hudson Rocks	2009	0	49.221667	-123.921667			
Gabriola Cliffs	2009	43	49.160595	-123.86249			
Canoe Islet	2009	0	49.023667	-123.585833			
Rose Islets	2009	0	49.005	-123.638333			
Ladysmith Harbor	2009	0	48.996294	-123.811594			
Bare Point	2009	0	48.923333	-123.703			
Galiano Island cliffs	2009	47	48.918667	-123.45			
Ballingal Islets	2009	0	48.904167	-123.455			
Charles Island	-	-	48.900833	-123.433333			
Shoal Island (Crofton)	2009	83	48.9	-123.666667			
Second Sister Islet	2009	0	48.838333	-123.453333			
Annette Inlet	2009	0	48.821667	-123.388333			
Red Islets	2009	0	48.809333	-123.352			
Channel Islands	2009	0	48.801167	-123.375333			
Mandarte Island	2009	143	48.633333	-123.283333			
Chain Islets	2009	0	48.419167	-123.266667			
Great Chain Island	2009	0	48.418833	-123.272			
Vancouver Area							
Queen's Reach	1987	0	49.235667	-122.85			
Sand Heads	2009	0	49.105333	-123.290333			
Westshore Terminal	2009	0	49.018333	-123.155			

Colony	Adkins and Roby 2010 Year of Census	Adkins and Roby 2010 Number of Nests (breeding pairs)	Adkins and Roby 2010 Latitude	Adkins and Roby 2010 Longitude	Most Recent Estimates Year of Census	Most Recent Estimates Number of Nests (breeding pairs)	Most Recent Estimates Source
Second Narrows Bridge Power Tower	2009	63	49.294776	-123.032421			
<u>Interior</u>							
Stum Lake	2008	25	52.275	-123.02567			
Creston Valley Wildlife Management Area	2008	98	49.2	-116.58			
WASHINGTON							
<u>San Juan Islands</u>							
Drayton Harbor	2009	142	48.9875	-122.757833			
Puffin Island	2009	0	48.740333	-122.818667			
Little Sister Island	2009	0	48.687167	-122.755			
Viti Rocks	2009	0	48.633333	-122.6195			
Bare Island	2009	0	48.724667	-123.007833			
Waldron Island	2009	0	48.700833	-123.024667			
White Rock	2009	0	48.667333	-123.069			
Gull Rock	2009	0	48.650667	-123.086333			
Flattop Island	2009	0	48.641833	-123.075333			
Bird Rocks	2009	148	48.484667	-122.757167			
Williamson Rocks	2009	0	48.4505	-122.702833			
Goose Island (Cattle Pass)	2009	56	48.457787	-122.957016			
Hall Island	2009	0	48.434333	-122.906167			
Castle Island	2009	0	48.42	-122.818833			
Colville Islands	2009	0	48.409667	-122.8195			
Snohomish River Mouth	2009	249	48.022833	-122.217			
<u>Eastern Strait of Juan de Fuca</u>							
Smith Island	2009	28	48.318	-122.838667			
Protection Island	2009	0	48.123333	-122.925			
Point No Point	2009	0	47.909167	-122.521667			
<u>Olympic Peninsula Outer Coast</u>							
Seal Rock	2009	0	48.3575	-124.541667			
No Name 061	2009	0	48.369333	-124.725333			
Point of the Arches	2009	0	48.241667	-124.693			
Father and Son	2009	0	48.222667	-124.706833			
Bodelteh Islands	2009	0	48.172	-124.755			
White Rock	2009	0	48.134167	-124.733333			
Carroll Island	2009	1	48.003333	-124.719333			
Jagged Islands	2009	0	47.991333	-124.69			
No Name 303	2009	0	47.9525	-124.670667			

Colony	Adkins and Roby 2010 Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Most Recent Estimates Year of Census	Number of Nests (breeding pairs)	Source
Dahodaalah	2009	0	47.950833	-124.668833			
Dahdayla	2009	0	47.934667	-124.666833			
Petrel Island (Kohchaa)	2009	3	47.906333	-124.65			
Gunsight Rock	2009	0	47.904833	-124.650333			
Quillayute Needles	2009	0	47.905167	-124.64			
Ghost Rock	2009	0	47.853667	-124.5675			
Rounded Island	2009	0	47.825833	-124.552167			
Half Round Rocks	2009	0	47.809333	-124.504833			
Alexander Island	2009	0	47.792	-124.502667			
Hoh Head Mainland	2009	0	47.768667	-124.471667			
North Rock	2009	0	47.75	-124.471667			
Middle Rock	2009	0	47.742333	-124.442333			
South Rock	2009	0	47.692833	-124.421667			
Abbey Island	2009	0	47.709667	-124.418333			
Tunnel Islands	2009	0	47.458333	-124.34			
Little Hogsback Island	2009	71	47.435167	-124.3385			
Willoughby Rock	2009	0	47.407	-124.352833			
Split Rock	2009	0	47.404833	-124.357667			
No Name 535	2009	0	47.3925	-124.3575			
Point Grenville Islands	2009	0	47.3	-124.274167			
Grays Harbor							
Goose Island	2009	0	46.973333	-124.068333			
Unnamed Sand Island	2009	0	46.9575	-124.054167			
Grays Harbor Channel Markers	2009	90	46.9545	-123.9005	2010	44	BRNW, Real Time Research Inc.
Interior							
Mouth of Okanogan River	2009	36	48.0925	-119.70983	2010	26	BRNW, Real Time Research Inc.
Sprague Lake, Harper Island	2009	42	47.241	-118.08383	2010	86	BRNW, Real Time Research Inc.
North Potholes	2009	809	47.0406667	-119.40283	2010	830	BRNW, Real Time Research Inc.
Selah, WA	2006	B	46.658	-120.49217			
Hanford Reach	2009	0	46.6548333	-119.41667			
Lions Ferry Railroad Trestle	2009	0	46.5893333	-118.22383			
Goat Island	2009	0	46.2353333	-119.19283			
Foundation Island	2009	309	46.1593333	-118.99117	2010	310	BRNW, Real Time Research Inc.
Vancouver Lake	1936	4	45.673	-122.7175			
Miller Rocks	2009	0	45.657	-120.87183			
OREGON							

