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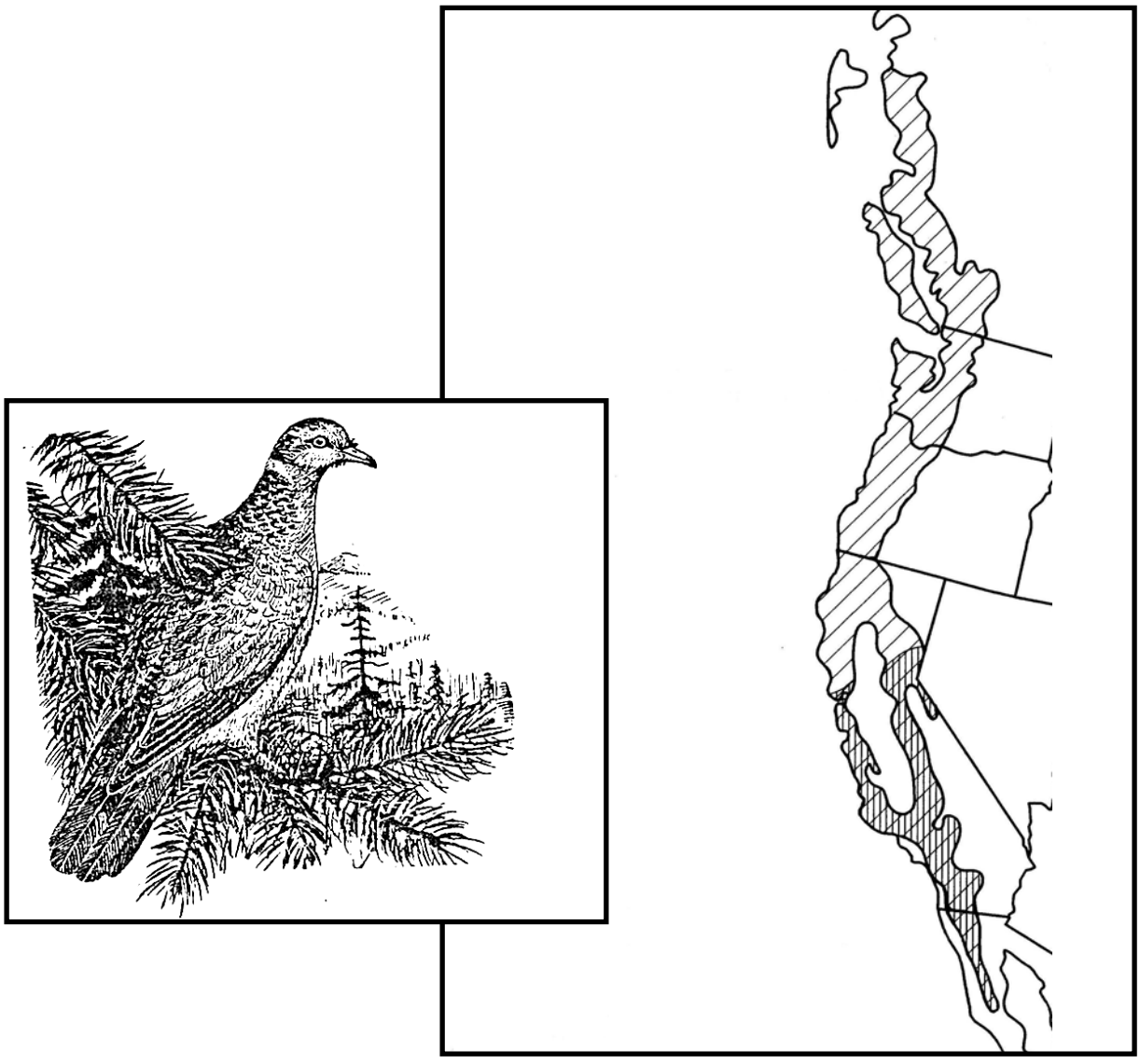
Pacific Flyway Management Plan for the

Pacific Coast Population of Band-tailed Pigeons



This management plan is one of a series of cooperatively developed plans for managing the 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. 11th Ave., Portland, OR 97232.

PACIFIC FLYWAY MANAGEMENT PLAN
PACIFIC COAST POPULATION OF
BAND-TAILED PIGEONS

Prepared for the:

Pacific Flyway Council
U.S. Fish and Wildlife Service
Canadian Wildlife Service

Prepared by:

Pacific Coast Band-tailed Pigeon Subcommittee
Pacific Flyway Study Committee

March 1983
March 1994
July 2010

Approved by: 
Chairman, Pacific Flyway Council

11/24/2010
Date

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PACIFIC FLYWAY MANAGEMENT PLAN
PACIFIC COAST POPULATION OF
BAND-TAILED PIGEONS

Prepared by the Pacific Coast Population of Band-tailed Pigeon Subcommittee of the Pacific Flyway Study Committee:

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INTRODUCTION

The Pacific Flyway Council is an administrative body that fosters cooperation among public wildlife agencies for the purpose of protecting and conserving migratory game birds in western North America. The Council has prepared numerous management plans for most populations of swans, geese, sandhill cranes, band-tailed pigeons, and mourning doves in the Pacific Flyway (www.pacificflyway.gov). These plans typically focus on populations, which are the primary unit of management, but may relate to a species or subspecies. Management plans serve to:

- Identify common goals
- Coordinate collection and analysis of biological data
- Establish priority of management actions and responsibility for them
- Emphasize research needed to improve management

Flyway management plans are products of the Council, developed and adopted to help state and federal agencies cooperatively manage migratory game birds under common goals. Management strategies are recommendations, but do not commit agencies to specific actions or schedules. Fiscal, legislative, and priority constraints influence the level and timing of implementation. Pacific Flyway plans generally guide management and research for a 5-year planning horizon. This management plan is a revision of earlier plans adopted by the Pacific Flyway Council in 1983 and 1994. Neff (1947), Braun (1994), and Keppie and Braun (2000) have reviewed a substantial body of literature on band-tailed pigeons, this plan is not intended to replicate those efforts.

The Pacific Coast band-tailed pigeon population ranges from British Columbia, Canada, through Washington, Oregon, California, and western Nevada in the United States and extends into northern Baja California in Mexico. Its breeding habitat preferences are conifer and oak-conifer woodlands, usually in mountainous terrain in and west of the Cascade and Sierra Nevada mountain ranges. Although migratory, the population breeds throughout its entire range and exhibits more of a nomadic movement, particularly in the south, than a true migration.

Several factors combine to make management of the population difficult. Nesting populations generally are sparsely scattered throughout forested habitat, much of it in largely inaccessible mountainous terrain. Even in accessible areas, forest canopies prevent adequate observation of the birds. Direct census of the breeding population and is not possible due to these factors, and managers must rely on indices to assess annual fluctuations in populations. Likewise, inaccessible fall and winter habitat and nomadic characteristics of band-tails combined to render counts of birds at that time unreliable as annual indices to post-breeding season population size. Although historic banding data demonstrate relatively high adult survival, available evidence suggests band-tailed pigeon reproductive potential is low for a game bird. Any unusually high mortality could have immediate and long-lasting detrimental effects on the population. Various sources suggest that band-tailed pigeon populations have experienced significant long-term declines, including state and federal surveys in the 1960s and early 1970s. Because of these trends, the delicate relationship between mortality and reproduction, and the difficulty in assessing population status, special attention must be given to the Pacific Coast band-tailed pigeon population by wildlife agencies charged with its management.

