Pacific Flyway Plan

A Framework for the Management of American White Pelican Depredation on Fish Resources in the Pacific Flyway

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 AMERICAN WHITE PELICAN DEPREDATION ON FISH RESOURCES IN THE PACIFIC FLYWAY

Prepared for the

Pacific Flyway Council

by the

American White Pelican Subcommittee

and the

Pacific Flyway Nongame Migratory Bird Technical Committee

July 2012

Approved by: _____ 7/31/12
Chair, Pacific Flyway Council Date

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EXECUTIVE SUMMARY

The American White Pelican (*Pelecanus erythrorhynchos*; herein AWPE) is one of two pelican species in North America and breeds predominantly in western and central Canadian provinces and north-central and western U.S. states. There are two rather discrete populations of AWPEs (i.e., Eastern and Western) roughly designated by the continental divide. The AWPEs of breeding colonies at Molly Islands of Yellowstone Lake, Wyoming and Canyon Ferry and Arod Lake, Montana are located just east of the continental divide and are considered within the Western Population. This plan considers and applies to the Western Population of AWPEs.

AWPE numbers and range were reduced throughout the 19th and early 20th century due to human expansion, habitat loss resulting from water use changes, and contaminants. Viability of the population remained in jeopardy throughout the 1940s and 1950s with continued environmental degradation and the widespread use of organochlorine pesticides. The Eastern Population began to stabilize in the 1960s and increase thereafter. The recovery of the Western Population was less pronounced, and there was concern in the early 1980s of a possible Federal listing for the Western Population under the Endangered Species Act (ESA). Since the 1980s, the Western Population has experienced substantial growth and population levels are secure. However, within the Pacific Flyway, AWPEs are currently designated as a state/provincial-listed endangered species in British Columbia and Washington. AWPEs are designated as a Species of Special Concern (SSC) in British Columbia, California, Montana, Utah, and Washington and a Species of Greatest Conservation Need (SGCN) in 7 states. AWPE colony sizes and nesting success fluctuate considerably in the Pacific Flyway due to large scale and regional climatic conditions and cycles. AWPEs in the Western Population show a high degree of interconnectivity between colonies and states.

AWPE depredation at localized areas within the Pacific Flyway is creating conflicts with federal ESA-listed and special status fish and supplemental fisheries. This plan was developed to address these localized conflicts while managing AWPE numbers and distributions at the Flyway scale. The goal of this plan is to maintain AWPEs as a natural part of the waterbird biodiversity of the Pacific Flyway, while minimizing substantial negative ecological, economic, and social impacts of AWPEs. This plan provides a synopsis of AWPE 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 AWPEs in the Pacific Flyway. This plan provides a framework for states and other entities to follow when addressing fish depredation issues involving AWPEs and is not intended to dictate specific management actions or policies. Management of AWPEs 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. This plan is for the Western Population of American White Pelicans (*Pelecanus erythrorhynchos*; herein AWPE). The Western Population includes all AWPEs west of the Continental Divide and the AWPEs of the colonies at Molly Islands of Yellowstone Lake, Wyoming and Canyon Ferry and Arod Lake, Montana.

Purpose

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

Goal

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

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 AWPE 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.—AWPEs are one of two pelican species in North America; the other is the Brown Pelican (*Pelecanus occidentalis*). AWPEs breed predominantly in western and central Canadian provinces and north-central and western U.S. states. There are also non-migratory AWPEs that breed and winter in Texas and Mexico (Knopf and Evans 2004). In the fall and winter, AWPEs typically migrate south to warm (i.e., January minimum temperature >4ºC (i.e., 39ºF) coastal or near coastal regions in central and southern California, southern Arizona, southern and southeastern U.S. coastal states (i.e., Texas to Florida), Mexico, and northern Central America (Root 1988; Knopf and Evans 2004).

Banding data supports the existence of two rather discrete populations (i.e., Eastern and Western) roughly designated by the continental divide. A degree of east-west mixing exists, more so for first year individuals and individuals within the states of Utah, Wyoming, and Montana (Anderson and Anderson 2005, King and Anderson 2005). Recent AWPE studies found no evidence of genetic structuring across the continental divide, and the Eastern and Western designation may be less discrete than previously thought (Oomen et al. 2011, Reudink et al. 2011).

Pacific Flyway.—This plan recognizes the Eastern and Western population designations and considers and applies to the Western Population of AWPEs. The AWPEs of breeding colonies at Molly Islands of Yellowstone Lake, Wyoming and Canyon Ferry and Arod Lake, Montana, which are located just east of the continental divide, primarily winter in California and the west coast of Mexico (Diem and Condon 1967, Hendricks and Johnson 2002) and are considered within the Western Population. Within the Western Population, AWPEs breed at 19 colonies within 8 states and British Columbia (see Western Population).

Biology and Ecology

Description and life history.—AWPEs are colonial-nesting, long-lived, fish-eating birds that are highly recognizable because of their large body size and strikingly white plumage. Typical adult body length is 127–165 cm. Adult body mass is between 5.4–9.0 kg, with male individuals, which are larger, ranging up to 13.6 kg (Behle 1958, Knopf and Evans 2004). Plumage is all white, except for black outer wing feathers, and the large bill and gular pouch is yellow-orange. Mean average life span is 12–14 years, and the oldest recorded banded AWPE was 26.4 years (Clapp et al. 1982). Survival rate was 59% from fledgling through the first year, 84% in the second year, and a mean of 79% for the third through thirteenth year (Strait and Sloan 1974, Ryder 1981).

Habitat.—During the breeding season, AWPEs predominantly use two habitat types for nesting: 1) isolated, permanent islands in freshwater lakes and 2) ephemeral islands in shallow wetlands (Knopf and Evans 2004). Primary winter habitats are shallow coastal bays, inlets, and estuaries with exposed loafing and roosting sites (i.e., sand bars) near foraging areas (Chapman 1988). Some AWPEs will winter inland, on reservoirs, large rivers, and areas below dams that remain ice-free (Knopf and Evans 2004).

Breeding.—Pair formation and egg-laying begins soon after arrival of individuals to nesting grounds, which is the last week of March in Utah (Knopf 1979), late April to early May in Wyoming (Schaller 1964), and early May to late June (i.e., peaking in the second and third weeks of May) in British Columbia (Dunbar 1984). The majority of females begin breeding within their third year (Sloan 1982). Mean clutch size is 2 eggs, but typically only 1 young will survive (Knopf and Evans 2004). Knopf (1979) found >0.85 young fledged/nest at Gunnison Island in Great Salt Lake, Utah and success decreased through time, from approximately one fledgling/nest in April to 0.4 fledglings/nest in June. At Stum Lake, British Columbia during 1963–2002, VanSpall et al. (2005) found 0.62 young fledged/nest (range; 0–1.48 young fledged/nest). At Anaho Island National Wildlife Refuge (NWR), Nevada during 1920–2010, the average number of young fledged/nest was 0.69 (range 0.04–1.63; USFWS, unpubl. data). Continentally, Johnson and Sloan (1978) reported a range of 0.21–1.23 young fledged/nest. AWPE are extremely sensitive to nesting disturbance and will commonly abandon nests. It is not well known if renesting occurs after clutch loss (Knopf and Evans 2004). Knopf (1979) found >22% nest desertion rates in Utah, and more nests were abandoned on the periphery of the colony where disturbance rates were higher. Young chicks are highly altricial and require adults for sustenance, heat, shade, and protection from predators (Johnson and Sloan 1976).

Community dynamics.—AWPEs typically nest in large colonies, which are divided into sub-colonies that vary spatially and temporally within a given geographic area. Sidle et al. (1985) found mean colony size to be 957 nests for 57 colonies across North America. Consistent use of breeding areas typically occurs between years, but AWPE 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. For example, the number of breeding AWPEs at Anaho Island NWR, Nevada over the past 50 years has varied from 2,670 to 21,500, with an annual average of 8,600 and a typical ten-year peak of 13,500 (see Appendix A).

Movement, migration and wintering.—AWPEs of the Western Population are highly migratory, and important wintering areas are coastal regions of Mexico and south-central California, the Salton Sea, Central America, and portions of Arizona (Yates 1999, Knopf and Evans 2004). During the winter, AWPEs congregate in large numbers around areas of available prey and spend the majority of their daily time budget loafing and resting (Knopf and Evans 2004). The Salton Sea is a vital link in the migratory path of AWPEs, and concentrations of AWPEs during the migratory season range between 25,000–33,000 individuals (Shuford et al. 2002), which is >65-85% of the Western Population. AWPEs typically leave for wintering grounds during September to mid-October in British Columbia (Dunbar 1984, BCME 2004) and October–December in Utah (Parrish et al. 1999). The timing of fall departure depends on disturbance levels, food availability, and ice up (Parrish et al. 1999). AWPEs have been occasionally observed staying in British Columbia and along the Columbia River in Washington and Oregon during winter months, but this is not common (USFWS 1984, Campbell et al. 1990, Doran et al. 1998).

AWPEs exhibit varying degrees of interconnectivity among colonies and throughout the year. AWPEs banded at Stum Lake, British Columbia were recovered in British Columbia,

Washington, Oregon, Idaho, Utah, California, and Mexico (BCME 2004). In Idaho, banded and patagial-tagged AWPEs were recovered primarily in Idaho, Utah, and southern California, but recoveries also occurred in Oregon, Montana, Wyoming, Colorado, Arizona, Nebraska, Kansas, Oklahoma, Texas, Arkansas, and Mexico (IDFG, unpubl. data). Smith et al. (1984) observed a high degree of interconnectivity of AWPEs between wetlands within the Klamath, Goose, Warner, and Harney Basins of southeastern Oregon and northeastern California, a >200 km distance. Interconnectivity is typically lowest during the breeding season and highest during the winter. After the breeding season and before migrating south, AWPEs can move substantial distances as they explore spatially and temporally available resources throughout their range. Satellite-marked AWPEs at Anaho Island NWR, Nevada dispersed north several hundred kilometers into the Intermountain West after the breeding season (Parrish et al. 1999, Bates et al. 2006). One satellite-marked AWPE left Anaho Island NWR in early July, flew to northern California, then to southern Oregon, then to southern Idaho, and arrived at the Great Salt Lake, Utah by mid-August. In early/mid-September it returned to north central Nevada then flew to north central Wyoming before migrating south in late September (Bates et al. 2006). Juvenile AWPEs marked at Anaho Island NWR, Nevada dispersed into the central valley of California and areas within the Western Great Basin, and juvenile AWPEs marked at Lower Klamath Lake and Clear Lake, California moved to the Snake River Plain and the Great Salt Lake (Keith and O'Neill 2000).

Feeding.—AWPEs are opportunistic foragers and typically feed in groups, forming lines to drive prey species to shallow water (McMahon and Evans 1992, Knopf and Evans 2004). Foraging flock size varies greatly depending on location and the time of day and year. McMahon and Evans (1992) determined average foraging flock size to be 9.8 individuals (range; 1– >2,000). Nocturnal feeding is a common behavior, more so during the breeding season than the wintering season (Knopf and Evans 2004). AWPEs are known to steal fish brought to the surface by other bird species and con-specifics (Knopf and Evans 2004). Prey species are predominantly small (<0.5 bill length) fish (i.e., carp (*Cyprinus* spp.), suckers (*Castostomus* spp.), chub (*Couesius* spp.), trout (*Oncorhynchus* spp.), and minnows), but crayfish and amphibians are also eaten (Knopf and Evans 2004). Adult AWPEs require approximately 1.8 kg of fish/day, or 20–40% of their body mass/day (Hall 1925). Ideal foraging areas are shallow (i.e., 0.3–2.5 m), open marshes along coastal, lake, or river edges, but AWPE will feed in deep water if prey species are at or near the surface (Anderson 1991, Findholt and Anderson 1995). AWPE prefer areas where prey is concentrated or vulnerable, such as aquaculture facilities and areas with concentrations of stocked or spawning trout (King and Michot 2002, Kaeding 2002, Stapp and Hayward 2002, IDFG 2009).