Colony	Adkins and Roby 2010				Most Recent Estimates		
	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
<u>Columbia River Mouth</u>							
East Sand Island	2009	12,087	46.258	-123.986833	2010	13,596	BRNW, Real Time Research Inc.
Rice Island	2009	0	46.258333	-123.758333			
Miller Sands Spit	2009	0	46.244651	-123.682977	2010	254	BRNW, Real Time Research Inc.
Miller Sands Navigational Aids	2009	162	46.253333	-123.658			
Other Upper Estuary Navigational Aids	2009	73	46.256993	-123.501669			
Trestle Bay	2009	0	46.218667	-123.987833			
Desdemona Sands Pilings	2009	0	46.206167	-123.8725			
Astoria-Megler Bridge	2009	24	46.200333	-123.8525			
<u>Northern Coast</u>							
Bird Rocks - North	2009	0	45.905667	-123.97			
Unnamed Colony (Oswald West)	2009	95	45.742333	-123.959667			
Three Arch Rocks - Finley Rock (East)	2009	417	45.458667	-123.9845			
Three Arch Rocks - Middle Rock (Middle)	2009	22	45.458333	-123.986167			
Three Arch Rocks - Shag Rock (West)	2009	0	45.457	-123.9875			
Unnamed Colony (Unnamed Rock)	2009	0	45.342333	-123.984			
Unnamed Colony (Cape Lookout)	2009	128	45.335833	-123.989			
Haystack Rock	2009	75	45.207	-123.9855			
<u>Central Coast</u>							
Yaquina Bay Bridge	2006	2	44.619667	-124.0535			
Unnamed Colony	2006	0	44.588833	-124.019			
Heceta Head	2009	0	44.136833	-124.123167			
Conical Rock	2009	0	44.137167	-124.122			
Blast Rock	2009	12	44.135	-124.123667			
Parrot Rock	2009	19	44.1345	-124.123833			
Sea Lion Caves	2009	0	44.119333	-124.121333			
<u>Southern Coast</u>							
Siuslaw River Trees	2009	0	43.959	-124.090833			
Bolon Island	2009	763	43.707	-124.1015			
Unnamed Colony	2009	0	43.688667	-124.167167			
Unnamed Colony	2009	56	43.4385	-124.216833			
Unnamed Colony	2009	183	43.422333	-124.220167			
Chiefs Island (Gregory Point)	2009	0	43.339	-124.372333			
Unnamed Colony	2009	88	43.337333	-124.371667			
Qochyax (Squaw) Island	2009	26	43.336	-124.373333			
Table Rock	2009	125	43.1175	-124.435833			
Middle Coquille Point Rock	2009	0	43.108667	-124.436667			

Colony	Adkins and Roby 2010				Most Recent Estimates		
	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
Elephant Rock	2009	0	43.107667	-124.436167			
Castle Rock	2009	15	42.853833	-124.541833			
Gull Rock	2009	27	42.850333	-124.5545			
Redfish Rocks (East Central)	2009	6	42.692666	-124.470667			
Sisters Rocks Island (South)	2009	49	42.587667	-124.405167			
Hunters Island	2009	222	42.308333	-124.422167			
Unnamed Colony (Unnamed Rock)	2009	1	42.2545	-124.409333			
North Crook Point Rock	2009	0	42.254	-124.408167			
Unnamed Colony (Mack Reef)	2009	24	42.242167	-124.407333			
Unnamed Colony (Mack Reef)	2009	14	42.2405	-124.406167			
Unnamed Colony (Mack Reef)	2009	0	42.234833	-124.408333			
Unnamed Colony	2006	0	42.1695	-124.359167			
Whaleshead Cove (East Rock)	2009	17	42.137167	-124.356667			
Whaleshead Cove (West Rock)	2009	0	21.46	42.1365			
Rainbow Island	2006	0	42.084333	-124.335667			
Interior							
Snake River Unnamed Island	2009	27	43.8417083	-117.00853			
Snake River Unnamed Island	2009	63	44.241948	-117.04232			
Crane Prairie Reservoir	2009	20	43.8116667	-121.78833			
Malheur Lake	2009	0	43.330591	-118.78816			
Sodhouse Ranch (Malheur NWR)	2009	29	43.263857	-118.84297			
Summer Lake, Unnamed Island	2009	0	42.9075	-120.76983			
Upper Klamath Lake	2009	850, 1,270	42.509639	-122.03903	2010	175	BRNW, Real Time Research Inc.
Swan Lake	2009	0	42.323774	-121.60807			
Anderson Lake	2009	0	42.502744	-119.81705			
Rivers End (Lake Abert)	2009	16	42.51	-120.26833	2010	<5	BRNW, Real Time Research Inc.
Crump Lake, Tern Island	2009	0	42.2838333	-119.83967			
Pelican Lake, Pelican Island	2009	36	42.2013333	-119.8765	2010	<5	BRNW, Real Time Research Inc.
Gerber Reservoir	2009	0	42.205018	-121.10474			
Drews Reservoir	2009	0	42.171287	-120.66331			
CALIFORNIA							
Northern Coast – North Section					1989	1,408	Wires et al. 2001
Prince Island	2008	220	41.950667	-124.206833			
Castle Rock	2008	35	41.756167	-124.25			
Tolowa Rocks	2008	0	41.7525	-124.233333			
Unnamed Small Rocks	2008	0	41.7	-124.133333			