GOAL AND OBJECTIVES

The goal of this management plan is to maintain the Pacific Coast band-tailed pigeon population and its habitat at levels to maintain current distribution and abundance, while sustaining recreational uses of this resource.

Objectives of this management plan are to:

A. Maintain or increase the Pacific Coast band-tailed pigeon population (objective is 5-year mean 2004-08 mineral site survey index).

B. Maintain sustainable levels of traditional consumptive and non-consumptive use.

C. Maintain, manage, and enhance nesting, migration and wintering habitats in sufficient quantity and quality to meet population and public use objectives.

STATUS

A. Taxonomy and Description

Taxonomy—Various authorities recognize six subspecies of band-tailed pigeon (*Patagioenas fasciata*) in the Western Hemisphere (Keppie and Braun 2000). The Pacific Coast band-tailed pigeon *(P. f. monilis*) has a distribution farther north and west than any of the other subspecies.

Description— Pacific Coast band-tailed pigeons are large, stout-bodied birds, approximately 36 cm long and 300-500 gm in weight (Jeffrey 1977). Adults are blue-gray and both sexes have a conspicuous white neck crescent above an iridescent nape. The Pacific Coast band-tailed pigeon is larger and darker than the Interior subspecies (*P. f. fasciata*) which breeds in Arizona, Utah, Colorado, and New Mexico (see Figure 1). Detailed descriptions are given by Jeffrey (1977) and Braun (1994).

B. Distribution, Abundance, and Migration

Distribution—The breeding range of the Pacific Coast band-tailed pigeon encompasses habitat from British Columbia, Canada, south to northern Baja California, Mexico (Figure 1). Winter range is primarily in California, south of the latitude (39^{o} 30' N) of Oroville (Figure 1), although some birds are known to enter northern Mexico and frequent areas in the Sierra San Pedro Martin of Baja California. The eastern limit of distribution is, with a few local exceptions, the western slope of the Cascade-Sierra Nevada mountain ranges.

Figure 1: Breeding and winter ranges of the Pacific Coast band-tailed pigeon (*P.f. monilis*) and Interior band-tailed pigeon (*P.f. fasciata*)

Abundance—Direct population estimates of Pacific Coast band-tailed pigeons are extremely difficult to obtain because of their habits, visibility, and inaccessibility. In the early 1970s, the total population size was approximated at 2.9–7.1 million (Braun 1994). Two indirect estimates from the early 1990s placed the population at 2.4–3.1 million (R. Trost, pers. comm. 1993).

The North American Breeding Bird Survey (BBS) has been conducted since 1966 in western states and Canada. From 252 BBS routes in British Columbia, California, Oregon, and Washington, coastal band-tailed pigeon populations are estimated to have decreased by 2.6 percent per year between 1966 and 2009, although the trend has not been significant (Sanders 2010). Recent BBS estimates indicate that the coastal population has decreased by 0.3% per year during the 2005-2009 period (Sanders 2010) (see Appendix 1).

In much of their range, Pacific Coast band-tailed pigeons seek a mineral supplement to their diet of berries, which contain few minerals (Jarvis and Passmore 1992). Mineral sites have been known for many years to be important use areas for Pacific Coast band-tailed pigeons, which satisfy an elevated need for sodium (and possibly calcium), during the nesting season for egg and crop milk production (Sanders 2000). In 1950, Oregon Department of Fish and Wildlife (ODFW) initiated counts at mineral sites in August, just before the hunting season. Eight springs were selected based on consistency of surveys, and used as an index to the population (Jarvis and Passmore 1992). Although this index declined by over 50% from the early 1960s to the mid-1970s, the trend has been relatively stable since that time.

In the late 1960s, students at Oregon State University demonstrated the feasibility of conducting call-count trend routes (Sisson 1968, Keppie et al. 1970). Their work was continued by the Washington Department of Fish and Wildlife (WDFW), and operational routes were established in Washington during 1975 (Jeffrey 1989). WDFW conducted the call-count survey from 1975-2003, maintaining 50 routes per year (WDFW 2008). Data from the survey were analyzed by USFWS using a route-regression method similar to the mourning dove call-count analysis (Sauer et al 2003). The survey showed a significant decline in the call-count index of 6.0% per year from 1975-1993 ($p<0.05$). After a season closure from 1991-2001, the survey indicated a long-term non-significant increasing trend of 1.8% per year for the period 1975-2003.

In the 1960's, the California Department of Fish and Game (CDFG) conducted extensive counts of Pacific Coast band-tailed pigeons immediately before the hunting season (1960-63) and immediately after the season (1964-68). In each case, the department concluded that the surveys counted only a small and variable proportion of the total population and were not valid indices to population numbers (Mallette 1968), and these surveys were discontinued.

Casazza et al. (2000) conducted a statistical power analysis of Pacific Coast band-tailed pigeon survey methods in Oregon and Washington, the BBS, and an experimental mineral site survey conducted at intervals throughout the nesting season. When compared with other surveys used at the time, mineral site counts conducted in July had the greatest power for detecting trends. Sample size requirements determined by power analysis suggested that a mineral site count of between 40 and 70 sites offered a high probability or power (>0.85) to detect 3-5 year trends in abundance. The analysis indicated that variance in the Oregon mineral site survey was adversely affected by the presence of migrants, which increasingly used the sites in August. For

the Washington call-count survey, the low number of birds heard per route and observer changes led to high variance estimates. Based on this analysis, a mineral site survey (MSS) was developed and initiated on an experimental basis in 2001 and became operational range-wide in 2004 (Casazza et al. 2005). After development of the MSS, Washington call-count surveys were discontinued in 2004, but Oregon continued most August surveys of their mineral sites in addition to the MSS surveys in July.

The MSS is a coordinated effort among State wildlife agencies in California, Oregon, and Washington, as well as the Canadian Wildlife Service (CWS) and U.S. Fish and Wildlife Service. The MSS involves a visual count of Pacific Coast band-tailed pigeons at approximately 45 mineral sites throughout the range of the population (10 in California, 19 in Oregon, 12 in Washington, and 4 in British Columbia) during July, from one-half hour before sunrise to noon. Results of the 2004-2009 MSS are presented in Figure 2 (see Appendix 2 for additional details). Analysis methods are described in Sanders (2010).