Landscape variables and prey abundances may affect foraging distances. Breeding colonies are typically <50 km from feeding areas (Knopf and Evans 2004), but AWPEs commonly forage >100 km (Johnson and Sloan 1978, Findholt and Anderson 1995, BCME 2004, Bates et al. 2006). In British Columbia, aerial surveys have documented AWPEs foraging 165 km from the nesting colony at Stum Lake (Wood 1990, BCME 2004). AWPEs from Stum Lake foraged at 40 different lakes, which composed a 30,000 km^2 area on the Fraser Plateau (Harper and Steciw 2000, BCME 2004). AWPEs breeding at Anaho Island NWR, Nevada commonly foraged at Stillwater NWR, Carson Lake, and Walker Lake, which are located >100–160 km from Anaho Island (Shannon et al. 2002, Bates et al. 2006). Fish tag recoveries at Chase Lake NWR, North

Dakota show that the majority of foraging movements (28 of 31 fish recoveries) were within a 128 km radius of Chase Lake, but round-trip foraging distances of 611 km were observed (Johnson and Sloan 1978). Findholt and Anderson (1995) found AWPEs foraging >75 km from the nesting colony at Pathfinder Reservoir, Wyoming.

Threats and Limiting Factors

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). Allocation of water for agricultural/ranching, urban, and wildlife uses can be, and often is, a contentious issue in Western states because water resources are limited. The continued, competing demands for water and land in support of human uses are the greatest threat to regional waterbird populations in general (Ivey and Herziger 2006, Shuford 2010). Low or unpredictable water levels decrease nesting success at colonies by allowing predator access or flooding nests, eggs, and hatchlings (Moreno-Matiella and Anderson 2005, Murphy and Tracy 2005). At Clear Lake Reservoir, California, AWPE nest success was affected by the timing and duration of fluctuating water levels, and water levels dictated predator access to these islands (Moreno-Matiella and Anderson 2005). At Pyramid Lake, Nevada, AWPE adult, nest, and chick abundances were positively correlated with spring and summer flow volumes of the Truckee River, and upriver water diversions depressed AWPE production (Murphy and Tracy 2005, GBBO 2010). Diem and Pugesek (1994) found that maximum seasonal levels of Yellowstone Lake >1.6 m caused near or complete reproductive failures. Conversely, years with maximum lake levels <1.4 m had high fledging success. At Gunnison Island of Great Salt Lake (GSL), Utah, fluctuations in breeding population appear to mirror fluctuations in GSL water levels (see Appendix A).

Predation and continued disturbance at breeding sites are the major mortality factors of AWPE eggs and chicks, particularly hatchlings <3 weeks of age (Knopf and Evans 2004). Common natural predators are red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), badgers (*Taxidea taxus*), raccoons (*Procyon lotor*), gulls (*Larus spp.)*, Common Ravens (*Corvus corax*), Great Horned Owls (*Bubo virginianus*), and Bald Eagles (*Haliaeetus leucocephalus*; Thompson et al. 1979, Koonz 1987, IDFG 2009). Human disturbance (e.g., by foot, boat, or plane) causes adult AWPEs to abandon nests or loafing areas, which increases predation rates and energy expenditure (Knopf and Evans 2004). In long-lived waterbird species, such as AWPEs, reproductive success in any one year may not be as critical to population sustainability as adult mortality (Kushlan et al. 2002). Adult AWPEs are rarely killed by natural predators. Historically, and to a lesser extent now, humans directly killed AWPEs for sport, feathers, or to alleviate suspected impacts to fisheries. Shooting was the greatest cause of mortality of AWPEs banded at Chase Lake NWR, North Dakota during 1928–1972 (Strait and Sloan 1975). Bioaccumulation of contaminants, particularly dichlorodiphenyltrichloroethane (DDT) and its metabolites, contributed to population declines during the mid-20th century (Knopf and Street 1974, Knopf and Evans 2004, Keith 2005). Contaminants continue to pose threats to AWPEs and other waterbirds (Kushlan et al. 2002, Ivey and Herziger 2006). Other causes of mortality are lightning, collision with objects, and hail (Rocke et al. 2005, Knopf and Evans 2004). The greatest mortality recorded from a hailstorm killed 1,624 AWPEs near La Junta, Colorado in 2001 (Rocke et al. 2005).

Disease transmission.—AWPE mortality from disease increased in recent decades (Rocke et al. 2005, Sovada et al. 2008). In the Pacific Flyway, five disease related die-offs of >10 AWPEs (i.e., 594 individuals) were reported before 1990, but, during 1990–2005, the number of die-offs increased to 19 (10,047 individuals; Rocke et al. 2005). Avian botulism, and to a much lesser extent West Nile Virus, are the most prevalent disease of AWPEs. In 1996 at the Salton Sea, California, 8,500 AWPE were killed by avian botulism, which was the largest single recorded die-off of any pelican species and represented 15–20% of the Western Population (Rocke et al. 2005). Botulism is typically found in AWPEs at the Salton Sea to some extent annually (Rocke et al. 2005). Avian cholera, aspergillosis, and Newcastle Disease also cause mortality in AWPE, but incidences of these diseases in the Pacific Flyway are rare or non-existent (Rocke et al. 2005, Sovada et al. 2008, Johnson et al. 2010). Additionally, AWPEs are a host for various fish parasites, especially the digenetic trematode (*Bolbophorus damnificus*). Substantial economic losses to aquaculture producers, predominantly catfish farmers in Louisiana, Mississippi, and Arkansas, have occurred because of this trematode, more so than direct depredation (Overstreet et al. 2002, King 2005).

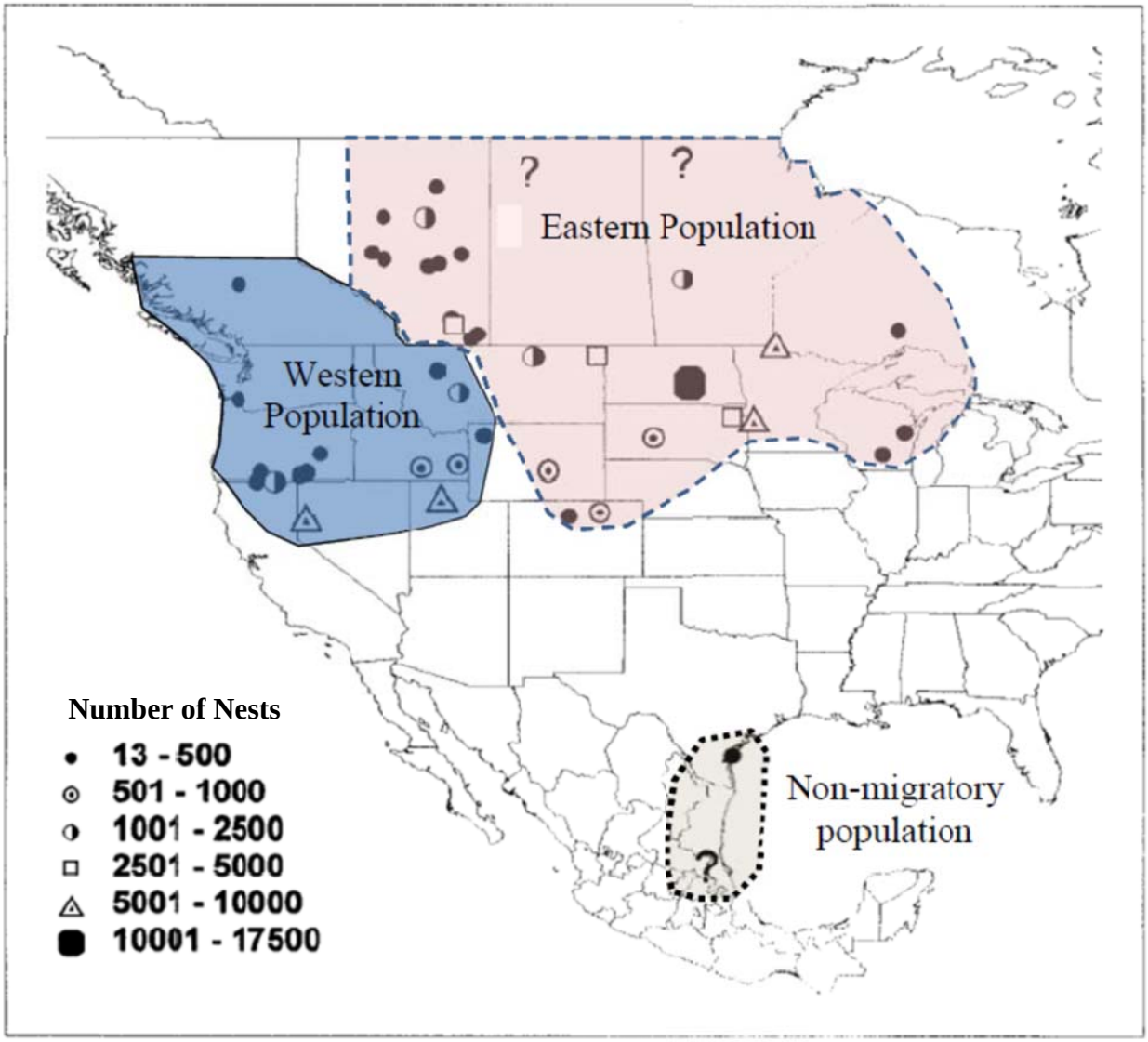
Historical Trends and Population Status

Continental.—AWPE numbers and range were reduced throughout the 19th and early 20th centuries due to human expansion and direct persecution, habitat loss resulting from water use changes (i.e., water diversions, damming, and land reclamation for agriculture), contaminants, and other unknown factors. In 1933, Thompson (1933) estimated that there were 30,000 breeding adults in North America. Viability of the population remained in jeopardy throughout the 1940s and 1950s with continued environmental degradation and the widespread use of organochlorine pesticides (i.e., DDT and its metabolites, toxaphene, endrin, and dieldrin; Sidle et al. 1985, Koonz 1987). The AWPE population, particularly the Eastern Population, began to stabilize in the 1960s and increased thereafter with improved environmental regulations, more legal protection, expansion into new areas and habitats, and, more recently, growth in the aquaculture industry (King and Grewe 2001, Anderson et al. 2003, Keith 2005). In 1963–1964, Lies and Behle (1966) estimated that the continental adult breeding population was 36,200–40,067. During 1964–1981, the number of AWPE nests documented in the U.S. increased from 17,872 to 22,299 (Lies and Behle 1966, Sidle et al. 1985), and, during 1967–1986, the number AWPE nests in Canada increased from 14,103 to 53,345 (Vermeer 1970, Koonz 1987). In 1979–1981, the continental population was >109,000 breeding individuals within 55 known colonies (Sidle et al. 1985). The most recent continental estimate, using survey data from 1998–2001, was 134,000 breeding individuals within 42 known colonies (Fig. 1; King and Anderson 2005). During 1966–1999, the continental population of AWPEs increased 3.2%/year (n=377; 95% CI = -5.7 to 7.0%; Sauer et al. 2011). During 2000–2009, the continental population of AWPEs increased 10.2%/year (n=377; 95% CI = 0.4 to 21.7%; Sauer et al. 2011). The Eastern Population is approximately three times larger than the Western Population (i.e., the percentage of total surveyed nest continentally was 72% in the Eastern Population compared to 28% in the Western Population; King and Anderson 2005).

Considerable uncertainty exists when extrapolating a total population estimate from the number of breeding individuals. Lies and Behle (1966) estimated that the percentage of non-breeders to breeders was 13–22%, and King and Anderson (2005) used 17% to derive a total AWPE population estimate. Aerial surveys conducted in Idaho during 2010, 2011, and 2012 found that

the percentage of AWPEs present but not breeding was 44%, 52%, and 0% of the total estimated AWPE population in the state, respectively. However, it is not well understood what proportion were non-breeders, unsuccessful breeders, or breeders from adjacent areas outside of Idaho, and whether the observed non-breeder to breeder ratio is applicable to other states (IDFG, unpubl. data).