Colony	Adkins and Roby 2010 Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Most Recent Estimates Year of Census	Number of Nests (breeding pairs)	Source
Last Chance Rock	2008	0	41.634167	-124.121667			
False Klamath Rock	2008	48	41.59	-124.106			
Radar Station Rocks	2008	57	41.555	-124.1			
Flint Rock Head	2008	0	41.521833	-124.083333			
White Rock (DN)	2008	6	41.509333	-124.084333			
High Bluff South	2008	0	N/A	N/A			
Big Lagoon	2008	42	41.168135	-124.113886			
Sea Gull Rock	2008	13	41.086833	-124.151167			
Sea Lion Rock	2008	0	41.09	-124.158167			
White Rock (HU)	2008	0	41.0855	-124.1555			
Pilot Rock	2008	0	41.051	-124.1515			
Trinidad Bay Rocks	2008	5	41.05	-124.133333			
Little River Rock	2008	100	41.034667	-124.119333			
Arcata Bay Sand Islands	2008	103	40.840381	-124.124112			
Old Arcata Wharf	2008	51	40.8405	-124.105333			
Humboldt Bay Platforms	2008	0	40.717167	-124.234333			
Teal Island	2008	485	40.6911	-124.224			
False Cape Rocks	2008	1	40.506333	-124.39			
Sugarloaf Island	2008	69	40.436333	-124.406833			
Northern Coast – South Section							
Kibesillah Rock	2008	0	39.574833	-123.775167			
Russian Gulch	2008	50	38.466667	-123.156			
Russian River Rocks	2008	25	38.452333	-123.139			
Gull Rock	2008	0	38.421667	-123.118333			
Shell-Wright Beach Rocks	2008	30	38.416667	-123.1			
Dillon Beach Rocks	2008	0	38.271	-122.985167			
Hog Island	2008	285	38.1915	-122.9345			
Central Coast – Outer Coast North							
Point Resistance	2008	0	37.9925	-122.823333			
South Farallon Islands	2008	334	37.7	-123			
Seal Rocks	2008	0	37.773667	-122.508833			
Lake Merced	2009	99	37.719167	-122.490333			
Pillar Point	2008	0	37.488333	-122.4925			
Central Coast – San Francisco Bay							
Russ Island	2008	38	38.176167	-122.3195			
Knight Island	2008	37	38.136	-122.293			
N. San Pablo Bay Radar Target	2008	15	38.100667	-122.323333			

Colony	Adkins and Roby 2010: Year of Census	Adkins and Roby 2010: Number of Nests (breeding pairs)	Adkins and Roby 2010: Latitude	Adkins and Roby 2010: Longitude	Most Recent Estimates: Year of Census	Most Recent Estimates: Number of Nests (breeding pairs)	Most Recent Estimates: Source
N.E. San Pablo Bay Beacon	2008	2	38.0695	-122.286167			
Wheeler Island	2008	126	38.072833	-121.957833			
Donlon Island	2008	0	38.024167	-121.775			
Richmond-San Rafael Bridge	2009	169	37.9335	-122.421			
San Francisco-Oakland Bay Bridge	2009	83	37.818333	-122.3385			
Lake Merritt	2009	68	37.803667	-122.252667			
Alviso Plant, Pond Nos. A9 & A10	2009	0	37.452833	-122.006667			
Dumbarton Bridge Power Towers	2008	160	37.505846	-122.120919			
Bair Island Power Towers (incl. Steinberger Slough)	2008	294	37.523833	-122.2175			
Moffett Power Towers	2009	31	37.444585	-122.065958			
San Mateo Bridge & PG&E Towers	2005	78	37.587333	-122.24			
Central Coast – Outer Coast South							
Schwan Lake	2009	142	36.965273	-121.994564			
Pinto Lake	2009	66	36.955489	-121.771631			
San Lorenzo River Mouth	2009	4	36.964483	-122.012621			
Partington Ridge North	2008	0	36.167667	-121.685667			
Anderson Canyon Rocks	2008	0	36.151167	-121.658833			
Rockland Landing North	2008	0	36.0095	-121.538333			
Cape San Martin	2008	0	35.886167	-121.459167			
Morro Rock & Pillar Rock	2008	14	35.352167	-120.868			
Fairbank Point	2008	225	35.350833	-120.839667			
Shell Beach Rocks	2008	204	35.151	-120.6685			
Southern Coast							
Goleta Slough	2008	11	34.421063	-119.842585			
Prince Island	2008	98	34.054833	-120.333333			
Hoffman Point Area	2008	0	34.040333	-120.358667			
Sierra Pablo Area	2008	16	33.94295	-120.028425			
Scorpion Rocks	2008	0	34.042	-119.541167			
Anacapa Island - West	2008	335	34.006833	-119.419833			
Anacapa Island - Middle	2008	47	34.00454	-119.393078			
Shag Rock	2008	0	33.485833	-119.034167			
Santa Barbara Island	2008	89	33.472833	-119.033833			
Sutil Island	2008	51	33.475	-119.041667			
Cormorant Rock Area	2008	0	33.238833	-119.552833			
Seal Cove Area	2008	73	32.901667	-118.526333			
Ship Rock	2008	0	33.457833	-118.487833			
La Jolla	2008	0	32.8425	-117.259333			