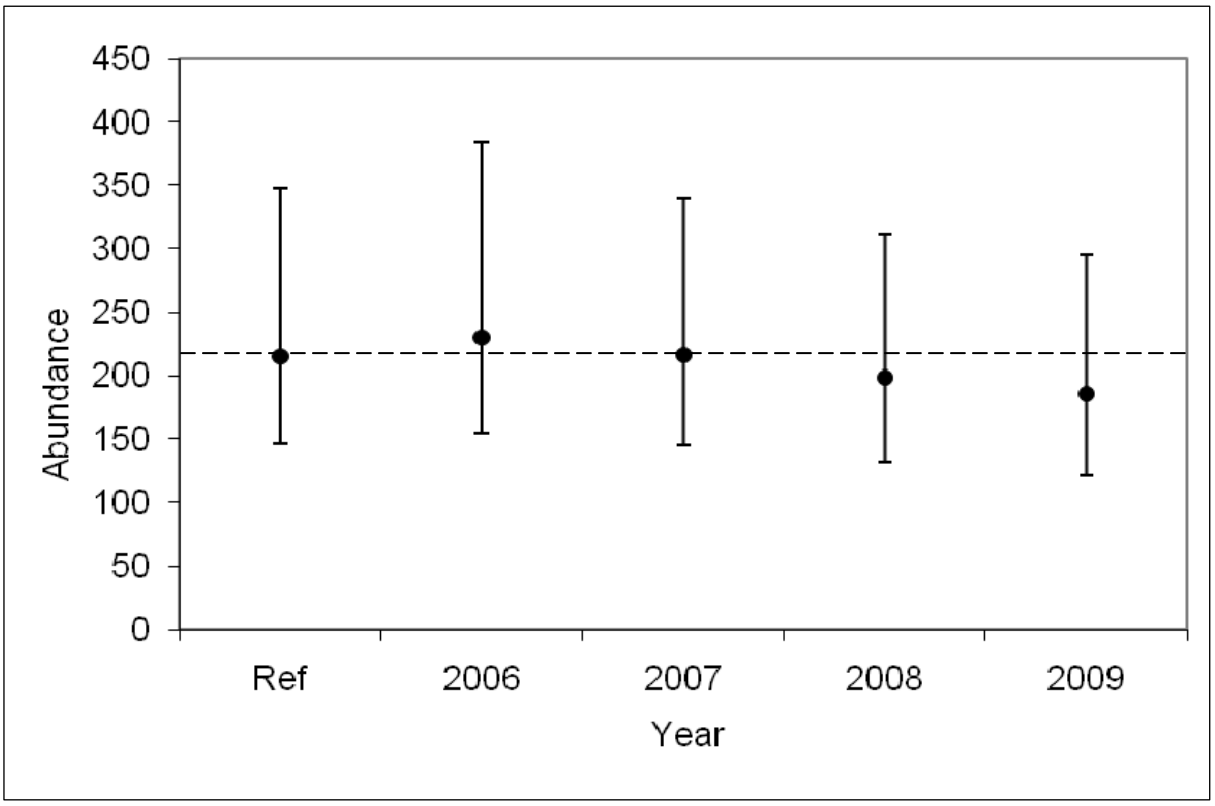


Figure 2**.** Estimated abundance (with 95% credible intervals) of Pacific Coast band-tailed pigeons from the Mineral Site Survey, 2004–2009. The first estimate is the average annual abundance index during the 5-year interval 2004–2008 (also the population objective and reference), and subsequent estimates are average annual abundance indices during 3-year moving intervals (2006 = 2004–2006, 2007 = 2005–2007, etc.).

Migration— Since 1929, 57,457 Pacific Coast band-tailed pigeons have been banded preseason and 5,727 within season or postseason in California, Oregon, Washington, and British Columbia. Over 95% of these birds were banded before 1978. Because of the difficulty in trapping immature band-tailed pigeons, the preseason-banded sample consists mainly of adult birds (91%). Recovery locations from preseason bandings during 1929-2008 are summarized in Appendix 3.

In 2006, a satellite telemetry study was initiated by Casazza and Overton (2008) to evaluate breeding distribution and migration routes of Pacific Coast band-tailed pigeons. This study, which tracked 21 PC band-tails during 2007-09, found that spring migration started between April 16 and May 23 and ranged from 15 to 6 days, with an overall mean of 19 days. Fall migration had an average start date of September 23 and an average end date of November 7, for an average duration of 45 days. The overall average distance traveled between winter and breeding season use areas was about 740 km (n=35).

C. Productivity and Survival

Productivity— Early studies provided basic data on nesting (Neff 1947, MacGregor and Smith 1955, Peeters 1962), while later projects have evaluated mineral site use, nesting habitat, and movements (Jarvis and Passmore 1992, Leonard 1998, Sanders 2000). Pacific Coast band-tailed pigeons nest primarily in conifers, occasionally in hardwoods and shrubs, within closed canopy conifer or mixed hardwood and conifer forest stands (Sanders 2008). Nests are loosely constructed twig platforms and placement is highly variable, ranging 6–120 feet above ground, but is generally near the bole and in dense foliage. Adults are presumably monogamous, and most clutches have one egg; however, some nesting pairs may complete up to three nesting cycles a year in mild climates offering long nesting seasons. Both parents incubate the egg and brood the squab. Nestlings are fed curd-like "crop milk" formed from the inside lining of the crop of both adults.

Peak hatching dates were estimated from the progression of primary molt of wings collected from hunters in California (Slosson and Goss 1982), Washington (Jeffrey 1989), and Oregon (Jarvis and Passmore 1992). The peak of hatch was estimated to be during late July and early August. However, most of the wings were obtained from early September samples, and were thought to underestimate the numbers of squabs hatched between 1 August and 15 October. Wing collections of pigeons shot during mid- to late-September in California and Oregon, and during December in California, estimated that the peak of hatch was during the first 10 days of August, with a substantial number of birds hatched during September and October.

Efforts to obtain age ratios in the Pacific Coast band-tailed pigeon harvest through wing-collection surveys were conducted sporadically in the past (Slosson and Goss 1982, Jeffrey 1989, and Jarvis and Passmore 1992). Since 1994, Pacific Coast band-tailed pigeons have been included in the nationwide Parts Collection Survey, which randomly selects a sample of hunters registered with the Harvest Information Program (HIP). These persons are sent envelopes in which to return one wing from each bird harvested. All wings received annually are examined and categorized by species, age, and sex (see Appendix 4).

Survival— In an unpublished analysis of survival and recovery rates using the Brownie Robson method (Graham Smith, USFWS, pers. comm.), survival estimates for adults during 1965-78 varied from about 60-77% in California, Oregon, and Washington (see Appendix 5). A recent evaluation of banding needs concluded that over 15,000 bands would be required over a 5 year period to estimate survival, due to low band recovery rates associated with the population (Michael Casazza, USGS, pers. comm.).

Due to low band recovery rates, it is likely that hunting plays a minor role in annual mortality. Slosson and Goss (1982) reported mean direct band recovery rates of 0.37% and 2.38%, respectively, for pre- and post-season bandings in California during 1973-77. In Washington, mean direct recovery rates were 0.34% for immatures and 0.26% for adults during 1971-77 (Jeffrey 1989). Recovery rates derived from the Brownie-Robson method (Brownie et al. 1978) ranged from 1.29% in California to 2.98% in Oregon during varying time periods from 1965-78 (Appendix 5).

In some years, virulent avian trichomoniasis contributes to increased mortality of band-tailed pigeons (Cole 1999). This disease is caused by a parasite passed directly from one bird to another through food, water, and crop milk, and is responsible for mortalities of at least 16,000 Pacific Coast band-tailed pigeons in California in 1988 (Cole 1999).

D. Habitat Use

Preferred habitat types vary within breeding and wintering areas from near sea-level on the coast to 14,000 feet in elevation in the Cascade and Sierra Nevada mountains. Preferred tree species generally consist of conifers such as Douglas fir (*Pseudotsuga menziesii*), hemlock (*Tsuga heterophylla)*, spruce (*Picea spp*.), fir (*Abies spp*.), and pine (*Pinus spp*.); broad-leaved trees such as alder (*Alnus spp*.), maple (*Acer spp*.), and particularly oak (*Quercus spp*.). Habitats components include berry- and nut-producing trees and shrubs such as cascara (*Rhamnus purshiana*), elderberry (*Sambucus spp*.), wild cherry (*Prunus spp*.), huckleberry (*Vaccinium spp*.), madrone (*Arbutus spp.*).