Figure 1. The size and location of AWPE breeding colonies in North America, 1998-2001 (from King and Anderson 2005).



Provinces and states with historic AWPE colonies but lacking recent data are identified with "?"

Western Population.—The historic recovery of the Western Population was less pronounced than the Eastern Population, and there was concern in the early 1980s of a possible Endangered Species Act (ESA) listing (USFWS 1984). In the early 1900s, there was an estimated 60,000 breeding individuals at 23–24 colonies in the Western Population (Paullin et al. 1988, Keith 2005, IDFG 2009). Shuford (2005) speculated that AWPE populations in California during the late 1800s and early 1900s may have exceeded 20,000 breeding pairs at 11 known colonies

across the entire state. During the mid-1900s substantial population losses occurred throughout the Pacific Flyway, particularly within California. By the late 1970s to early 1980s, there were only 16,000 at 5–8 colonies (Paullin et al. 1988, Keith 2005, IDFG 2009). Since the 1980s, the Western Population has experienced substantial population growth. From 1979–1981 to 1998–2001, Western Population AWPE nest numbers approximately doubled, from 9,289 to 18,650 (King and Anderson 2005). Between 1991 and 2009, the Western Population increased 10.1%/year (95% CI = 4.59 to 18.18%; Sauer et al. 2011).

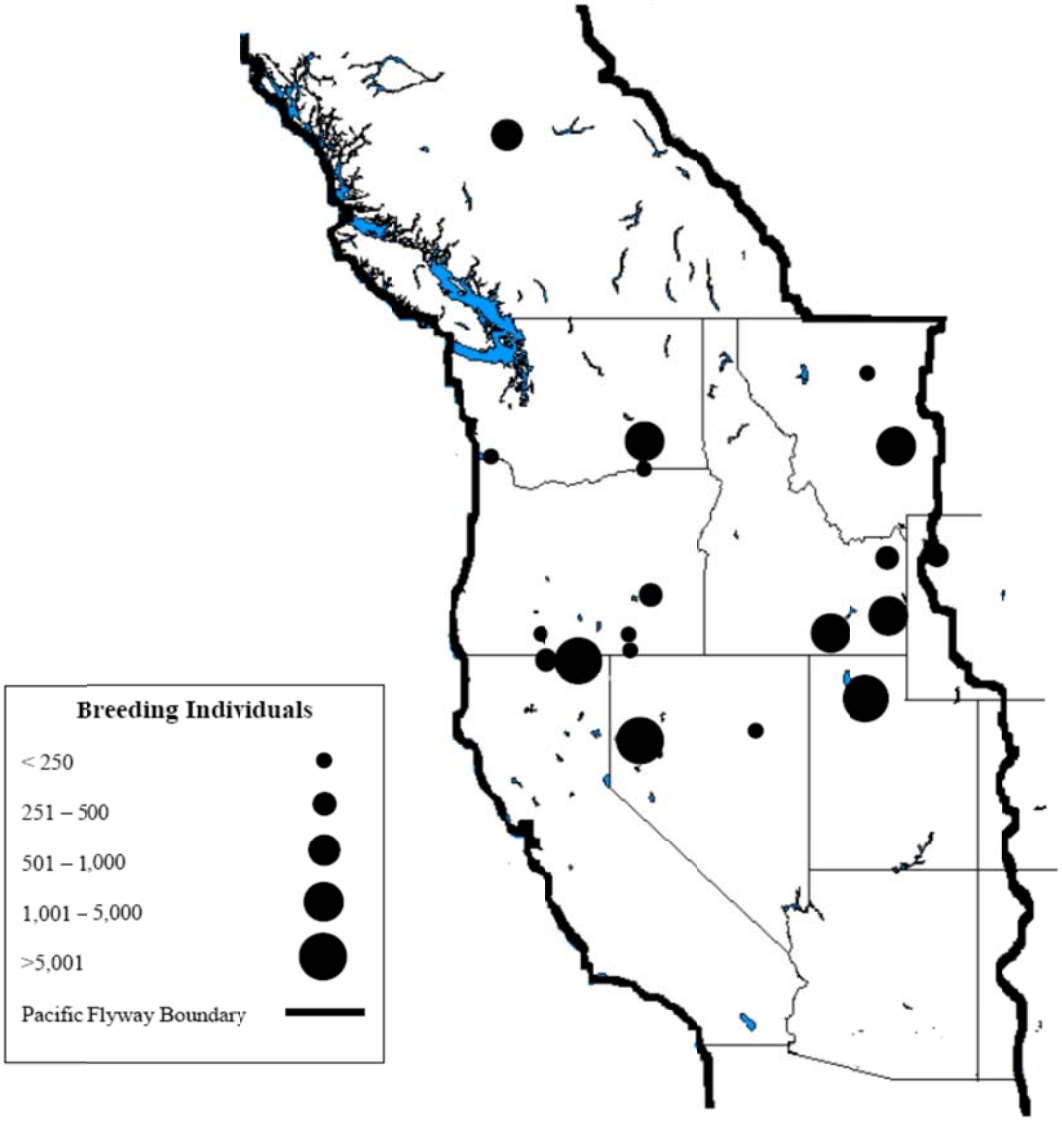
Based on the most recent and available colony estimates, the Western Population of AWPEs is estimated at 45,996 breeding individuals at 19 colonies (Table 1). Idaho Department of Fish and Game (IDFG) (2009) estimated 46,000 breeding individuals at 13–15 known colonies. The most recently established breeding colonies were at Arod Lake and Canyon Ferry, Montana in 1989, Badger and Crescent Island on the Columbia River in the early 1990s, Ruby Lakes, Nevada in 2009, Miller Sands Spit in the Columbia River estuary in 2010, and Island Park Reservoir, Idaho in 2012. Historic breeding colonies at the Lower Klamath NWR, California, and Malheur NWR, Oregon were inactive in the late 2000s (IDFG 2009). The largest AWPE breeding colony in the Western Population resides at Gunnison Island Wildlife Management Area (WMA), Utah, and other large nesting colonies are at Anaho Island NWR, Nevada, Clear Lake NWR, California, Minidoka NWR, Idaho, and Canyon Ferry, Montana (Table 1; Fig. 2).

Table 1. The number of breeding individuals and most recent colony estimates of AWPEs in states/provinces within the Pacific Flyway. [a]

State / Province	Colony Location	# of Breeding Individuals[b]	Year	Source
British Columbia				
	Stum Lake	600	1993-02	Van Spall et al. 2005
California				
	Clear Lake NWR	5,836	2009	Shuford and Henderson 2010
	Lower Klamath NWR	372	2009	Shuford and Henderson 2010
Idaho				
	Blackfoot Reservoir	3,034	2012	IDFG, unpubl. data
	Minidoka NWR	4,408	2012	IDFG, unpubl. data
	Island Park Reservoir	300	2012	IDFG, unpubl. data
Montana[c]				
	Arod Lake	112	2012	MFWP, unpubl. data
	Canyon Ferry	4,102	2012	MFWP, unpubl. data
Nevada				
	Anaho Island NWR	8,000	2011	NDOW, USFWS, unpubl. data
	Ruby Lakes	<50	2012	NDOW, USFWS, unpubl. data
Oregon[d]				
	Crump Lake	130	2011	KBO, WCWS, unpubl. Data
	Malheur NWR	400	2011	KBO, WCWS, unpubl. Data
	Upper Klamath NWR	58	2011	KBO, WCWS, unpubl. Data
	Pelican Lake	130	2011	KBO, WCWS, unpubl. Data
	Miller Sand Spit	100	2010	Roby and Collis 2010
Utah				
	Gunnison Island WMA	16,170	2012	UDWR 2012
Washington				
	Badger Island	1,643	2011	Roby et al. 2011
	Crescent Island	<100	2011	WDFW, agency database
Wyoming[c]				
	Molly Lake	451	2012	WGFD, unpubl. data
TOTAL		**45,996**		

[a] States/provinces not listed have no known breeding population (see Appendix A for colony estimates through time).
[b] In some cases, the number of nests or breeding pairs was multiplied by two to derive the number of breeding individuals.
[c] Estimates for Montana and Wyoming only refer to the Western Population portion of the state.
[d] At some sites, exact colony location differed minimally from location name due to local water conditions. KBO=Klamath Bird Observatory; WCWS=Western Colonial Waterbird Survey.

Figure 2. The size and location of AWPE breeding colonies in the Western Population.



Other Existing Management Plans

In 1984, the USFWS prepared a management plan for the Western Population of AWPEs because of the continued population decline and to identify conservation efforts necessary to preclude a listing under the ESA (USFWS 1984). At the state-level, Idaho developed a management plan in 2009 for AWPEs in the southeast portion of the state (IDFG 2009). IDFG has proposed maintaining a five-year average of 2,800 breeding individuals at existing nesting colonies in Idaho by 2013 (IDFG 2009). 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 AWPEs as a management option (MFWP 2010). AWPEs were 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 Migratory Bird Treaty Act (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. AWPEs are included on 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 AWPEs, 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 the control of migratory bird depredation under certain conditions (see Management Alternatives).

Special status designations.—Continentally, AWPEs have a status of "least concern", the lowest designation under the International Union for Conservation of Nature (IUCN) ranking system (IUCN 2011) and a global rank of G4, "apparently secure" under the NatureServe ranking system (NatureServe 2011). AWPEs are not federally listed as an endangered or threatened species or a species of concern. However, there are conservation concerns at the state and provincial level within the Pacific Flyway. In British Columbia, AWPEs are designated as an endangered species under the British Columbia Wildlife Act (VanSpall et al. 2005, B.C. Conservation Data Centre 2011), and a state-listed endangered species in Washington (Table 2). AWPEs are designated as a Species of Special Concern (SSC) in British Columbia, California, Montana, Utah, and Washington (Table 2). Seven states listed AWPEs as a Species of Greatest Conservation Need (SGCN), and 7 states/provinces have a state/provincial-level NatureServe ranking of "S1-critically imperiled" (Table 2). State/provincial rankings and conservation designations result from few breeding colonies within a state/province and predominantly low numbers of individuals at a colony, which make AWPEs potentially susceptible to population declines or local extirpation.

Table 2. Conservation designations by state/province for AWPEs as of November 2011.

State/Province	NatureServe Ranking[a]	State/Provincial ESA[b] Listed	SGCN[b]	SSC[b]	Other Designations
Arizona	S3				
British Columbia	S1	X		X	
California	S1		X	X	Bird Species of Special Concern Priority Level 1 (breeding)
Colorado	S1		X		
Idaho	S1		X		Priority Species
Montana	S3			X	Tier 3 Species
Nevada	S2		X		Species of Conservation Priority
New Mexico	NA				
Oregon	S2		X		"Vulnerable" on Sensitive Species List
Utah	S1		X	X	
Washington	S1	X	X	X	
Wyoming[c]	S1				PIF Priority Species II

[a] NaturServe's ranking system is 1–5: 1=critically imperiled; 2= imperiled; 3=special concern, vulnerable; 4=apparently secure; 5=demonstrably widespread, abundant, and secure; S = state (NatureServe 2011)
[b] ESA=Endangered Species Act; SGCN=Species of Greatest Conservation Need; SSC=Species of Special Concern
[c] removed from SGCN list in 2010

RESOURCE CONFLICTS

AWPEs are known to consume fish resources that are of conservation significance or have economic or social value. The impacts of AWPEs on fish resources range from minor to substantial, but are often characterized by a lack of information. The section below outlines AWPE resource conflicts.

Fish

Effects of AWPEs foraging on fisheries can be difficult to quantify. A multitude of predator and prey species and environmental conditions contribute to fish population dynamics. AWPE diet is composed of predominantly *Cyprinidae* and *Catostomidae* spp. of low economic value (Derby and Lovvorn 1995, Findholt and Anderson 1995, Knopf and Evans 2004). For example, at Pathfinder Reservoir in Wyoming, >83% of the AWPE dietary biomass was composed of common carp (*Cyprinus carpio*), white suckers (*Catostomus commersoni*) and tiger salamanders (*Ambystoma trigrinum*; Findholt and Anderson 1995). Although sport fishes compose a small percentage of AWPE diet in general, AWPEs are opportunistic feeders, shifting preference to readily and easily accessible food supplies, and have been shown to impact localized populations of fish (Knopf and Kennedy 1981, Knopf and Evans 2004, Teuscher 2004, and Teuscher et al. 2005).