Colony	Adkins and Roby 2010				Most Recent Estimates		
	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
South San Diego Bay Saltworks	2008	55	32.6	-117.116667			
<u>Interior</u>							
Lake Shastina	2009	41	41.5181667	-122.38833			
Meiss Lake, Butte Valley WA	2009	0	41.8535	-122.05717			
Sheepy Lake, Lower Klamath NWR	2009	79	41.9683333	-121.78833	2010	60	BRNW, Real Time Research Inc.
Trout Lake	1992	40	41.6845	-122.47233			
Iron Gate Reservoir - Copco Lake	1980	PB	41.9518333	-122.43367			
Tule Lake NWR, Sump 1A	2009	0	41.896743	-121.52973			
Tule Lake NWR, Sump 1B	2009	0	41.837	-121.442			
Clear Lake NWR	2009	126	41.8885	-121.13717	2010	0	BRNW, Real Time Research Inc.
Goose Lake	2009	0	41.8036667	-120.42017			
Big Sage Reservoir	2009	0	41.5925	-120.6425			
Reservoir F	1970's	13	41.5711667	-120.87367			
Modoc NWR	1977	16	41.4573333	-120.5195			
Eagle Lake, unnamed island	2009	2	40.65946	-120.7148			
Eagle Lake, Pelican Point	2009	0	40.6266667	-120.74083			
Hartson Reservoir	1990	50	40.29	-120.37267			
Butt Valley Reservoir	2009	11	40.1383333	-121.17167			
Llanco Seco Rancho (Sac. River E)	1999	15	39.5761667	-121.98883			
NNE Grimes (Sac. River W)	1999	0	39.1063333	-121.903			
North Butte Country Club, Butte Sink	1999	65	39.2703333	-121.89117			
Sutter Bypass West	1999	12	38.837	-121.65467			
Beaver Lake (Sac. River W)	1999	16	38.8865	-121.807			
Port of Sacramento	1999	0	38.5583333	-121.55367			
North Stone Lake, Stone Lakes NWR	1999	154	38.384	-121.486			
Valensin Ranch, Cosumnes R. Reservoir	1999	3	38.3038333	-121.39167			
Pellandini Ranch	1999	29	38.284	-121.367			
Cut-off Slough, Solano Co.	1920	40	38.1866667	-122.006			
Venice Tip	1999	9	38.0416667	-121.52533			
Clear Lake (Lake Co.)	1999	97	39.0238333	-122.87467			
Petaluma Waste Water Treatment Plant	1999	6	38.2193333	-122.57283			
Laguna de Santa Rosa	1999	59	38.3865	-122.80067			
Arroyo del Valle, Shadow Cliffs Park	2008	14	37.6586667	-121.83633			
San Luis NWR	2009	14	37.126393	-120.58761			
San Joaquin River NWR	2009	0	37.626	-121.193			
Merced NWR (East Side Bypass)	1999	0	37.1673333	-120.62667			
San Felipe Lake	1998	11	36.9756667	121.456167			

Colony	Adkins and Roby 2010				Most Recent Estimates		
	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
Milburn, San Joaquin River Eco. Res.	1999	9	36.8521667	-119.87067			
South Wilbur Flood Area	1999	119	35.8723333	-119.64067			
East Hacienda Ranch	1999	6	N/A	N/A			
Tulare Lake	1907	100's	36.0675	-119.75217			
Corcoran Irrigation District Ponds	1980	6	36.171	-119.5855			
Buena Vista Lake, Kern Co.	1912	300	35.2206667	-119.25867			
Bridgeport Reservoir, Mono Co.	1974	6	38.2903333	-119.22667			
San Gabriel River, Pico Rivera	1999	6	33.9838333	-118.07383			
Santa Ana River Ponds	1999	0	33.8528333	-117.8255			
Anaheim Lakes	1999	105	33.8576667	-117.842			
Sweetwater Reservoir	1999	28	32.7045	-116.97233			
Lake Henshaw, San Diego Co.	1932	B	33.2356667	-116.74133			
Prado Basin near dam	1999	30	33.8895	-117.63833			
Mystic Lake	1999	64	33.8751667	-117.07417			
Johnson St., Salton Sea (No.)	1999	2	33.4575	-116.0565			
East Poe Rd., Salton Sea (So.)	1999	13	33.1003333	-115.73383			
New River mouth, Salton Sea (So.)	1999	30	33.1335	-115.69017			
Alamo River mouth, Salton Sea (So.)	1999	106	33.205	-115.61683			
Mullet Is., Salton Sea (So.)	2009	2,000	33.222	-115.60517			
Ramer Lake, Imperial WA	1998	18	33.0731667	-115.507			
IDAHO							
Gull Island - Minidoka NWR	2009	61	42.662828	-113.45054			
Pelican Island - Minidoka NWR	2009	87	42.662514	-113.45439			
American Falls Reservoir	2009	500	42.59	-112.36			
Blackfoot Reservoir	2009	634	42.898034	-111.61359			
Mud Lake WMA	2009	26	43.877617	-112.37937			
Bear Lake NWR	2009	58	42.188552	-111.31998			
Mormon Reservoir	2008	0	43.255969	-114.82903			
Island Park Reservoir	2009	136	44.405801	-111.54254			
Lake Lowell Sector - Deer Flat NWR	2009	0	43.4	-116.45			
Gosling Island, Snake River Sector - Deer Flat NWR	2009	25	44.12	-117.05			
Stork Island	2009	0	42.5	-116.1			
Foreman Reservoir	2009	0	43.024156	-116.3326			
Henry's Lake	2009	0	44.639291	-111.40265			
Palisades Reservoir	2009	0	43.262017	-111.12894			
Boise River - Hop Road	2009	0	N/A	N/A			