Wintering Pacific Coast band-tailed pigeons generally frequent pine-oak woodland and coastal chaparral plant associations. However, they are nomadic and seek out locations with abundant food sources, particularly oak mast, pinon pine (*Pinus edulis*) nuts, and manzanita (*Arctostaphylos spp*.) fruits (Neff 1947, Smith 1968). Cultivated crops, such as wheat, corn, and peas also are attractive to pigeons as food sources in some years, particularly during early spring and winter (Braun 1994); commercial fruit, particularly cherries, also lure band-tails to orchards in years of natural food shortage. Feeding areas vary in location from year to year; an area containing large numbers of birds one year may be completely empty of birds the next.

Habitats for Pacific Coast band-tailed pigeons have been influenced by timber harvest and other human activities. Although timber harvest on private lands began in the late 1800s, major timber harvest programs by the Forest Service and BLM started between 1945-50 (Lujan et al. 1992). Clear-cutting with subsequent replanting has been the most widely used technique. Modern silvicultural practices, including the use of herbicides to control deciduous shrubs and trees, have potentially reduced food-producing plants throughout the range of the Pacific Coast band-tailed pigeon (Braun 1994). Berry/mast- producing shrubs and trees are important food sources, particularly close to mineral sources and higher elevation areas used during migration (Braun 1994).

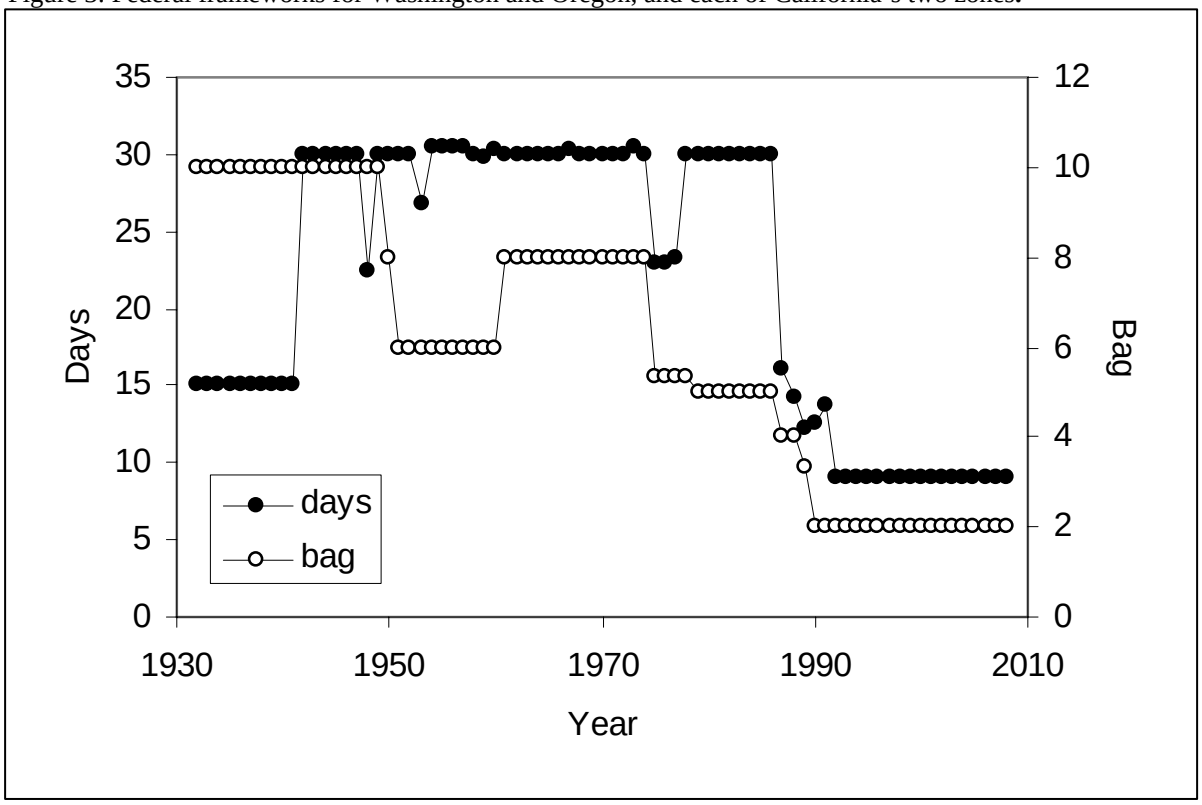
Mineral sites used by band-tails are not very common, and many are in private ownership without protection from loss or degradation (Casazza 2003). Casazza and Overton (2008) found high fidelity of birds to breeding areas. Based on tracking movements of individual birds with satellite transmitters between 2007 and 2009, the average distance between the centers of annual

breeding season home ranges was 2.9 km (n=9). Virtually all birds were located within 35km of a mineral site during the breeding season.

E. Hunting and Other Public Use

After a 19-year moratorium, federal frameworks have permitted hunting of Pacific Coast band-tailed pigeon throughout their range, in whole or in part, since 1932. Hunting seasons for Pacific Coast band-tailed pigeons in Baja California have been closed in all years except for a 6-year period during 1981-86; during that time, bag/possession limits were 5/10 and seasons generally were about 2 months long during November and December. In the United States, season dates and bag limits varied through the years, and have been more restrictive since 1987 in response to declining populations (see Figure 3 and Appendix 6). Due to declines in call-count survey indices, Washington's season was closed from 1991 through 2001, and British Columbia's season was closed from 1994 through 2001 based on Washington's call-count survey trends.

Figure 3: Federal frameworks for Washington and Oregon, and each of California's two zones.



Between 1957 and 1988, each of the wildlife agencies in the principal Pacific Coast band-tailed pigeon states/province obtained annual harvest statistics through general random mail surveys. Data after 1988 are generally not comparable to earlier estimates because of changes in sampling techniques. Beginning in 1999, USFWS obtained estimates of harvest, hunter numbers, and days afield for Pacific Coast band-tailed pigeons as part of the USFWS Harvest Information Program (see Appendices 7-9). WDFW has required permits and mandatory harvest reports for hunters in western Washington since the season reopened in 2002 (see harvest estimates in Appendix 7).

The Canadian Wildlife Service (CWS) has estimated harvest in British Columbia since 1967, and the BC Ministry of Environment has provided an additional mail questionnaire since re-opening the season in 2002 (see Appendix 7). The CWS Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2008) recently completed an assessment of the status of Pacific Coast band-tailed pigeons in Canada and recommended the species be listed under the Species At Risk Act (SARA) as "*Species of Concern*", which may affect its future status as a game species. The federal Minister of the Environment will oversee consultation on whether the species should be added to the List of Wildlife Species at Risk (Schedule 1) under SARA. Provincially the species is Blue-listed in BC (equivalent of Special Concern).

Studies conducted in Oregon in the 1980s found that hunting at mineral sites in Oregon during early September may disproportionately harvest experienced adult breeders (Jarvis and Passmore 1992). Based on this information, federal season frameworks in Oregon and Washington have been restricted to September 15 or later since 1988 to reduce harvest on this productive portion of the population. Likewise, research in British Columbia by March (1971) indicated similar impacts from early September harvest. Band-tailed pigeon seasons were closed in British Columbia between 1994 and 2001 and a restrictive season with a delayed opening (moved from 1 to 15 September) was re-introduced in 2002.