ESA-listed and special status fish.—In southern Idaho, there is concern about AWPE depredation of Yellowstone cutthroat trout (*O. clarkii bouvieri*; YCT) in the Blackfoot Reservoir/River and McCoy Creek (i.e., tributary to Palisades Reservoir) and Bonneville cutthroat trout (*O. c. utah*; BCT) in St. Charles Creek (i.e., tributary to Bear Lake; IDFG 2009, IDFG, unpubl. data). YCT and BCT are both listed as a SGCN in Idaho (IDFG 2005). At Blackfoot Reservoir during 2004, 2007, and 2010, 14%, 33%, and 14% of adult radio-tagged YCT were recovered at AWPE nests, respectively, and these recoveries were estimated to represent 40% of all AWPE depredation due

to defecation of tags outside of the colony (IDFG, unpubl. data). In 2010, AWPEs consumed 71% of Passive Integrated Transponder (PIT) tagged age-1 (≤ 224 mm) YCT (IDFG, unpubl. data). In 2011, AWPE depredation of juvenile YCT was 36% (IDFG, unpubl. data). Data suggests that AWPE impacts to juvenile YCT were most severe during years of high AWPE abundances and low water conditions (IDFG, unpubl. data). To date, empirical data documenting impacts of AWPEs on BCT is limited. In Wyoming, foraging of AWPEs on the Yellowstone River was associated spatially and temporally with related abundances of spawning YCT, and AWPEs consumed 5% of adult YCT spawning in streams (Kaeding 2002, Stapp and Hayward 2002). In Utah, AWPE foraging on spawning BCT at Strawberry Reservoir and its tributaries has been an on-going concern. BCT are listed as a SGCN in Utah. AWPE activity at Strawberry Reservoir and its tributaries increased dramatically during 2000–2006. Few AWPEs were observed on tributaries of Strawberry Reservoir in 2000, but, in 2006, >550 AWPEs were observed (UDWR 2010). An AWPE deterrent and hazing policy was developed (UDWR 2010), and a variety of non-lethal management actions enacted to deter AWPE foraging. In 2005, approximately 2,400 AWPEs were hazed from tributaries of Strawberry Reservoir, which required >289 personnel and volunteer hours (UDWR 2010). In California, AWPE forage on Eagle Lake Rainbow Trout (*O. mykiss aquilarum*), a Fish Species of Special Concern, and CDFG has used non-lethal deterrent measures (e.g., screamers and bangers) to lessen AWPE impacts to spawning fish (CDFG, unpubl. data).

In Nevada, AWPE congregations at Walker River were suspected of depredating federally threatened Lahontan cutthroat trout (*O. c. henshawi*), but no formal assessment has been conducted (NDOW, pers. comm..). AWPEs forage on, and may be hindering recovery of the federally endangered Cui-ui (*Chasmistis cujus*), which is a sucker endemic to Pyramid Lake, Nevada and spawns in the lower Truckee River (Murphy 2005). This conflict is most severe when alternative non-game fish populations (i.e., tui chub and carp) are less available due to water availability in the Lahontan Valley and Humboldt Sink wetlands. Two other federally endangered suckers, the Lost River Sucker (*Deltistes luxatus*) and the Short-nose Sucker (*Chasmistes brevirostris*) are found in the Klamath Basin in northern California/southern Oregon, Clear Lake Reservoir, California and other nearby lakes, which are areas where AWPEs forage. No formal assessment has been conducted to evaluate AWPE impacts to these fish species (Murphy 2005).

In Oregon and Washington, impacts of avian depredation on the 13 federal ESA-listed salmonid (*Oncorhynchus* spp.) stocks in the Columbia River Basin have been an on-going concern. Since the late 1990s, the Badger Island AWPE colony has experienced significant growth and the number of non-breeding AWPEs along the Columbia and Snake rivers has increased (Roby and Collis 2010). Based on smolt PIT tag detections, AWPEs do not appear to be a significant source of smolt mortality (Roby and Collis 2010).

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 AWPEs on hatchery stocks can result in economic loss due to loss of both hatchery production and 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 Idaho, there are concerns about AWPE depredation on hatchery-reared trout in areas surrounding AWPE colonies. At Blackfoot Reservoir, Idaho, Teuscher (2004) and Teuscher et al. (2005) estimated that AWPEs and Double-crested Cormorants (*Phalacrocorax auritus*) consumed 7.6 tons of rainbow trout and 27% of newly-stocked rainbow trout were consumed during the first week after stocking. In 2011, tags from 32% of the PIT-tagged rainbow trout in Chesterfield Reservoir were detected on two islands of Blackfoot Reservoir (IDFG, internal reports). Based on PIT-tag recovery efficiencies in this area, IDFG suspects consumption of rainbow trout by AWPEs could have been close to 100% of stocked fish at Chesterfield Reservoir (IDFG, internal reports). Costs associated with these depredation losses can be substantial. For example, IDFG estimated that it cost $20,800 to replace the 3.2 tons of trout consumed by AWPEs from Daniels Reservoir in 2008 (IDFG 2009). In Montana, fish survival has been an ongoing concern in the Upper Missouri River. AWPE 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 AWPEs is needed prior to implementing controls (MFWP 2010).

Fish culture facilities.—AWPEs forage on concentrations of easily accessible fish; thus, fish reared at fish culture facilities (i.e., aquaculture facilities and state, Federal, and tribal hatcheries) are particularly vulnerable to AWPE depredation. Fish at fish culture facilities also experience loss from AWPEs in regard to stress on fish, disease, and parasites (Overstreet et al. 2002, King 2005). The Pacific Flyway has not documented the prevalence of aquaculture related conflicts as south and southeastern states, predominantly with catfish facilities (King 2005, USDA APHIS WS 2010), and there are no long-standing, pervasive AWPE conflicts at fish culture facilities. Under depredation permits, 16 AWPEs were taken at aquaculture facilities during 2005–2010, and 10 AWPEs were taken by a private pond operator in Montana in 2004. In California, the aquaculture industry has voiced concerns over increasing conflicts with piscivorous birds, including AWPEs, and are advocating for future research to better quantify depredation impacts.

Other Bird Species

In the Pacific Flyway, there are no long-standing, pervasive, or current AWPE conflicts with other bird species. Other birds compete with AWPEs for nesting/resting sites and food resources, but these competitive effects have not been well quantified. Competitive dominance of any of these species has not been documented. Additionally, prey differences among bird species that overlap in foraging areas with AWPEs further reduce competition (Knopf and Evans 2004). AWPEs commonly nest in close proximity to Double-crested Cormorants and gulls (*Larus* spp.), and less frequently, Canada Geese (*Branta canadensis*), Great Blue Herons (*Ardea herodias*), Common Terns (*Sterna hirundo*), and Caspian Terns (*Hydroprogne caspia*); Knopf and Evans 2004). Gulls, Common Ravens, Great Horned Owls, and Bald Eagles (as well as mammalian predators) commonly depredate AWPE nests (Thompson et al. 1979, Koonz 1987, IDFG 2009). No study has brought attention to the need for management to control bird species depredating AWPE nests.

MANAGEMENT

The intention of this document is to provide information relevant to AWPE management in the Pacific Flyway, with emphasis on how to maintain viable AWPE 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 AWPE 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 AWPE 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 depredations 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 the National Environmental Policy Act (NEPA). The AWPE is not a non-native species (options 3) nor overabundant throughout its range (option 4). Therefore, options 3 and 4 are not appropriate tools for the management of AWPEs 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 Environmental Assessment (EA) or Environmental Impact Statement (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.

During 2005–2010 in the Pacific Flyway, 432 AWPEs were authorized for take under depredation permits, and 16 AWPEs were lethally taken (USFWS depredation permitting records, 2005–2010). The number of AWPEs taken within each state was: California (Imperial and Kern Counties; 10), Colorado (Jackson County; 3), and Wyoming (Park County; 3). All take occurred at aquaculture facilities. In 2004, 20 AWPEs were authorized for take, and 10 AWPEs were lethally taken by a private pond operator in Teton County, Montana.

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.

Scientific collecting and airport depredation permits.—Lethal take of AWPEs 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. During 2005–2010 in the Pacific Flyway, 202 AWPEs were authorized for take under Scientific Collecting permits and 73 were lethally taken. All 73 AWPEs were taken by IDFG to evaluate the effectiveness of using lethal control to reduce the impacts of AWPEs on YCT in the Blackfoot Reservoir/River (see Management Alternatives and Appendix A for more detail). No AWPEs were taken under Airport Depredation permits during 2005–2010.

Management Alternatives

Non-lethal and lethal methods are available to manage AWPEs 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, Gorenzel et al. 1994, 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 AWPEs 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 AWPEs, which typically habituate to these measures (Gorenzel et al. 1994, King 1997, Carter 2001, Tiller et al. 2003, IDFG 2009). Disturbance using airplanes can be quite effective, but efforts must be sustained to cause lasting results (Gorenzel et al. 1994). When using these hazing techniques in combination and with continued persistence, and before AWPEs establish feeding patterns, the methods can achieve greater and more lasting effects. Hazing may need to be conducted at night since AWPEs forage nocturnally (Knopf and Evans 2004). Greater long-term effects can be achieved by hazing at loafing and resting sites compared to foraging sites (King 1997, Glahn and King 2004). Additionally, hazing at foraging sites can scatter AWPE concentrations, which makes future disturbance more difficult to administer if the area of depredation is large. 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 AWPE predation at aquaculture facilities and hatcheries (Gorenzel et al. 1994). However, the cost of obstruction devices and barriers can be great at large scales and are not applicable in many open water scenarios. Flagged monofilament lines were used in the Blackfoot River, Idaho to reduced AWPE predation of YCT, but effectiveness was dependent upon water levels (Wackenhut and Farnsworth 2006, IDFG 2009). Continued human presence and using string and flagging to cover stretches of stream were the most effective methods of deterring AWPE activity on tributaries of Strawberry Reservoir, Utah (UDWR 2010). Obstruction devices can effectively dissuade AWPEs from nesting. Barrier fencing and fladry have been used at Blackfoot Reservoir, Idaho to reduce the area available for nesting AWPEs. This technique has been successful at eliminating AWPE nesting within the treated area (IDFG, unpubl. data). However, similar to hazing methods, these measures must be applied before egg laying has commenced.

3) Habitat modifications can be undertaken to reduce AWPE accessibility to exposed loafing and resting areas (e.g., planting vegetation/trees, removing man-made structures or making them unsuitable for use, etc.). To reduce AWPEs nesting at an area, nest sites can be made less desirable by increasing ground cover and/or flooding the area.

4) Alterations of fisheries management practices can reduce AWPE predation. Effective management actions pertaining to released fish include: 1) releasing fish away from areas of AWPE concentration; 2) changing the time of release during the year so as to avoid peak AWPE concentrations; 3) randomly changing locations of fish release; 4) dispersing fish upon release; 5) releasing fish during high water levels or controlling for high water levels to reduce AWPE foraging efficiency; and 6) modifying habitat to provide fish refuge from AWPE depredation.

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 AWPEs.

1) Few studies have documented the effects of AWPE lethal control. In 2005, IDFG was issued a scientific collection permit authorizing take of up to 50 AWPEs annually on the Blackfoot River, Idaho to evaluate the effectiveness of lethal control used in combination with hazing regimes. Thirteen, 10, and 50 AWPEs were shot in 2006, 2008, and 2009, respectively, and, in 2009, pyrotechnics (i.e., discharged twice daily from mid-May–mid-June) were used in conjunction with lethal take. These efforts caused short term decreases in AWPE numbers at the sites of hazing. AWPE use and numbers were not reduced in the long term, and there was no documented reduction of depredation on YCT (IDFG 2009, IDFG, unpubl. data). Studies have shown that shooting of Double-crested Cormorants, when conducted in conjunction with other harassment techniques, can be effective at ameliorating 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 (Glahn et al. 2000, USFWS 2009).