Colony	Adkins and Roby 2010				Most Recent Estimates		
	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Year of Census	Number of Nests (breeding pairs)	Source
Boise River - Wagner 2	2009	50	N/A	N/A			
Boise River - Lemp Lane	2009	20	N/A	N/A			
Payette River - Letha	2009	16	43.907952	-116.64736			
Magic Reservoir	2009	0	43.258535	-114.36619			
Old Castle Rookery A	2004	13	N/A	N/A			
Old Castle Rookery B	2004	14	N/A	N/A			
Emmett Rookery	2009	0	N/A	N/A			
MONTANA							
Warm Springs Ponds WMA	2009	29	46.14264	-112.78429	2010-2011	12	MFWP, unpubl. data
Lee Metcalf NWR	2009	3	46.56965	-114.07844			
Ninepipes NWR	2009	B	47.4317	-114.1171	2012	137	MFWP, unpubl. data
Pablo Reservior	2009	B	47.6291	-114.15645	2010-2011	5-11	MFWP, unpubl. data
NEVADA							
Ruby Lake NWR	2009	100	N/A	N/A	2010	50	NDOW, unpubl. data.
Borderline, East Fork Owyhee River	2009	40	N/A	N/A			
Wildhorse Reservoir	2009	200	N/A	N/A			
Wilson Reservoir	2009	100	N/A	N/A			
Kirch WMA	1994	40	38.419866	-115.08274			
S-Line Reservoir	2009	20	39.297	-118.433	2010	40	NDOW, unpubl. data.
Lahontan Reservoir	1996	18	39.264	-119.404	2000-2010	25	NDOW, unpubl. data.
Humboldt WMA	2007	500	39.594	-118.365			
Anaho Island	2009	200	39.576	-119.308	2010	400	USFWS data
Carson Sink	1987	B	39.815282	-118.76644			
Virginia Lake					2010	25	NDOW, unpubl. data.
UTAH							
Pelican Lake	2009	0	N/A	N/A			
Green River	2009	4	N/A	N/A			
Mona Reservoir	2009	13	N/A	N/A			
Fish Springs NWR, Mallard Pond	2009	2	N/A	N/A			
Ouray NWR	2009	76	N/A	N/A			
Great Salt Lake	2009	82	N/A	N/A			
COLORADO							
Fruitgrowers Reservoir	2009	41	38.828613	-107.9519			

Colony	Adkins and Roby 2010 Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude	Most Recent Estimates Year of Census	Number of Nests (breeding pairs)	Source
ARIZONA							
Painted Rock Dam	1996	5	33.0791667	-113.02083			
Painted Rock Road Exit	2001	8	32.9096047	-112.9568			
San Carlos Lake	2008	50	33.2552392	-110.4383			
Roosevelt Lake	2009	147	33.675	-111.14167	2005-2010	150-200	ADFG, unpubl. data
Lake Pleasant	2009	18	33.9166667	-112.24167			
River Reservoir	2006	30	34.0301665	-109.43586			
Scholz Lake	2009	31	35.1916667	-112.01667			
Willow Creek Reservoir	2009	52	34.6083333	-112.45			
Telephone Lake	2009	26	34.2916667	-110.04167			
Lake Mead, below Hoover Dam	2009	51	36.0096723	-114.74271			

*In the Pacific Flyway portion of New Mexico, nesting has been reported on only one occasion. A single probable nest was documented on Morgan Lake, San Juan County in 2010 during aerial colonial waterbird surveys conducted by New Mexico Department of Game and Fish (New Mexico Department of Game and Fish unpubl. data).

ii) Colony name, year of census, number of nests (i.e., breeding pairs), and locality coordinates for DCCO colonies in Alaska, Mexico, and the portion of Montana within the Pacific Flyway east of the Continental Divide. Colony names in brackets refer to historical colonies which were not active when the colony was last censused. B = breeding; PB = possibly breeding. Alaska and Mexico estimates are from Carter et al. 1995. Montana estimates are from MFWP, unpubl. data.