Because the band-tailed pigeon generally is a secretive bird in secluded habitat, birders seek it and other forest birds during field trips. The band-tailed pigeon's habit of frequenting mineral springs is exploited by photographers who can establish blinds in advantageous positions for close-up photographs. During the past 30 years, many people have established backyard feeder and water stations in urban and suburban areas that attract band-tails on a daily basis.

PROBLEMS

A. Uncertainty associated with assessment of population size and trends.
B. Lack of current information to derive survival and harvest rates, assess vital rates, and determine effects on population dynamics.
C. Low reproductive potential relative to other game birds, limiting population growth rates.
D. Unknown effects of timber management, as well as loss or degradation of mineral sites, on the potential for remaining habitats to support desired population levels. Of particular concern are:
    a. Herbicide treatment of clear-cut areas causing reduction of food-producing shrubs.
    b. Monoculture in forest regeneration causing lack of variety in feeding areas.
    c. Harvest of cascara bark; this practice kills the plants with resultant loss of an important food source.
    d. Removal of oak species for charcoal and firewood and to provide grazing areas in California and Oregon; removal of oak and other forage species by residential and commercial development in Washington and British Columbia.
    e. Loss of mineral springs because of natural degeneration or development.
E. Unknown effects of environmental pollution and disease, including Trichomoniasis.

RECOMMENDED MANAGEMENT STRATEGIES

The following management procedures are recommended in recognition that the degree and timing of their implementation by the various agencies will be influenced by staffing levels and fiscal and legislative constraints beyond the scope of this plan. However, considering the present status of Pacific Coast band-tailed pigeons, a renewed effort among states, provinces, and federal wildlife/land management agencies should be made to provide adequate funding and personnel to achieve the goals, objectives, and management strategies outlined in this plan.

A. Population Assessment

1. Coordinate and conduct annual mineral site survey to assess population trends.

   Lead Agency: USFWS
   Participating: States, BC, CWS
   Priority: 1
   Schedule: Ongoing

2. Maintain and enhance mail-parts survey to assess annual production.

   Lead Agency: USFWS
   Priority: 2
   Schedule: Ongoing

B. Habitat

1. Develop and distribute habitat management guidelines to promote beneficial silvicultural and land development practices for Pacific Coast band-tailed pigeons.

   Lead Agencies: States, BC, USFWS, USFS, CWS
   Priority: 1
   Schedule: ongoing

2. Support documentation, acquisition, and enhancement of all existing mineral sites, and establishment of new mineral sites.

   Lead Agencies: States, BC, USFWS, USFS, CWS
   Priority: 1
   Schedule: ongoing

3. Identify status and trends of habitat used by Pacific Coast band-tailed pigeons throughout their range.

   Lead Agencies: States, BC, USFWS, USFS, CWS
   Priority: 2
   Schedule: ongoing

C. Harvest

1. Maintain conservative harvest regulations because of low recruitment, past declines, and potential for overharvest. Establish annual hunting season regulations according to the prescribed harvest strategy in Table 1, and change regulation packages when the Population Index (80% of the model posterior probability distribution [PPD] for the current 3-year average MSS Index) exceeds prescribed threshold levels (see Appendix 2 for additional details).

   Lead Agencies: States, USFWS
   Priority: 1
   Schedule: ongoing

Table 1: Pacific Coast Band-tailed Pigeon Harvest Strategy

Population Index[1]	**Regulation Package**	**Daily Bag Limit[2]**
25% Above Objective[3]	Moderate	4
Objective[3]	Restrictive	2
25% Below Objective[3]	Closed	--
Reopening Level After Closure = Population Index 10% Above Closure Level		

[1]Current 3-yr. average MSS Index
[2]Assumes 9-day season (including each of two California zones)
[3]Objective is 2004-08 average adjusted MSS Index

2. Establish improved sampling techniques for collection of harvest data.

   Lead Agencies: Each state or province in conjunction with USFWS
   Priority: 1
   Schedule: ongoing

D. Research

1. Evaluate the reliability of the MSS and BBS to estimate trends and abundance.

   Lead Agencies: USFWS, USGS, CWS
   Priority: 1
   Schedule: 2011-2012

2. Support research to evaluate foraging habitat in relation to nesting areas, compare quality of foraging habitat relative to vital rates, investigate the effects of herbicide applications on forage species, and evaluate other silvicultural practices affecting band-tail survival and reproduction.

   Lead Agencies: Subcommittee
   Priority: 1
   Schedule: 2011-2012

3. Evaluate effects of disturbance on daily use of mineral sites and reproductive success.

   Lead Agencies: USGS, States, BC/CWS
   Priority: 2
   Schedule: 2010-11

4. Investigate the effects of diseases and contaminants on Pacific Coast band-tailed pigeons.

   Lead Agencies: USGS
   Priority: 2
   Schedule: ongoing

5. Evaluate telemetry marking project to assess current survival rates.

   Lead Agency: USGS
   Participating: Subcommittee
   Priority: 3
   Schedule: 2010-11

ANNUAL REVIEW OF THE PLAN

The subcommittee shall meet annually, or as needed, to review progress in meeting the goals and objectives of this plan and to recommend revisions. The subcommittee shall report on this progress to the Pacific Flyway Council and to other organizations interested in cooperating in management of Pacific Coast band-tailed pigeons. It will be the responsibility of the U.S. Fish and Wildlife Service (DMBM) to annually update tables on population status and harvest, and determine the current population parameters for the harvest strategy.

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APPENDIX 1

Breeding Bird Survey (BBS)

Breeding Bird Survey 5-year (2005–2009) trend estimates (expressed as annual percentage change) and 95% credible intervals for band-tailed pigeon abundance (Sanders 2010).

		Credible Interval		
	Trend	Lower	Upper	Routes
Pacific Coast	-0.3	-5.3	7.5	187
British Columbia	-5.2	-13.9	7.5	20
California	-0.2	-7.6	11.8	96
Oregon	0.9	-7.4	16.3	37
Washington	2.3	-8.7	19.8	34