2) Nest and egg destruction (i.e., such as addling with corn oil) as management controls have never been documented, if ever used, on AWPEs. These management controls had variable results at reducing Double-crested Cormorant populations (Hatch and Weseloh 1999). 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 Double-crested Cormorant 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 Double-crested Cormorant populations. On Young Island, Vermont, Double-crested Cormorant nesting numbers were reduced to zero in four years by egg-oiling all nests and culling 20% of adults (Strickland et al. 2011).

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. In 2010, IDFG released three badgers, two of which were radio-marked, and two radio-marked skunks on Gull Island in Blackfoot Reservoir, an area where AWPEs nest and which was used historically by badgers before removal by APHIS in 1991–1992 (IDFG 2009, Miller 2010). The released predators vacated Gull Island soon after release, and no impacts to AWPEs were observed (Miller 2010).

Breeding areas.—From the early 1900s through the 1980s, the Western Population of AWPEs experienced population declines and breeding range retractions largely as a result of habitat loss, water use changes, and lack of reliable food resources in proximity to secure nesting colonies. This species is currently the focus of conservation concern in many of the Pacific Flyway states and provinces (see Table 2). For these states and provinces, management should consider and/or implement actions that promote healthy breeding colonies. Management alternatives for breeding areas of conservation concern are described below.

Management actions to improve breeding success include: 1) minimizing human disturbance and establishing adequate buffer zones; 2) protecting nesting colonies from predators and flooding; 3) creating adequate nesting habitat; and 4) establishing new colonies.

1) To protect against disturbance, Carney and Sydeman (1999) recommended buffers >100–600m around breeding colonies from humans and boats, and, in Alberta, approaching within 800m of AWPE breeding areas between April 15 and September 15 is illegal (Ontario Ministry of Natural Resources 2011). In British Columbia, aircraft flight restrictions of <610m were imposed over Stum Lake (Bunnell et al. 1981). Similar disturbance-free, safety zones should be established for primary feeding and winter resting areas.

2) When possible and appropriate, water management practices can be used to maintain or improve breeding success at AWPE colonies. Actions may include protecting colonies from low water conditions to reduce predator access, reducing flooding that can destroy nests or kill fledglings, or managing water levels to reduce disease outbreaks. Identification of priority habitat areas for a given breeding season dependent upon current and expected water levels can help managers concentrate efforts, and barriers (i.e., water, fences, electric fences, etc.) can be used to exclude predators. For example, after identifying important nesting habitat from hydrologic and topographic computer modeling, electrified fences were used successfully at Clear Lake Reservoir, California to protect AWPE breeding colonies from predators (Moreno-Matiella and Anderson 2005).

3) If nesting habitat is limited, islands of soil or dredged material can be created to increase the number of available nesting sites. The islands should be flat, well-offshore, and at least 0.1 ha in size (USFWS 1984, Stepney 1987).

4) Translocation efforts to establish new breeding colonies have yet to be proven effective (Knopf and Evans 2004). AWPE captive rearing programs, particularly using the ill-fated, last-hatched offspring, have been successful at rearing fledglings when implemented (Knopf and Evans 2004).

Recommended Management Strategies

This plan establishes three objectives and associated strategies to facilitate AWPE 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 AWPE management plan in the future.

A. Population Assessment Objective
Identify, develop, and implement monitoring protocols necessary to determine AWPE 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 AWPEs 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.

Strategy 1: Develop and implement standard monitoring protocols during breeding and wintering seasons to help determine AWPE (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 AWPEs 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 AWPEs is important to better elucidate population shifts and movements through time and to aid in addressing resource conflicts at the local and flyway scale.

Strategy 2: 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 AWPEs among colonies, foraging areas, and populations. Gathering this information will provide the data necessary to understand relationships within and among AWPE populations within the Pacific Flyway and more accurately delineate management units. Efforts should be made to understand the factors affecting AWPE populations in areas where populations are limited or have decreased.

B. Impact Reduction Objective

State wildlife agencies may address local impacts of AWPEs 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 AWPEs 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 AWPEs. 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 AWPE depredation impacts on fish resources of concern.

Impacts of AWPE depredation on fish resources should be clearly documented with empirical evidence. An assessment and quantification of the effects of AWPE 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 AWPE populations should be clearly stated. Non-lethal and lethal methods currently exist to manage fishery related AWPE 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).

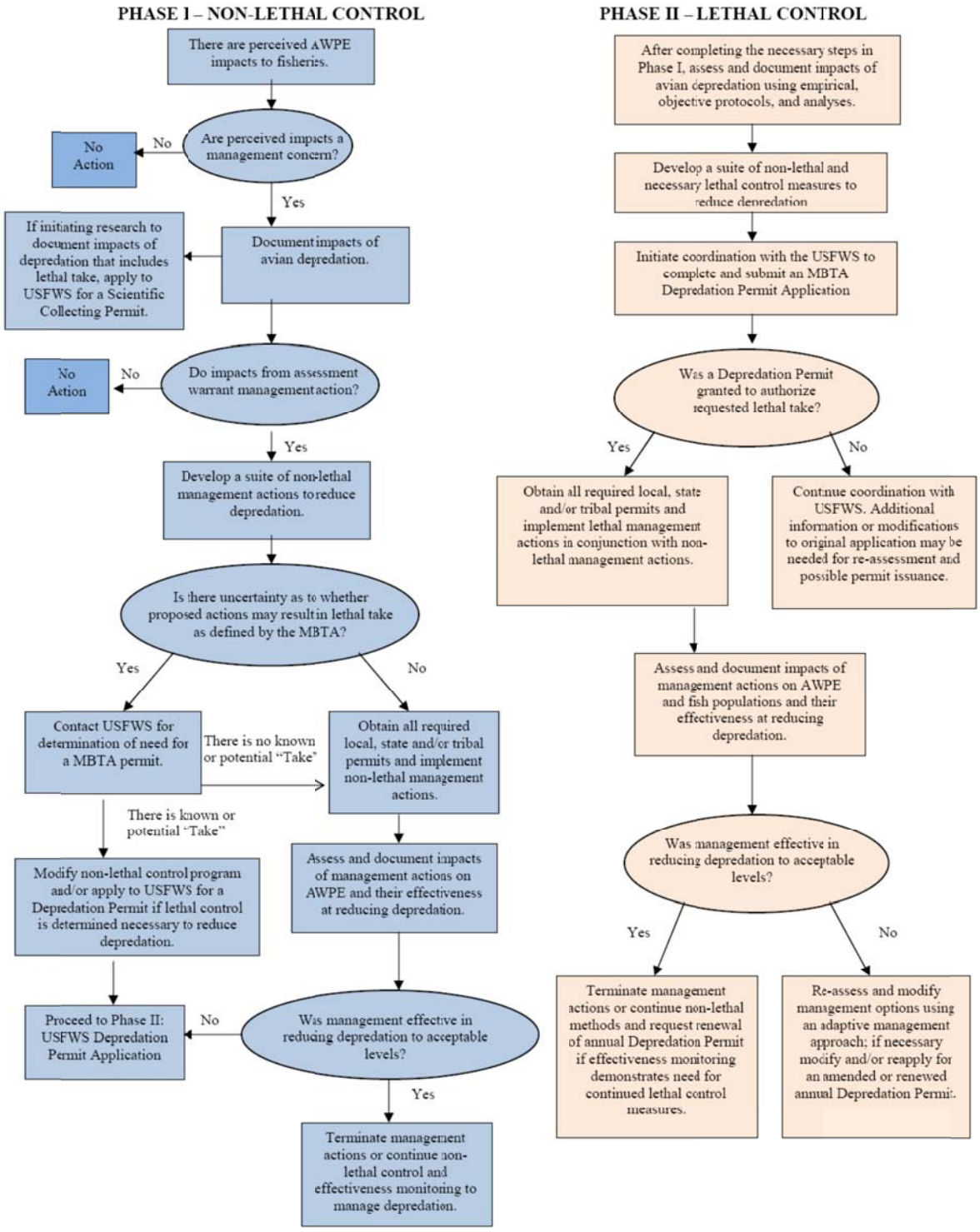
Strategy 3: Implement effectiveness monitoring.

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

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

Modeling options should be explored to assess the impact of take on AWPEs 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 AWPE population reduction objectives.

Figure 3. 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 C, and contact USFWS for specific information and guidance regarding Depredation Permits and Scientific Collecting Permits.

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

Population information and AWPE 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 AWPE 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 AWPEs 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 AWPE management actions in Pacific Flyway.

Annual reports from the USFWS that summarize take of AWPEs 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 AWPEs 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 AWPEs 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 AWPE research and management. A variety of options should be explored, including multi-agency agreements and public-private partnerships.

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 an AWPE 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

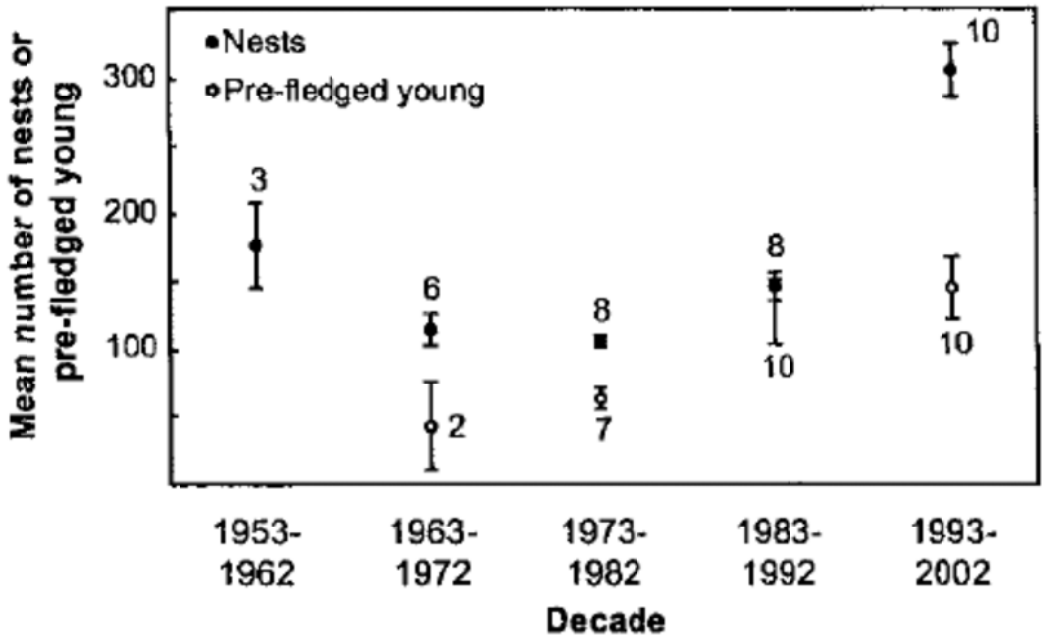
APPENDIX A: State/Provincial Colony Information

Alaska.—AWPEs are accidental in southeast Alaska; only reported once or twice (Osborne 1982, ADFG, unpubl. data).

Arizona.—AWPEs have never been documented nesting in Arizona. Highest winter concentrations are along the lower Colorado River. The largest single concentrations noted in recent years were 300–500 individuals (AGFD, unpubl. data).

British Columbia.—Stum Lake is the only AWPE breeding colony in British Columbia, and during 1993–2002, the number of nests averaged approximately 300. AWPEs are listed as an endangered species in British Columbia (BCME 2004, VanSpall et al. 2005).

Figure 1. Mean number of AWPE nests and pre-fledged young at Stum Lake, British Columbia, 1953–2002 (from VanSpall et al. 2005). The numbers above or below each vertical standard error bar represent the number of complete surveys for that decade.