Colony	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude
ALASKA				
Bristol Bay				
Shaiak Island	1976	300	58°00'00"	161°40'00"
Unnamed Island E. Lagoon Point	1976	10	56°00'00"	161°08'17"
Unnamed Island	1976	30	55°46'17"	160°17'38"
Summit Island	1977	6	58°50'25"	160°12'15"
Crescent Island	1970	6	56°54'07"	158°45'31"
Chistiakof Island	1970	B	56°56'05"	158°42'09"
Lake 65	1976	12	58°16'21"	157°22'34"
Kikertakik Lake	1976	211	58°39'05"	159°14'09"
Aleutian Islands				
Ananiuliak Island	1980	16	53°00'28"	168°54'11"
Chuginadak Island	1982	15	52°51'02"	169°49'41"
Kagamil Island	1982	13	52°59'08"	169°43'16"
Kigul Islet #4	1980	28	53°01'46"	168°27'36"
Paso Point	1981	33	53°23'24"	167°41'20"
West Point	1981	16	53°24'36"	167°34'59"
Peter Island	1981	30	53°41'45"	166°50'24"
Middle W. Usof Bay	1981	18	53°30'24"	166°46'01"
Cape Cheerful	1981	11	54°00'50"	166°41'02"
Triangle Ear	1981	31	53°31'33"	166°38'20"
Cape Yanaliuk	1981	18	53°32'18"	166°35'49"
Unalga Island	1980	41	53°58'50"	166°08'46"
Islet N. Sedanka Bay	1981	36	53°51'22"	166°07'16"
Reef Point	1980	41	54°07'30"	166°06'55"
Cape Morgan	1980	23	54°02'44"	166°02'52"
Egg Island	1980	41	53°51'51"	166°02'38"
Battery Point	1980	15	54°02'00"	165°53'13"
Akutan Point	1980	21	54°08'44"	165°44'17"
Mt. Gilbert, Akun Island	1980	31	54°15'28"	165°40'26"
Akun Head	1980	12	54°17'49"	165°37'41"
Jackass Point	1980	107	54°06'45"	165°34'12"
Rootok Island	1980	10	54°02'34"	165°31'44"
Tanginak Island	1980	41	54°12'03"	165°19'16"
Derbin Island	1980	54	54°04'16"	165°09'17"
Aiktak Island	1980	42	54°11'08"	164°49'58"
Ugamak Island	1992	150	54°12'30"	164°50'00"
Alaska Peninsula South Side				
Sealion Point	1977	PB	54°34'34"	164°56'48"
Cherni Group	1978	385	54°38'12"	162°21'54"
Buyan Island	1978	10	54°52'34"	162°05'17"
Ivan Island	1992	<30	55°30'53"	161°39'24"

Colony	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude
W.-central Koniuji Island	1976	11	55°07'37"	159°39'04"
Yukon Harbor	1976	33	55°03'31"	159°30'36"
Cape Thompson	1976	41	55°13'22"	159°30'36"
E.-central Koniuji Island	1976	9	55°08'29"	159°30'04"
Brothers Island	1979	24	55°55'23"	158°49'23"
Atkulik Island	1979	15	56°16'40"	157°43'55"
Long Island	1979	14	56°47'54"	157°00'14"
Ugaiushak Island	1976	34	56°47'30"	156°51'50"
David Island	1991	<20	57°01'56"	156°29'38"
Portage Bay	1991	<10	57°33'00"	155°58'41"
Puale Bay	1992	25	57°45'20"	155°36'50"
South Central Alaska				
Island in Izhu	1976	5	58°14'36"	152°17'35"
S.E. of Tolstoi Point	1976	11	58°23'18"	152°06'43"
McNeil Cove	1978	14	59°07'32"	154°12'32"
Mushroom Rock	1978	31	59°06'34"	154°10'19"
Amakdedulia Cove	1978	122	59°12'02"	154°08'42"
Contact Point	1978	125	59°21'28"	153°57'22"
Douglas River Island	1978	50	59°04'28"	153°45'29"
Rocky Cove	1978	16	59°28'11"	153°42'14"
South Head	1978	13	59°35'54"	153°33'14"
Knoll Head	1978	13	59°38'15"	153°30'29"
Iniskin Island	1978	50	59°37'32"	153°25'12"
Oil Reef	1978	6	59°37'43"	153°18'22"
Pt. S. Marka Bay	1976	22	58°03'07"	152°39'04"
Chisik & Duck Island	1970	250	60°07'51"	152°33'40"
N.E. Cape Kostrromatinof	1976	8	58°06'12"	152°31'41"
Bet Triangle Cliff	1976	6	58°21'42"	152°29'31"
The Triplets	1989	5	57°59'10"	152°28'23"
Perenosa Bay Islands	1976	10	58°24'36"	152°28'01"
Shuyak-S. Big	1976	8	58°29'00"	152°26'35"
Island Bay Isle	1975	21	57°57'43"	152°24'25"
Bald Triangle	1976	PB	58°30'00"	152°16'30"
SugarLoaf Island	1979	PB	58°53'00"	152°02'00"
West Amatuli Island	1979	PB	58°56'00"	152°03'00"
W. Selezen Point	1976	6	58°07'12"	152°24'00"
Yak Triangle South	1976	11	58°34'12"	152°21'18"
Skat Triangle	1976	11	58°35'54"	152°20'18"
Middle Nuka	1976	5	59°21'47"	150°37'16"
35 Point	1986	3	59°27'01"	150°35'00"
Matushka Island	1986	2	59°36'50"	149°37'30"
Chiswell Island	1986	6	59°36'00"	149°33'50"
Cheval Island	1976	18	59°46'33"	149°30'24"
Hive Island	1976	5	59°53'06"	149°22'16"
Wooded Islands	1976	41	59°52'23"	147°23'17"
S.E. Hinchinbrook Island	1972	31	60°17'02"	146°29'52"
Hook Point	1972	21	60°19'55"	146°15'30"
Point Steele	1972	21	60°20'42"	146°11'54"