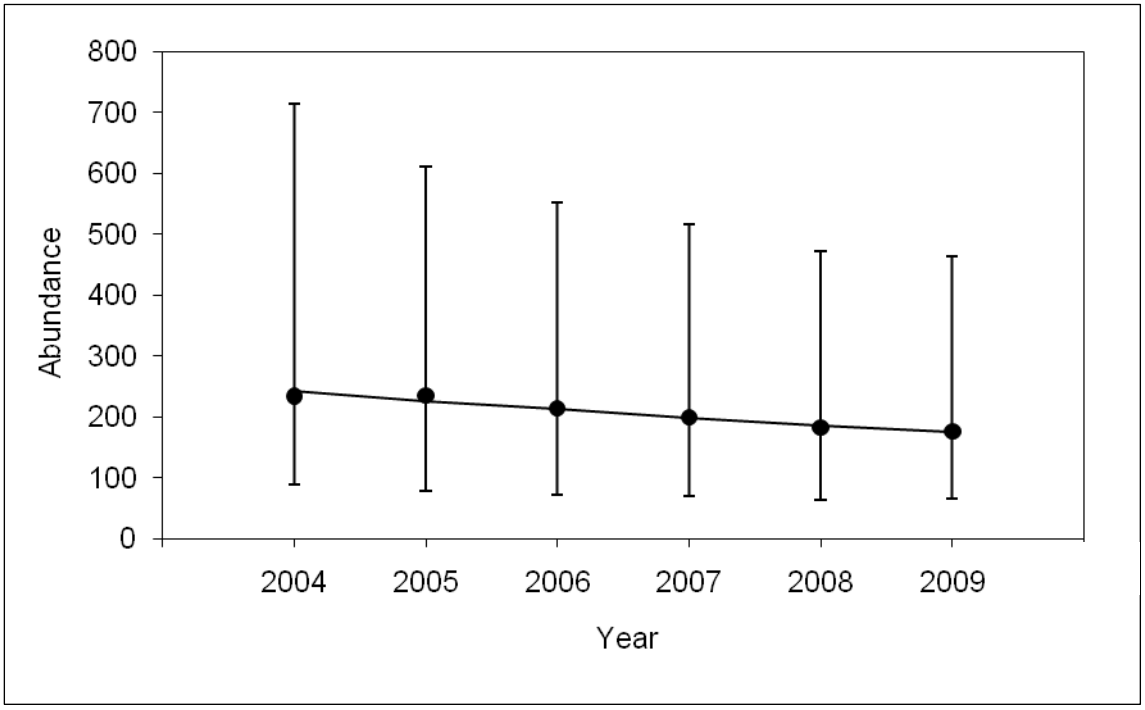
APPENDIX 2

Mineral Site Survey (MSS)

Estimated trend[a] (percent change per year and lower and upper 95% credible intervals) in band-tailed pigeon abundance based on Mineral Site Survey data during a 6-year (2004–2009) period (Sanders 2010).

		Credible interval		
	Trend	Lower	Upper	N
Pacific Coast	-5.6	-18.1	4.4	234
British Columbia	-17.2	-36.5	19.5	18
California	3.6	-6.7	14.6	53
Oregon	0.7	-8.2	10.8	93
Washington	-4.7	-12.3	5.6	70

[a] Annual indices are estimated from exponentiated year effects derived from a log-linear hierarchical model fit using Bayesian methods.



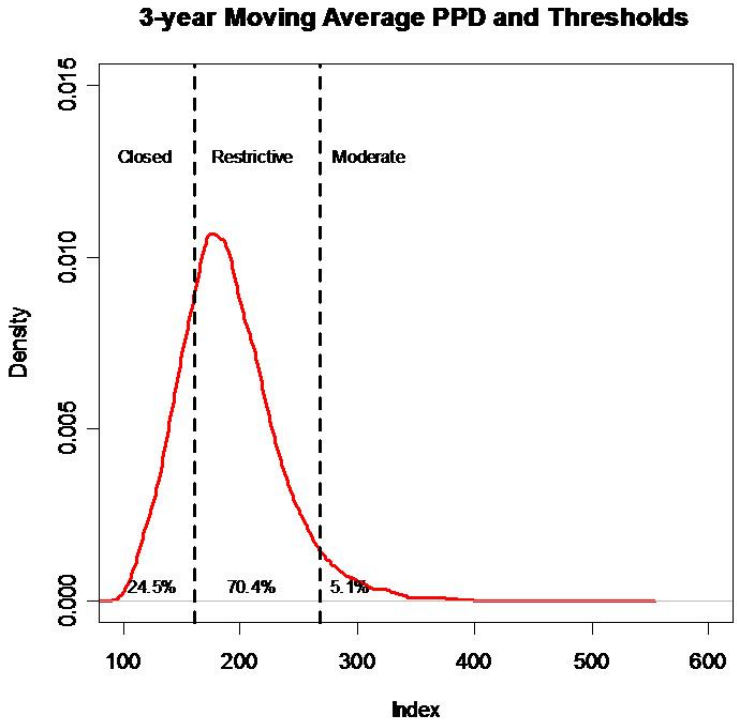
Annual abundance indices (with 95% credible intervals) and predicted trend of Pacific Coast band-tailed pigeons, based on 2004-2009 Mineral Site Survey data. The trend line is exponentiated predicted values from fitting a regression line through the log transformed annual indices. This same information is summarized into three-year averages in Figure 2. Annual indices are not used in the following harvest strategy due high variances.

HARVEST STRATEGY PARAMETERS

Mineral Site Survey median estimates, 95% credibility intervals, and percentages of posterior probability distributions (PPD) relative to harvest strategy parameters, for band-tailed pigeons seen at mineral sites (Sanders 2010). The median and credibility interval estimates below are also displayed in Figure 2.

- All natural mineral sites with known mineral sources surveyed at least 3 times from 2004 to 2009 were included.
- Median estimates below may change based on the number of surveys and the length of time that data from these surveys are available.
- The median population objective (2004-08) will change slightly based on additional data, less so for each subsequent survey year.
- Estimates were derived from the same hierarchical model used to assess Christmas Bird Count, Breeding Bird Survey, and Mourning Dove Call-count Survey data (Link and Sauer 2002, Link et al 2006).
- At least 80% of the PPD must be beyond a threshold before a regulation change is triggered (see example in figure below).

Period	Median	LCI	UCI	% of PPD below Res level	% of PPD above Mod level
2004-08 (objective)	214.9	145.5	347.7	--	--
2004-06	229.6	154.2	384.5	--	--
2005-07	216.2	145.1	339.5	--	--
2006-08	198.6	132.5	310.9	--	--
2007-09	185.8	121.3	294.9	24.5	5.1



Example of 3-year moving average (2007-09) Mineral Site Survey Posterior Probability Distribution (PPD) compared to thresholds (25% above and below objective).

APPENDIX 3

Direct and Indirect Recovery Locations of Pacific Coast Band-tailed Pigeons Banded Preseason* and Subsequently Shot or Found Dead, 1929-2008.

	Recovery Location						
Banding Location	California	Oregon	Washington	British Columbia	Mexico	Other	Totals
California							
Direct *n* (%)	260 (81.5)	37 (11.6)	15 (4.7)	3 (0.9)	4 (1.3)	---	319 (100.0)
Indirect *n* (%)	303 (75.8)	57 (14.3)	33 (8.3)	5 (1.3)	2 (0.5)	---	400 (100.0)
Oregon							
Direct *n* (%)	189 (32.1)	347 (58.9)	50 (8.5)	2 (0.3)	---	1 (0.2)	589 (100.0)
Indirect *n* (%)	368 (36.9)	517 (51.9)	92 (9.2)	15 (1.5)	3 (0.3)	2 (0.2)	997 (100.0)
Washington							
Direct *n* (%)	74 (30.3)	46 (18.9)	122 (50.0)	1 (0.4)	1 (0.4)	---	244 (100.0)
Indirect *n* (%)	148 (38.4)	56 (14.5)	173 (44.9)	8 (2.1)	---	---	385 (100.0)
British Columbia							
Direct *n* (%)	---	---	---	---	---	---	---
Indirect *n* (%)	2 (66.7)	---	---	1 (33.3)	---	---	3 (100.0)
Totals							
Direct *n* (%)	523 (45.4)	430 (37.3)	187 (16.2)	6 (0.5)	5 (0.4)	1 (<0.1)	1152 (100.0)
Indirect *n* (%)	821 (46.0)	630 (35.3)	298 (16.7)	29 (1.6)	5 (0.3)	2 (0.1)	1785 (100.0)
All *n* (%)	1344 (45.8)	1060 (36.1)	485 (16.5)	35 (1.2)	10 (0.3)	3 (0.1)	2937 (100.0)

* Preseason = April 1 through August 31, normal wild status (300)

APPENDIX 4

Parts Collection Survey age structure of Pacific Coast band-tailed pigeons, determined from hunter shot birds during September through December, 1994 to 2008.