California.—CDFG is currently working with PRBO Conservation Science and the USFWS to complete statewide colonial waterbird surveys for 17 species of birds, including AWPEs. These surveys are expected to be completed in 2012 and a final report published in 2013. Shuford (2010) estimated 2,346–3,039 AWPE breeding pairs for the state of California from surveys during 1997–1999. The number of AWPE nests range between 600–2,300 on average in recent years, representing between 1,200 to 4,600 breeding individuals (CDFG, unpubl. data). AWPEs currently only breed at Sheepy Lake in the Lower Klamath NWR and Clear Lake NWR (Shuford and Gardali 2008, Shuford 2010, CDFG, unpubl. data).

Figure 2. Numbers of AWPE fledglings and nests at Lower Klamath NWR, California, 1950–2000 (from Shuford 2005).

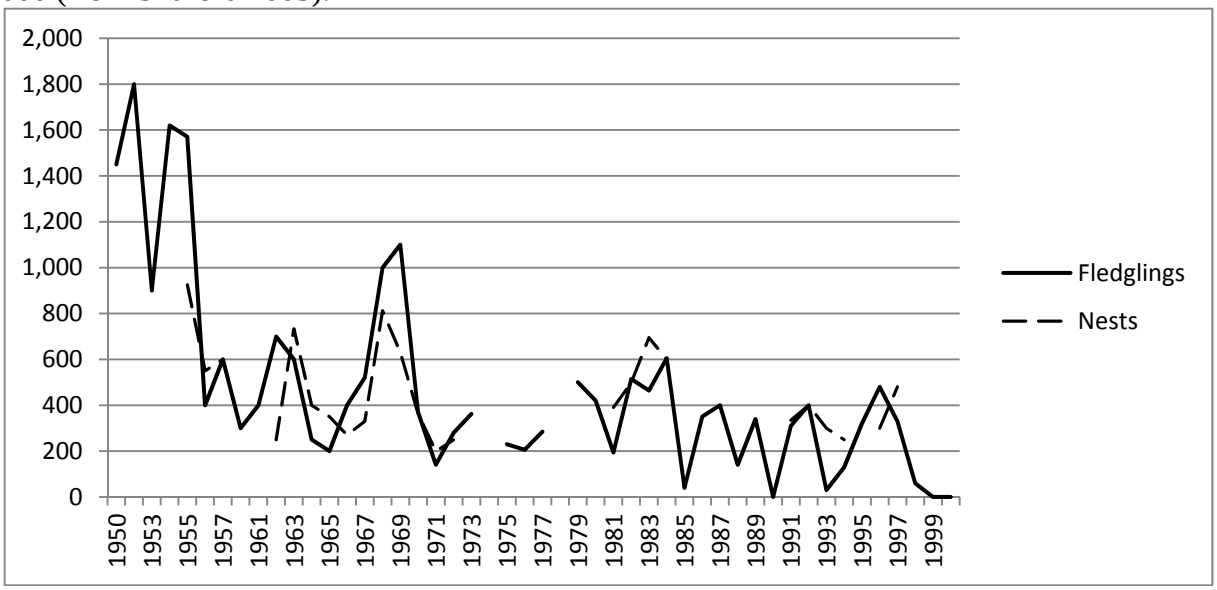
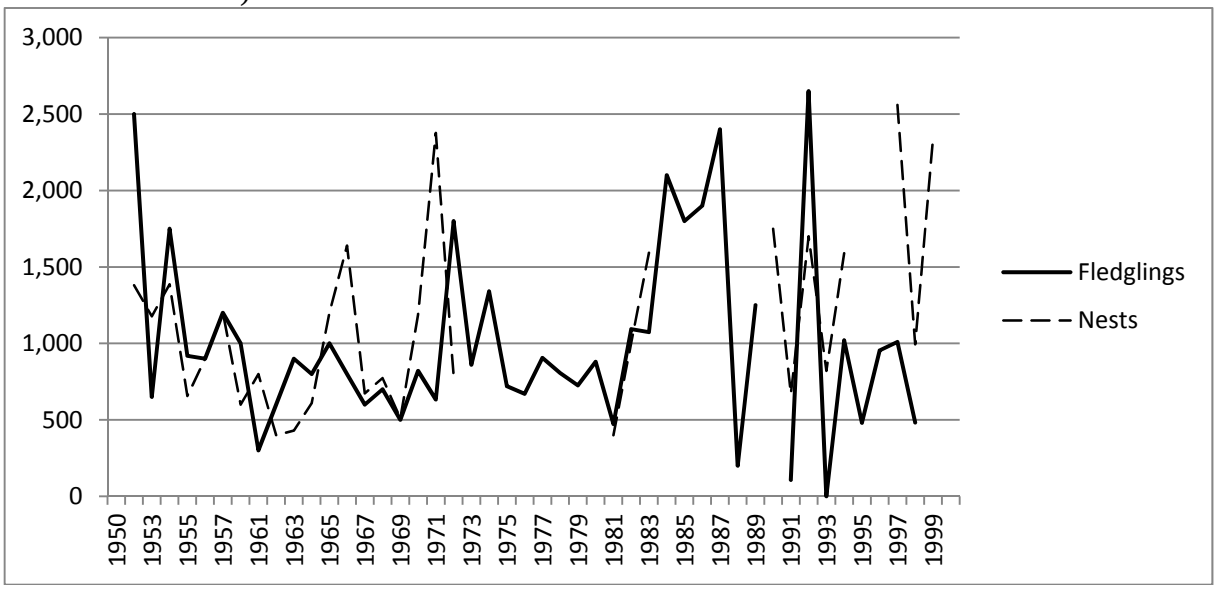


Figure 3. Numbers of AWPE fledglings and nests at Clear Lake NWR, California, 1950–2000 (from Shuford 2005).

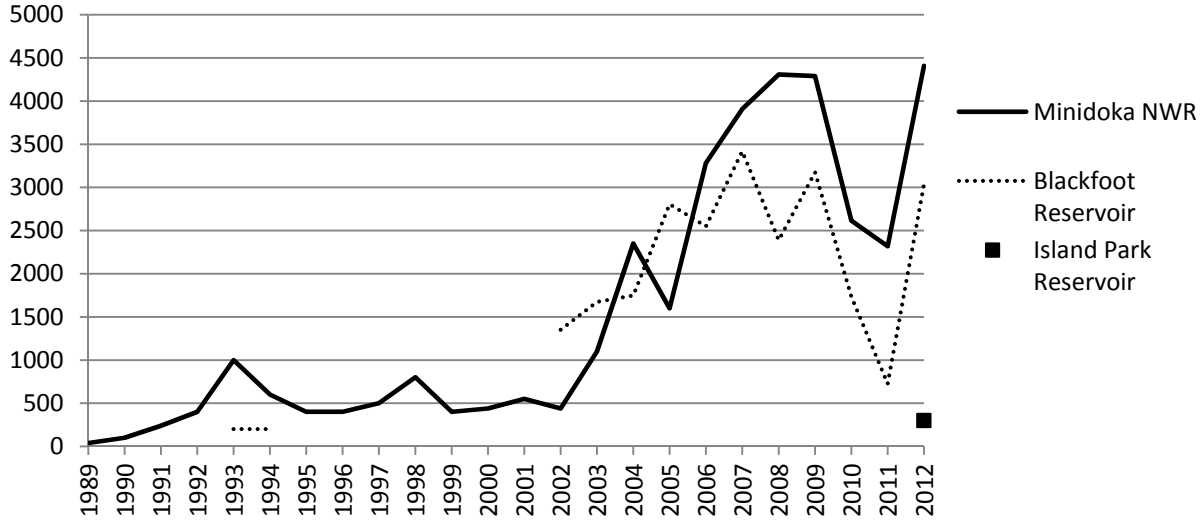


Colorado.—No estimate of breeding AWPEs in the Pacific Flyway portion of Colorado has been made, but the number, if any, is few. In the Central Flyway, total AWPE population is likely >2,500 breeding individuals.

Idaho.—The minimum estimate of AWPEs (breeders and non-breeders) in Idaho in late May/early June 2011 was 6,297 individuals, which includes 3,042 breeders. In 2011, there were two nesting colonies in Idaho: Minidoka NWR (2,318 breeding individuals) and Blackfoot Reservoir (724 breeding individuals; IDFG, unpubl. data). The estimated mean nest success for

the two islands of the Blackfoot Reservoir colony was 34% from 2008–2011. In 2012, a new colony at Island Park Reservoir was established (300 breeding individuals), and the number of breeding individuals at Minidoka NWR and Blackfoot Reservoir were 4,408 and 3,034, respectively.

Figure 4. The number of AWPE breeding individuals at Minidoka NWR (1989–2012), Blackfoot Reservoir (1993 and 2002–2012), and Island Park Reservoir (2012), Idaho (IDFG, unpubl. data).



IDFG personnel conduct annual ground-based nest surveys at the Blackfoot Reservoir colony. IDFG, in collaboration with USFWS, conduct annual ground-based surveys at the Minidoka NWR colony. Nest surveys are conducted the last week of May or first week of June. Nest counts are used to obtain an estimate of the breeding population at individual colonies and statewide. For the Blackfoot Reservoir colony, pre-fledglings counts in late summer are used to obtain an estimate of productivity.

In 2009-2011, IDFG conducted aerial surveys of areas which are used by AWPE to obtain a statewide population estimate. In 2009, this survey was conducted in late summer, during the late breeding/migration time period. In subsequent years, this survey has been conducted during early June to coincide with the nest count surveys. The aerial survey, in conjunction with the breeding population estimates, provides an estimate of the number of AWPE in Idaho that are non-breeders or breeding birds associated with nesting colonies in other states.

IDFG began banding and patagial tagging juvenile AWPE at the Blackfoot Reservoir and Minidoka NWR nesting colonies in 2007. Resightings and band returns are expected to provide information on wintering areas, migration movements and colony fidelity. This banding and tagging project is expected to continue in 2012 and perhaps further into the future.

IDFG is conducting studies to determine predation rates by AWPE on adult and juvenile YCT in the Blackfoot Reservoir and upper Blackfoot River drainage. These studies include radio-tagging adult YCT and PIT-tagging juvenile YCT. IDFG, in cooperation with Idaho State University,

helped support a Master's Degree research project investigating AWPE predation on adult YCT. The thesis for this project is nearing completion.

IDFG is conducting AWPE management activities at the Blackfoot River and the nearby Blackfoot Reservoir nesting colony. Attempts to haze AWPEs from a portion of the Blackfoot River began in 2002. Hazing has included a mix of lethal and nonlethal measures. Nonlethal measures have included propane cannons, pyrotechniques, boats, ATVs and habitat manipulation. Hazing approaches have been variable in technique and intensity. In 2008 and 2009, volunteers hazed AWPE from the river segment twice daily from mid-May through about mid-June.

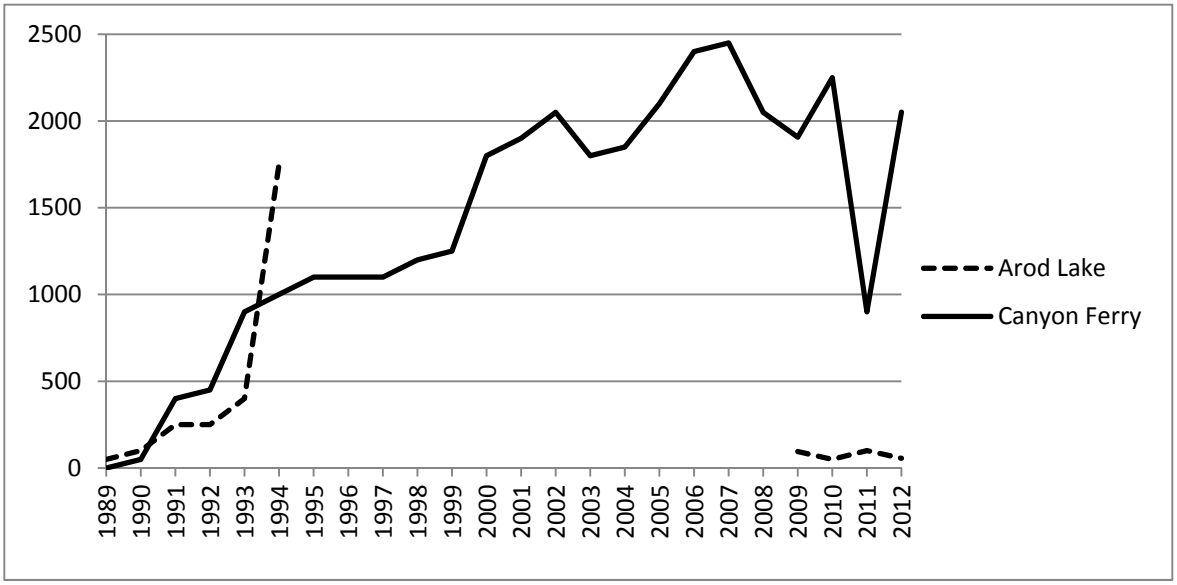
In 2005, IDFG installed flagged lines across sections of the Blackfoot River to discourage AWPE foraging. While birds avoided foraging within the lined sections, river fluctuations during spring runoff created a maintenance concern and safety risk, due to lines being submerged or washed out.