Colony	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude
Boswell Rocks	1991	32	60°24'37"	146°06'06"
Pinnacle Rock	1974	16	59°47'23"	144°36'02"
West Kayak Island	1974	23	59°54'42"	144°27'03"
Wingham Island	1974	94	60°02'34"	144°23'32"
<u>Southeastern Alaska</u>				
Hazy Islands	1982	1	55°52'44"	134°35'23"
<u>Interior Alaska</u>				
Egg Island - Becharof Lake	1990	24	-	-
Islands near Severson Peninsula - Becharof Lake	1990	22	-	-
Lower Ushagak Lake	1990	30-40	-	-
Campground Rock-Skilak Lake, Kenai Peninsula	1951	11	-	-
Skilak Rock-Skilak Lake, Kenai Peninsula	1982	7	-	-
Bird Island, Lake Louise, Matanuska-Susitna	1986	30	-	-
Lake Iliamna	<1959	B	-	-
BAJA MEXICO				
<u>Norte and Sur</u>				
Northwest Coast				
Islas Los Coronados	1991	174	32°25'30"	117°15'30"
Islas Todos Santos	1987	50	31°47'00"	116°46'00"
[Isla San Martin]	1975	11,000	30°29'30"	116°06'30"
Isla San Geronimo	1977	100	29°47'30"	115°58'30"
Santa Rosaliaita	1992	400	28°41,30"	114°16'30"
Conchas (Guerro Negro)	1977	75	27°50'00"	114°14'30"
Isla San Benito Este	1932	B	28°18'30"	115°32'30"
Isla Cedros (E. side)	1968	5	28°10'00"	115°10'00"
Isla Natividad	1987	130	27°54'30"	115°13'00"
<u>Southwest Coast</u>				
Isla San Roque	1977	500	27°09'30"	114°22'30"
Isla Ascuncion	1922	PB	27°07'30"	114°16'30"
San Hipolito	1992	5	26°58'30"	113°59'00"
San Ignacio Lagoon	1992	100	26°53'30"	113°09'30"
Puerto Astorga	1992	25	25°11'30"	112°06'00"
Isla Santa Margarita (Las Tijeras Mangrove)	1992	1,500	24°23'30"	111°43'00"
<u>East Coast</u>				
Isla San Jose	<1991	PB	25°05'30"	110°33'30"
Isla Ildefonso	1992	5	24°29'30"	110°24'30"
Animas Bay	1972	21	28°27'00"	113°02'30"
Small Hermanito	1977	11	28°58'00"	113°28'00"
Large Hermanito	1981	8	28°58'00"	113°2730"
Isla San Luis	1986	285	29°58'00"	114°26'00"
SONORA				
<u>Coastal</u>				
Islas San Jorge	1991	100	31°01'00"	113°14'00"
Isla Patos	1977	PB	29°59'00"	111°58'00"
Isla Alcatraz	1975	1,500	28°59'00"	111°58'00"
Isla San Pedro Nalasco	<1991	PB	27°58'00"	111°22'00"

Colony	Year of Census	Number of Nests (breeding pairs)	Latitude	Longitude
Interior				
Roderiguez Reservoir	1990	258	-	-
El Molinito Reservoir	1992	43	-	-
SINALOA				
North Altamura Islets	1975	1,500	25°05'00"	108°14'00"
Isla las Tijeras (Pabellon)	1976	450	24°27'00"	107°34'00"
Bird Island (Punta Copalitos)	1973	25	24°06'30"	107°11'30"
MONTANA - EAST OF CONTINENTAL DIVIDE				
Arod Lake	2012	42	47.996	-112.015
Canyon Ferry WMA	2012	346	46.39329	-111.48426
Freezout WMA	2012	87	47.67903	-112.04038
Red Rock Lakes NWR	2009	225	44.63749	-111.8406

APPENDIX B: Studies of Non-lethal DCCO Deterrence Methods

Additional studies concerning the effectiveness of various non-lethal DCCO deterrence methods (from IDFG 2009).

Hazing Technique	Success and Failures	Habituation to Hazing	Effectiveness	Sources
DOUBLE CRESTED CORMORANTS				
Harassment at roost site	Reduced abundance at roost and at nearby feeding areas when harassment was intense.		Short term	Mott et al. 1998
Harassment at predation site	May require constant harassment, and may still not be effective.	X	Short term	Bayer 2000
Harassment at predation site	Limited effectiveness; difficult to implement.[a]	X	Short term	Glahn et al. 2000
Cracker shells, boats, remote airplanes, effigies	Results difficult to measure. Regional differences. Fish returns influenced by many variables.			Bayer 2000
Long wave length lasers	Use of lasers against cormorants at night roosts resulted in the abandonment of roosts by several thousand birds after three nights.		Long term	Blackwell et al. 2002
Dogs/People	Frightened birds only briefly	X	Short term	Brugger 1995
String barriers ("Arkansas technique")	Effective at reducing predation on aquaculture ponds in Arkansas.		Long term	Radomski et al. 2003
Scarecrows Reflecting tape Pyrotechnics Sound cannons	Limited effectiveness; brief response followed by acclimatization.	X	Short term	Brugger 1995
Autonomous robotic vehicles	Reduced predation in small test facility (flat water, no current)	X		Hall and Price 2003
Breco Bird Scarer©	Ineffective at reducing bird numbers, but slightly effective at modifying behavior (distance from device)	X		Whisson and Takekawa 1998

APPENDIX C: Depredation and Scientific Collecting Permits

In the Pacific Flyway, a Migratory Bird Depredation Permit is required for all lethal means of DCCO take. The USFWS Migratory Bird Depredation Permit form can be found at:

http://www.fws.gov/forms/3-200-13.pdf

This document includes and explains all the necessary information required to obtain a depredation permit. Contact the USFWS Regional Migratory Bird Office if there are any questions. A USFWS depredation permit alone is not valid unless all necessary and applicable state, tribal, and other required permits/approvals are obtained. Check with state, tribal, and local laws and personnel to see whether permits are required for lethal take and non-lethal harassment of migratory birds.