Values are percentage of hatch year birds (%), number of hatch year birds (n), and number of both hatch year and after hatch year birds examined (N).

	California			Oregon			Washington			Total		
Year	%	n	N	%	n	N	%	n	N	%	n	N
1994	44.6	226	507	22.9	131	571	†[a]	0	0	33.1	357	1078
1995	29.6	74	250	20.1	109	542	†	0	0	23.1	183	792
1996	27.9	68	244	15.1	38	252	†	0	0	21.4	106	496
1997	31.1	65	209	17.7	64	361	†	0	0	22.6	129	570
1998	32	81	253	18.4	45	244	†	0	0	25.4	126	497
1999	33.2	119	358	20.1	79	394	†	0	0	26.3	198	752
2000	32.1	69	215	17.5	58	332	†	0	0	23.2	127	547
2001	22.9	33	144	17	46	271	†	0	0	19	79	415
2002	31.5	52	165	14.1	33	234	3.8	22	180	18.5	107	579
2003	34.4	72	209	21.2	49	231	3.1	17	112	25	138	552
2004	25.2	33	131	19.6	38	194	2.6	9	27	22.7	80	352
2005	18.8	25	133	13.3	24	180	†	0	0	15.7	49	313
2006	18.1	47	260	19	48	253	13.6	6	44	18.1	101	557
2007	24.8	34	137	14.3	36	251	10.9	6	55	17.2	76	443
2008	29.8	39	131	20	22	110	31	9	29	25.9	70	270
2009	30.1	31	103	17.8	35	197	15.2	5	33	21.3	71	333

[a] The season in Washington was closed from 1991 through 2001, no estimate is available.

APPENDIX 5

Estimated survival and recovery rates of Pacific Coast Band-tailed Pigeons for those areas and years with sufficient data (Brownie-Robson Method)

				Survival (s)		Recovery (f)			
State	Years	Age	Sex	Rate	SE	Rate	SE	Model	
California	1969-78	A	Combined	67.76	2.91	1.29	0.08	H1 (Yr. spec. s&f)	
California	1969-78	I	Combined	75.2	10.05	1.88	0.25	H1	
Oregon	1953-58	A	Unknown	76.77	5.52	5.08	0.34	H1 (Yr. spec. s&f)	
Oregon	1966-72	A	M	65.79	3.84	2.56	0.22		
Oregon	1966-72	A	F	73.21	0.61	2.38	0.23		
Oregon	1966-72	A	Unknown	60.62	3.12	2.98	0.23		
Washington	1965-69	A	Combined	59.86	3.56	2.39	0.18	H1 (Yr. spec. s&f)	
Analysis by Graham Smith, DMBM, 1992									

APPENDIX 6

Pacific Coast band-tailed pigeon seasons, 1932–2009. The season was closed from 1913 through 1931. The daily possession limit is twice the daily bag limit.

	CA										
	North		South			OR			WA		
Year	Dates	Days	Dates	Days	Bag	Dates	Days	Bag	Dates	Days	Bag
1932	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Oct 16–30	15	10
1933	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Oct 16–30	15	10
1934	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Oct 16–30	15	10
1935	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Sep 16–30	15	10
1936	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Sep 16–30	15	10
1937	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Sep 16–30	15	10
1938	Dec 1–15	15	Dec 1–15	15	10	Oct 16–30	15	10	Sep 16–30	15	10
1939	Dec 1–15	15	Dec 1–15	15	10	Sep 1–15	15	10	Sep 16–30	15	10
1940	Dec 1–15	15	Dec 1–15	15	10	Sep 1–15	15	10	Sep 16–30	15	10
1941	Dec 1–15	15	Dec 1–15	15	10	Sep 1–15	15	10	Sep 16–30	15	10
1942	Dec 1–30	30	Dec 1–30	30	10	Sep 1–30	30	10	Sep 16–Oct 15	30	10
1943	Dec 1–30	30	Dec 1–30	30	10	Sep 1–30	30	10	Sep 16–Oct 15	30	10
1944	Dec 1–30	30	Dec 1–30	30	10	Sep 1–30	30	10	Sep 16–Oct 15	30	10
1945	Dec 1–30	30	Dec 1–30	30	10	Sep 1–30	30	10	Sep 16–Oct 15	30	10
1946	Sep 1–30	30	Sep 1–30	30	10	Sep 1–30	30	10	Sep 1–30	30	10
1947	Dec 1–30	30	Dec 1–30	30	10	Sep 1–30	30	10	Sep 1–30	30	10
1948	Sep 1–15	15	Dec 1–15	15	10	Sep 1–30	30	10	Sep 1–30	30	10
1949	Sep 16–30 and Dec 17–31	30	Sep 16–30 and Dec 17–31	30	10	Sep 1–30	30	10	Sep 1–30	30	10
1950	Sep 16–30 and Dec 17–31	30	Sep 16–30 and Dec 17–31	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1951	Sep 16–30 and Dec 17–31	30	Sep 16–30 and Dec 17–31	30	6	Sep 1–30	30	6	Sep 1–30	30	6
1952	Sep 16–30 and Dec 17–31	30	Sep 16–30 and Dec 17–31	30	6	Sep 1–30	30	6	Sep 1–30	30	6
1953	Oct 16–31	16	Dec 1–31	31	6	Sep 1–30	30	6	Sep 1–30	30	6
1954	Oct 1–31	31	Dec 1–31	31	6	Sep 1–30	30	6	Sep 1–30	30	6
1955	Oct 1–31	31	Dec 1–31	31	6	Sep 1–30	30	6	Sep 1–30	30	6
1956	Oct 1–31	31	Dec 1–31	31	6	Sep 1–30	30	6	Sep 1–30	30	6
1957	Oct 1–31	31	Dec 1–31	31	6	Sep 1–30	30	6	Sep 1–30	30	6
1958	Oct 1–31	31	Dec 11–Jan 10	31	6	Sep 1–28	28	6	Sep 1–30	30	6
1959	Oct 1–31	31	Dec 11–Jan 10	31	6	Sep 1–27	27	6	Sep 1–30	30	6
1960	Oct 1–31	31	Dec 17–Jan 15	30	6	Sep 1–30	30	6	Sep 1–30	30	6
1961	Sep 30–Oct 29	30	Dec 16–Jan 14	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1962	Sep 29–Oct 28	30	Dec 15–Jan 13	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1963	Sep 28–Oct 27	30	Dec 14–Jan 12	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1964	Sep 26–Oct 25	30	Dec 12–Jan 10	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1965	Sep 25–Oct 24	30	Dec 11–Jan 9	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1966	Oct 1–30	30	Dec 17–Jan 15	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1967	Sep 29–Oct 29	31	Dec 16–Jan 14	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1968	Sep 28–Oct 27	30	Dec 14–Jan 12	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1969	Sep 27–Oct 26	30	Dec 13–Jan 11	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1970	Oct 3–Nov 1	30	Dec 12–Jan 10	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1971	Oct 2–31	30	Dec 11–Jan 9	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1972	Sep 30–Oct 29	30	Dec 16–Jan 14	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1973	Sep 29–Oct 28	30	Dec 15–Jan 15	32	8	Sep 1–30	30	8	Sep 1–30	30	8
1974	Sep 28–Oct 27	30	Dec 14–Jan 12	30	8	Sep 1–30	30	8	Sep 1–30	30	8
1975	Oct 4–19	16	Dec 13–28	16	6	Sep 1–30	30	5	Sep 1–30	30	5

APPENDIX 6. Continued.