To test if non-lethal hazing may be more effective when conducted in combination with lethal hazing (take by shotgun), IDFG first obtained a scientific collecting permit from the USFWS in 2005. The permit authorized take of no more than 50 birds annually between May 1 and June 15. No birds were shot in 2005 and 2007; 13 were taken in 2006, 10 in 2008, and 50 in 2009. In 2009, USDA APHIS WS administered the scientific collection permit issued to IDFG for lethal take of 50 AWPE in the described river segment in conjunction with the nonlethal hazing. Results were inconclusive due in part to confounding variables known to change behavior of both YCT and AWPE (e.g., water temperature, river discharge, and prey availability).

In an effort to reduce the breeding population at the Blackfoot Reservoir colony, IDFG is implementing habitat manipulation techniques. In spring 2010, a perimeter fence (orange snow/construction barrier fence) and interior fladry (flagged lines) were installed over one-half of one of the Blackfoot Reservoir AWPE colony nesting islands prior to the onset of bird nesting. This action reduced the area available to nesting AWPE, and there was a reduction in the number of AWPE initiating nesting in 2010 compared to 2009. Fencing and fladry were installed over a larger portion of the island in 2011, further reducing the area available for nesting. AWPEs initiated nesting on the untreated portions of the island, however high water subsequently flooded these nests.

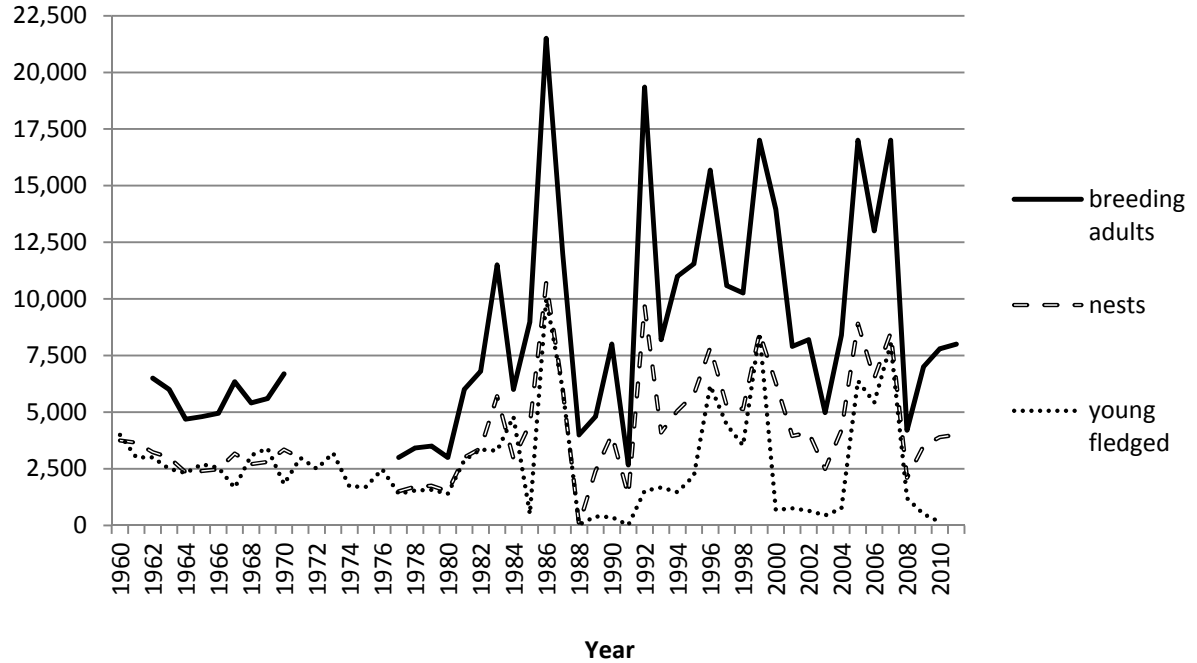
Montana.—There are four known AWPE breeding colonies in Montana; two which are considered within the Western Population (i.e., Canyon Ferry and Arod Lake). Estimates from the Western Colonial Waterbird Survey conducted 2009-2011 estimated 5,000–6,000 AWPE breeding pairs statewide. The two Western Population colonies comprise approximately 40% (i.e., 2,000–2,400 breeding pairs) of the Montana AWPE breeding population. The number of nests at Canyon Ferry fluctuated around 2,000 from 2000-2010. Arod Lake currently has the smallest colony in Montana (approximately 100 nests; MDFWP, unpubl. data). In 2011, primarily due to water conditions, nests numbers were <1,000 at Canyon Ferry. In 2012, the estimated number of nests at Canyon Ferry and Arod Lake were 2,051 and 56, respectively. Montana Fish, Wildlife, and Parks (MFWP) plan to continue to estimate the number of breeding AWPEs at colonies in Montana, in cooperation with staff at the National Wildlife Refuges.

Figure 5. Number of AWPE nests at Arod Lake and Canyon Ferry in Montana, 1989–2012 (MDFWP, unpubl. data).



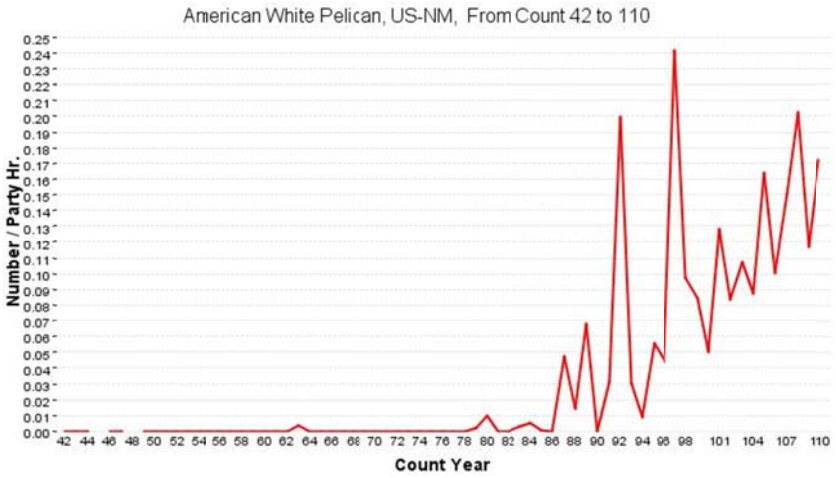
Nevada.—The number of AWPE breeding individuals at Anaho Island NWR over the past 50 years has varied from 2,670–21,500, with an annual average of 8,600 and a typical ten-year peak of 13,500. In 2011, there were 4,000 nests and an estimated 8,000 breeding individuals. In 2009, a second, small nesting colony (i.e., 25-50 breeding individuals) was established at Ruby Lakes NWR (NDOW, unpubl. data).

Figure 6. Number of AWPE breeding adults, nests, and young fledged at Anaho Island NWR, Nevada, 1960–2011 (NDOW, unpubl. data).



New Mexico.—AWPEs have never been documented nesting in New Mexico, though there have been some incidental, unverified reports that AWPEs might nest in Colfax County. Non-breeding AWPEs are found statewide during all four seasons on large bodies of water, and concentrations are highest during the migratory season. Christmas Bird Count (CBC) data indicate annual fluctuations with abundances increasing (NMDGF, unpubl. data).

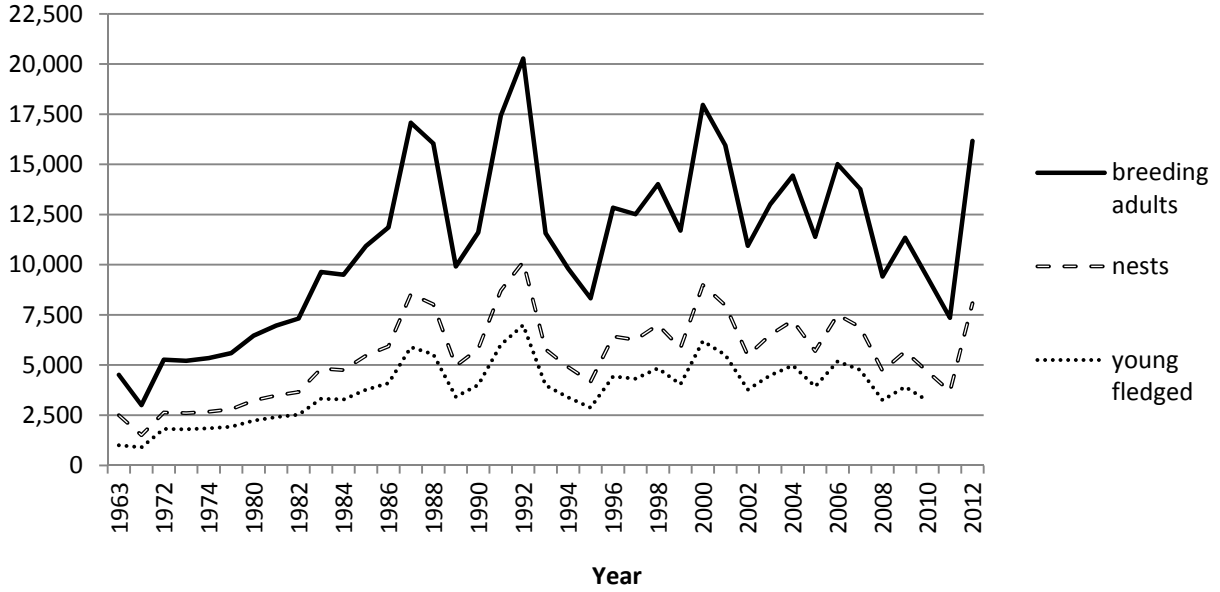
Figure 7. Christmas Bird Count (CBC) data for New Mexico during 1942–2009.



Oregon.—Breeding sites and colony sizes of AWPEs in Oregon experience extensive annual variation. Breeding sites include, but are not limited to, Malheur NWR, Lower Klamath and Upper Klamath NWRs, Summer Lake Wildlife Area, the Warner Basin, and islands in the Columbia River (Marshal et al. 2003). 2010 was the first record of AWPEs nesting in the Columbia River estuary on Miller Sand Spit (Roby and Collis 2010). AWPEs were included in the 2011 Western Colonial Waterbird Survey; a summary report will be available in 2012. AWPEs are an Oregon Conservation Strategy Species (ODFW 2005) in the Northern Basin and Range Ecosystem, and are listed on the State Sensitive Species List as Vulnerable.