Migratory Bird Scientific Collecting Permits are issued for legitimate scientific research and museum collection where lethal take does not have a population impact on the bird species. The USFWS Migratory Bird Scientific Collecting Permit form can be found at:

http://www.fws.gov/forms/3-200-7.pdf

Other USFWS permit forms pertaining to migratory birds and wildlife can be found at:

http://www.fws.gov/forms/display.cfm?number1=200

APPENDIX D: Pacific Flyway Council Policy Statement — Avian Predation on Fish Resources

I. Purpose and Scope:
This policy statement is intended to provide general guidance to member states of the Pacific Flyway (Flyway) when addressing migratory bird predation issues on fish resources in open waters. The policy establishes guiding principles developed for the Pacific Flyway Council (Council) to consistently respond to avian predation issues in an informed manner. These principles may also serve as a guide to member states responding to more localized bird-fish conflicts in the immediate future that precede Flyway planning and coordination initiated under this policy. Inherent in this policy is the recognition that management of avian predation must be implemented in a manner and at a scale consistent with the conservation of migratory bird populations and the fish populations with which they interact. This policy statement does not apply to hatchery, aquaculture facility, and/or private property concerns as these issues are currently addressed on a case-by-case basis through existing avian management practices.

II. Shared Management Authority:
Migratory birds comprise a shared international resource that provides substantial intrinsic and ecological benefits to the citizens of the U.S. and other countries. Federal authority to manage and protect migratory birds is derived from the Migratory Bird Treaty Act (MBTA) of 1918 [16 U.S.C. 503, as amended]. The Fish and Wildlife Conservation Act (1956) authorizes the coordination between the states and the U.S. Fish and Wildlife Service for wildlife conservation purposes. With specific regard to migratory bird damage control, some states within the Flyway have developed Memoranda of Understandings with the Wildlife Services Division of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service. Therefore, management of migratory birds, including avian predation control throughout the Flyway, is the joint responsibility of state and federal agencies.

III. Guiding Principles:

(1) **Vision and values are clearly and objectively defined —**

a) Migratory fish-eating birds are intrinsically valuable components of naturally-functioning ecosystems throughout the Flyway and are protected under international treaties, and state, provincial, federal, and tribal laws.
b) Native fish populations subject to predation by migratory birds are also intrinsically valuable components of the same ecosystems.
c) Non-native fish populations have other important values (e.g., recreational and economic).
d) The extent to which naturally-functioning ecosystems (relative to both bird populations and fish prey populations) have been altered by artificially-created or human-modified habitats, and/or subject to habitat loss, is acknowledged.
e) Where avian-fish conflicts occur, management options provide opportunities to seek the greatest balance with respect to conservation of both avian and fish resources.
f) Science-based conservation informs issue resolution at all levels of management.

(2) **Avian predation issues are best addressed within the context of population and distribution objectives established for the Flyway —**

a) Coordinated inter-state management is essential.
b) Consultations involve all affected stakeholders within the range of the subject populations.
c) All conservation, economic, recreational, and societal values are fully considered.

(3) **Dialogue between states, provinces, federal, and Tribal partners is critical —**

a) Shared and differing migratory bird management authorities and conservation objectives are considered.
b) Shared objectives for at-risk, candidate or species (birds and/or fish) listed as Threatened or Endangered (T&E) under the Endangered Species Act (ESA) are considered at the appropriate geographic scale.
c) Value of state and provincial recreational interests is considered.
d) Management authority is recognized and respected.

(4) **Responses to perceived avian predation issues are based on sound science —**

a) Magnitude and scope of predation impacts are best demonstrated through empirical evidence.
b) Monitoring, data sharing, data gaps, and research needs are acknowledged and addressed.
c) Expectations of how management actions will reduce impacts to affected fish populations are explicitly addressed.
d) Expected outcomes of management actions on affected avian populations are clearly understood.
e) Measures are implemented to assess effectiveness of management actions and inform future direction (i.e., adaptive management).

(5) **Important considerations when evaluating the need for management action in response to avian predation on fish resources —**

a) Assessment of population-level impacts for both migratory birds and fish.
b) T&E species conflicts.
c) Native species conflicts.
d) Non-native sportfish impacts.
e) Cost-benefit analyses for proposed management strategies.

(6) **Methods for reducing avian predation on fish resources are always implemented within existing regulatory frameworks —**

a) National Environmental Policy Act, ESA, MBTA, and applicable state, provincial, federal, and Tribal regulatory compliance are fully addressed in all proposed management actions.
b) Non-lethal control actions that result in no direct take of nongame migratory fish-eating birds should be attempted first.
c) If non-lethal control actions are deemed infeasible or ineffective, then lethal methods may be considered on a case-by-case basis.

IV. Pacific Flyway Policy Statement: It is the policy of the Council that issues related to migratory bird predation on fish resources in open waters be addressed using the above guiding principles and that comprehensive management plans for migratory fish-eating birds be established by the Council.