	CA													
	North		South			OR			WA			BC		
Year	Dates	Days	Dates	Days	Bag	Dates	Days	Bag	Dates	Days	Bag	Dates	Days	Bag
1976	Oct 2–17	16	Dec 11–26	16	6	Sep 1–30	30	5	Sep 1–30	30	5	S1-O24	54	10
1977	Oct 1–16	16	Dec 10–26	17	6	Sep 1–30	30	5	Sep 1–30	30	5	S1-O23	53	10
1978	Sep 30–Oct 29	30	Dec 16–Jan 14	30	6	Sep 1–30	30	5	Sep 1–30	30	5	S1-O23	53	10
1979	Sep 29–Oct 28	30	Dec 15–Jan 13	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O21	51	10
1980	Sep 27–Oct 26	30	Dec 13–Jan 11	30	5	Sep 13–Oct 12	30	5	Sep 1–30	30	5	S1-O21	51	10
1981	Sep 26–Oct 25	30	Dec 12–Jan 10	30	5	Sep 12–Oct 11	30	5	Sep 1–30	30	5	S1-O25	55	10
1982	Sep 25–Oct 24	30	Dec 11–Jan 09	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O24	54	10
1983	Sep 24–Oct 23	30	Dec 10–Jan 08	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O23	53	10
1984	Sep 24–Oct 23	30	Dec 10–Jan 08	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O31	61	10
1985	Sep 28–Oct 27	30	Dec 14–Jan 12	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O31	61	10
1986	Sep 27–Oct 26	30	Dec 13–Jan 11	30	5	Sep 1–30	30	5	Sep 1–30	30	5	S1-O31	61	10
1987	Sep 26–Oct 11	16	Dec 12–27	16	4	Sep 7–22	16	4	Sep 7–22	16	4	S1-O31	61	10
1988	Sep 24–Oct 9	16	Dec 10–25	16	4	Sep 15–30	16	4	Sep 17–25	9	4	S1-O31	61	10
1989	Sep 30–Oct 15	16	Dec 9–24	16	4	Sep 15–22	8	2	Sep 16–24	9	4	S1-O31	61	10
1990	Sep 15–30	16	Dec 8–23	16	2	Sep 15–23	9	2	Sep 15–23	9	2	S1-O31	61	10
1991	Sep 21–Oct 6	16	Dec 14–29	16	2	Sep 15–23	9	2	Closed	0	0	S1-30	30	5
1992	Sep 19–27	9	Dec 19–27	9	2	Sep 15–23	9	2	Closed	0	0	S1-30	30	5
1993	Sep 18–26	9	Dec 18–26	9	2	Sep 15–23	9	2	Closed	0	0	S1-30	30	5
1994	Sep 17–25	9	Dec 17–25	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
1995	Sep 16–24	9	Dec 16–24	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
1996	Sep 21–29	9	Dec 21–29	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
1997	Sep 20–28	9	Dec 20–28	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
1998	Sep 19–27	9	Dec 19–27	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
1999	Sep 18–26	9	Dec 18–26	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
2000	Sep 16–24	9	Dec 16–24	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
2001	Sep 15–23	9	Dec 15–23	9	2	Sep 15–23	9	2	Closed	0	0	Closed	0	0
2002	Sep 21–29	9	Dec 21–29	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2003	Sep 20–28	9	Dec 20–28	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2004	Sep 16–24	9	Dec 16–24	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2005	Sep 17–25	9	Dec 17–25	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2006	Sep 16–24	9	Dec 16–24	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2007	Sep 15–23	9	Dec 15–23	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2008	Sep 20–28	9	Dec 20–28	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5
2009	Sep 19–27	9	Dec 19–27	9	2	Sep 15–23	9	2	Sep 15–23	9	2	S15-30	16	5

APPENDIX 7

Harvest estimates for Pacific Coast band-tailed pigeons, 1999–2009

	Harvest Information Program harvest estimates (mean and 95% confidence interval ½ width expressed as percent of the mean)								WA State Harvest Survey	BC Provincial Harvest Survey	CWS National Harvest Survey	CWS National Harvest Survey
	California		Oregon		Washington		Total				BC Estimate	SE
Year	Mean	CI	Mean	CI	Mean	CI	Mean	CI				
1999	19,300	101	3,800	42	†[a]	†	23,100	85				
2000	12,200	65	4,100	92	†	†	16,300	54				
2001	8,300	49	5,000	45	†	†	13,200	35				
2002	4,200	39	4,000	36	†	†	8,200	27	273	87	188	78
2003	8,000	50	4,900	33	1,500	78	14,400	31	574	153	160	59
2004	14,300	45	3,300	44	300	160	17,900	37	383	138		
2005	11,100	58	1,400	34	1,000	84	13,500	48	492	33	130	75
2006	12,500	40	1,500	25	900	97	14,900	34	569	240	117	72
2007	9,700	39	1,400	74	1,700	61	12,700	32	661	361	197	76

APPENDIX 8

Harvest Information Program active hunter estimates (mean and 95% confidence interval ½ width expressed as percent of the mean) for Pacific Coast band-tailed pigeons, 1999–2009.

	California		Oregon		Washington		Total	
Year	Mean	CI	Mean	CI	Mean	CI	Mean	CI
1999	3,900	48	1,500	47	†[a]	†	5,400	†
2000	5,600	37	1,700	46	†	†	7,300	†
2001	2,600	34	1,700	31	†	†	4,200	†
2002	2,500	30	1,300	25	†	†	3,800	†
2003	4,600	38	1,800	24	1,000	23	†	†
2004	4,700	37	1,500	36	500	64	†	†
2005	3,900	39	500	14	700	58	†	†
2006	6,000	35	400	13	500	61	†	†
2007	4,900	33	700	113	900	44	6,500	†
2008	10,500	24	200	8	600	61	11,300	†
2009	8,200	25	600	12	1,000	68	9,700	

[a] The season in Washington was closed from 1991 through 2001, no estimate is available.

APPENDIX 9

Harvest Information Program days afield estimates (mean and 95% confidence interval ½ width expressed as percent of the mean) for Pacific Coast band-tailed pigeons, 1999–2009.

	California		Oregon		Washington		Total	
Year	Mean	CI	Mean	CI	Mean	CI	Mean	CI
1999	9,100	54	3,500	33	†[a]	†	12,600	40
2000	10,000	41	3,800	61	†	†	13,800	34
2001	7,500	39	4,700	39	†	†	12,200	28
2002	4,600	35	3,400	28	†	†	7,900	23
2003	11,500	52	5,100	29	1,600	58	18,300	34
2004	9,700	36	3,400	35	800	83	13,900	27
2005	8,800	47	1,300	21	1,000	62	11,000	38
2006	13,500	47	1,200	20	700	68	15,400	41
2007	10,600	37	1,200	69	1,800	60	13,500	30
2008	29,300	34	500	13	1,500	70	31,300	32
2009	20,100	29	1,800	19	2,500	85	24,400	25

[a] The season in Washington was closed from 1991 through 2001, no estimate is available.