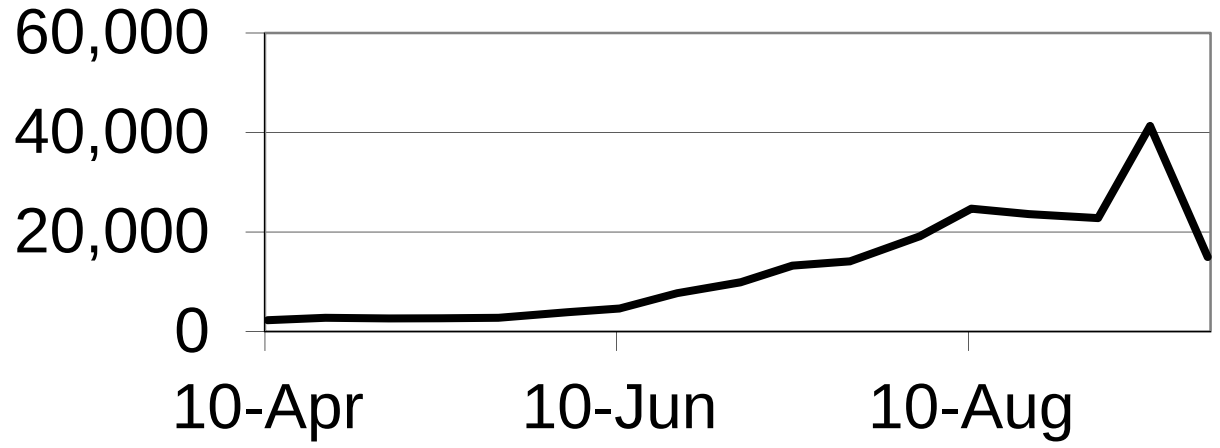
Utah.—Gunnison Island WMA, Great Salt Lake (GSL) is the only nesting site for AWPEs in Utah. This colony currently ranks as one of the largest breeding colonies in North America and represents one of the three most stable and productive sites on the continent (Parrish et al. 2002). In 2012, the number of breeding adults was 16,170 (Fig. 1).

Figure 8. Number of AWPE breeding adults, nests, and young fledged at Gunnison Island, Utah, 1963–2012 (UDWR 2012).



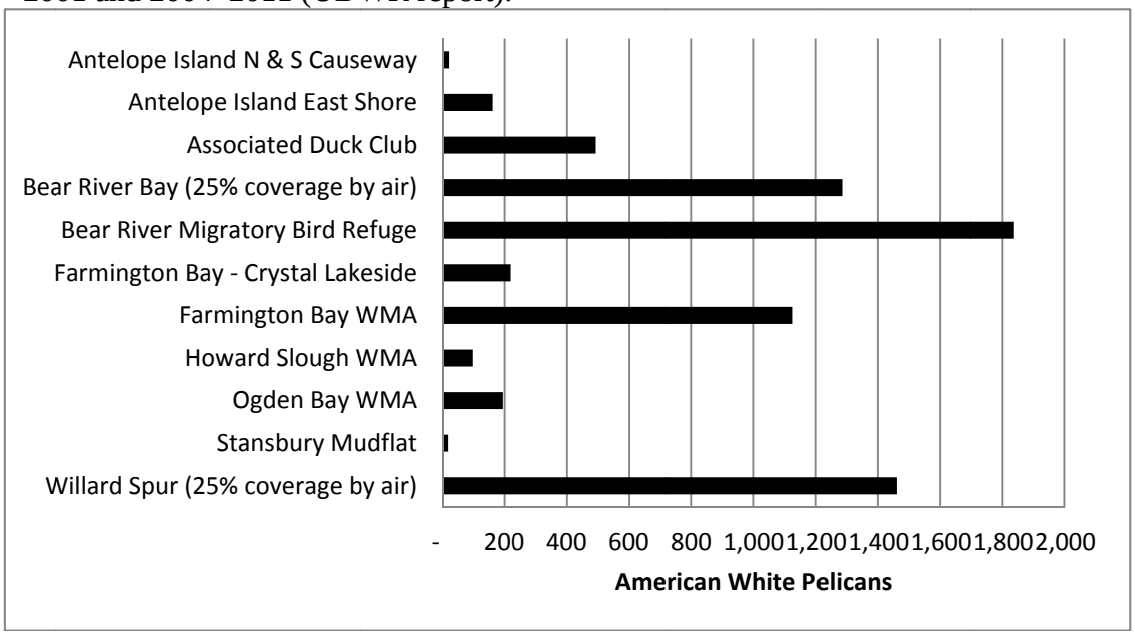
The average total number of AWPE observed at GSL was >40,000 during 1997–2001, and numbers peaked during early September, which may represent observations of fledglings leaving the colony at Gunnison Island. Numbers decreased throughout September as AWPE departed from the area in the fall (Fig. 2).

Figure 9. Mean number of AWPE at GSL, Utah by survey period during 1997–2001 (UDWR



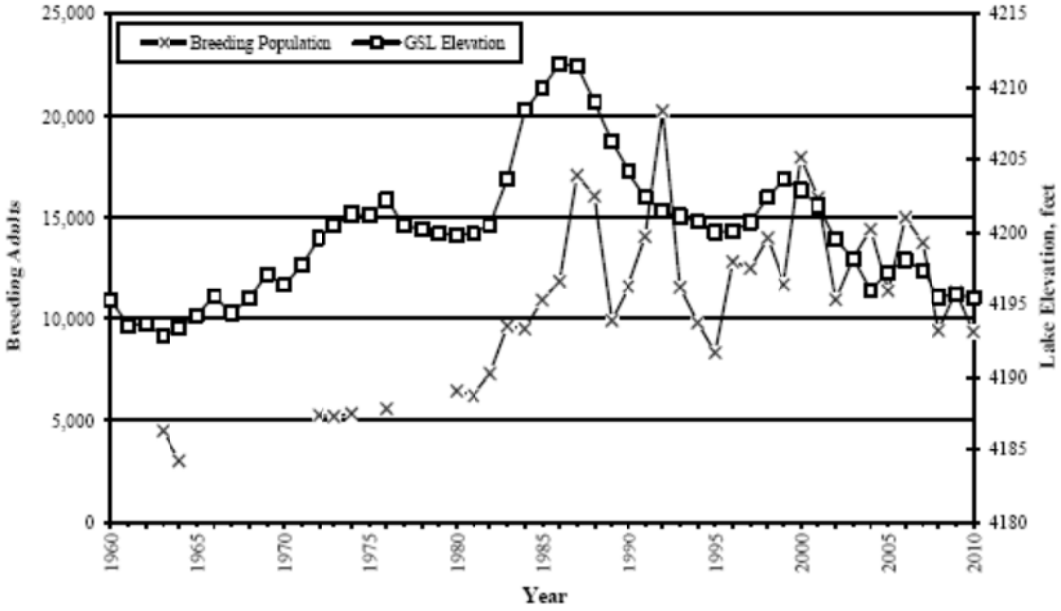
Many areas of GSL are used by AWPE, but the northern portions of the GSL (i.e., Bear River Bay, Bear Migratory Bird Refuge, Farmington Bay WMA, and Willard Spur) are consistently frequented by AWPEs throughout the breeding season (Fig. 3; Paul and Manning 2002, UDWR report).

Figure 10. Average annual early August AWPE counts for select GSL, Utah survey areas during 1997–2001 and 2004–2011 (UDWR report).



Water levels may influence AWPE breeding population on Gunnison Island. Fluctuations in breeding population appear to mirror fluctuations in water levels (Fig. 4). More detailed analyses on this effect and how water levels influence population demographics are needed.

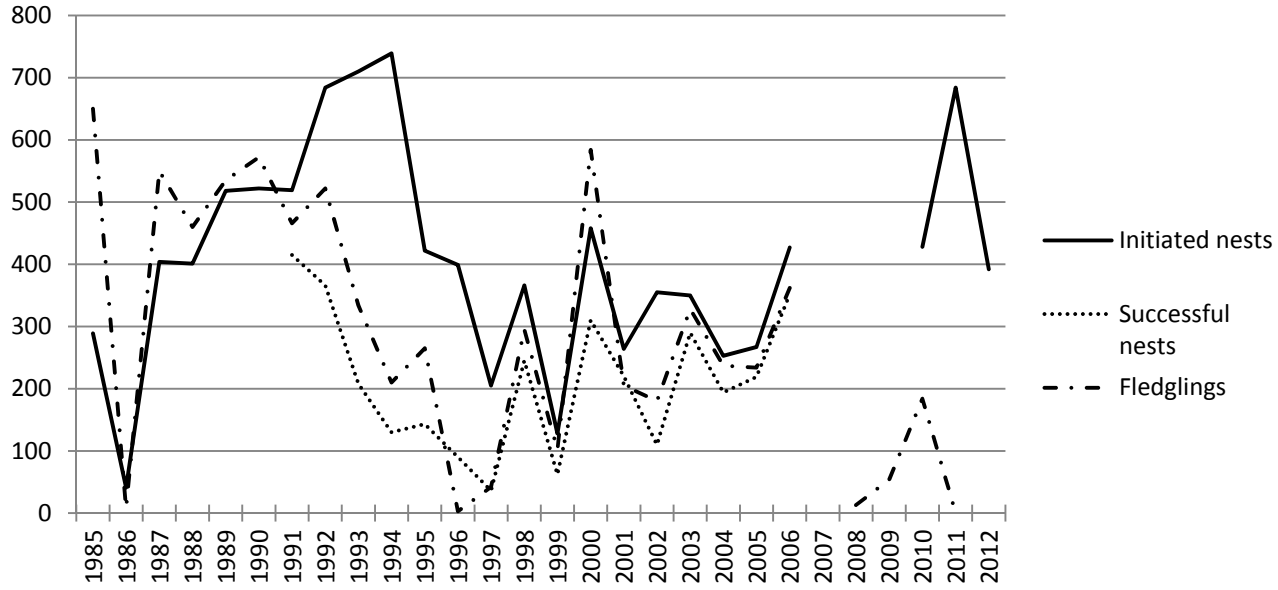
Figure 11. AWPE breeding populations compared with yearly May GSL, Utah South Arm elevation during 1963–2010 (UDWR 2012).



Washington.—AWPEs began nesting at Badger Island in 1997 and at Crescent Island in 1994 (Ackerman 1994, Doran et al. 1998, Wahl 2005). Badger Island is currently the largest and main colony in Washington, and, in 2010, there were 1,643 breeding individuals (Roby et al. 2011). The Washington population, including Crescent Island, was likely somewhat larger but not assessed (J. Buchanan, WDOW, pers. comm.). AWPEs are a state-listed endangered species in Washington.

Wyoming.—Molly Islands, Yellowstone Lake (used annually since early 1900s) is the only AWPE Western Population breeding colony in Wyoming. In 2011, there were 684 nests, but, due to flooding, zero fledglings survived in 2011. In 2012, there were 392 nests. Current estimate of AWPE breeding individuals is 1,000–1,500 (WGFD, unpubl. data).

Figure 12. The number of initiated nests, successful nests, and fledglings at Molly Islands, Yellowstone in Wyoming during 1985–2012.



APPENDIX B: Studies of Non-lethal AWPE Deterrence Methods

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

Hazing Technique	Success and Failures	Habituation to Hazing	Effectiveness	Sources
PELICANS				
Harassment at loafing site	May cause abandonment of the site, thus eliminating predation in localized problem areas.		Long term	King 1997 Glahn and King 2004
Harassment at predation site	Flocks fragment and harassment becomes more difficult.		Short term	King 1997 Glahn and King 2004
Nocturnal harassment	24-hour harassment necessary due to nocturnal foraging.			King 1997 Littauer et al. 1997 Glahn and King 2004
Nocturnal harassment: Bright spotlights	Easily frightens birds.			King 1997
Border collies	Reduced "bird" abundance in an area up to 20 square miles. Particularly effective on large waterfowl. Densities restored shortly after dog harassment stopped.		Short term	Carter 2001
Aircraft	Ultralight aircraft have been used by producers to intercept large flocks of birds and herd them away from commercial facilities. This has been most effective with large concentrations of pelicans.		Short term	Gorenzel et al. 1994a

APPENDIX C: Depredation and Scientific Collecting Permits

In the Pacific Flyway, a Migratory Bird Depredation Permit is required for all lethal means of AWPE 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) Nonlethal control actions that result in no direct take of nongame migratory fish-eating birds should be attempted first.

c) If nonlethal 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.