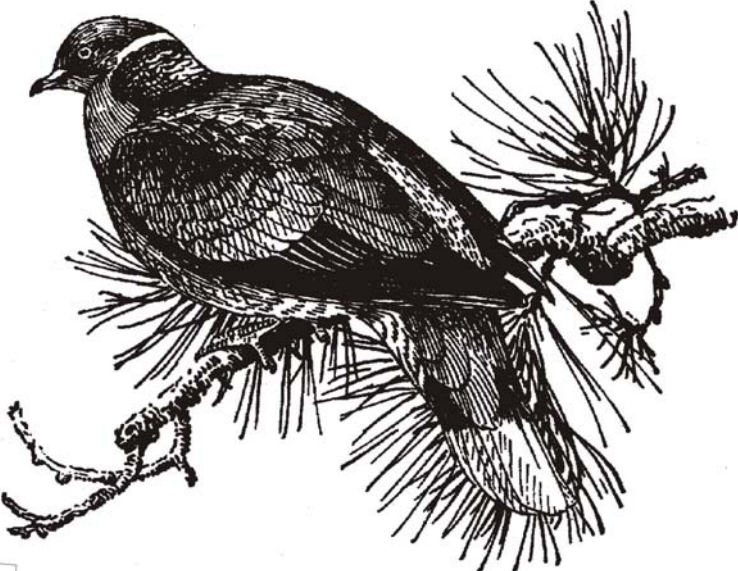


Four Corners Population of Band-tailed Pigeons



This management plan is one of a series of cooperatively developed plans for managing the various species of migratory birds of the Pacific and Central Flyways. Inquiries about this plan may be directed to the Pacific Flyway Representative, U.S. Fish and Wildlife Service, 911 N.E. 11th Avenue, Portland, Oregon 97232.

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PACIFIC AND CENTRAL FLYWAYS MANAGEMENT PLAN
FOR THE FOUR CORNERS POPULATION OF
BAND-TAILED PIGEONS

INTRODUCTION

Band-tailed pigeons (*Columba fasciata*) occupy suitable forest and woodland habitats in western North America, Central America, and northern South America (Goodwin 1983). Eight races of this species are recognized; however, only two exist north of Mexico (American Ornithologists' Union 1983). The Coastal race (*C. f. monilis*) occurs primarily along the Pacific coast in British Columbia, Washington, Oregon, and California (Braun 1994). The Interior race (*C. f. fasciata*) occurs primarily in the Rocky Mountains south of Wyoming (Braun 1994). The two races are geographically separated, but some interchange occurs between them (Schroeder and Braun 1993). Most of these birds are migratory, but some in Mexico and southern California may be nonmigratory. The Coastal race is referred to as the Pacific coast population and the Interior race is referred to as the Four Corners population. The Four Corners population derives its name from the observation that the population's range north of Mexico occurs nearly centered on the four adjoining corners of Arizona, Colorado, New Mexico, and Utah. There is great disparity in size between the two populations. Braun (1994) extrapolated from existing data that the Four Corners population north of Mexico was <250,000 birds, and the Pacific coast population was between 2.9 and 7.1 million birds. Both populations have separate management plans; the plan for the Pacific coast population was adopted by the Pacific Flyway Council in March 1983 and revised March 1994.

Management of the Four Corners population of band-tailed pigeons is especially challenging. Reliable estimates of population size, in either absolute or relative numbers, have been unattainable because of the difficulty in locating and observing pigeons. Band-tailed pigeons inhabit forested habitats, much of it in largely inaccessible mountainous terrain. Even in accessible areas, forest canopies prevent adequate visual contact with these birds. Nesting pigeons generally are sparsely scattered and flocks are nomadic during fall and winter. Although data indicate that band-tailed pigeons have high survival capacity, their reproductive potential is low within the range exhibited by game birds. Any especially high mortality resulting from disease, hunting, and other factors could have long-lasting effects on the population. Because of the delicate relationship between mortality and reproduction, and the difficulty in assessing population size, special consideration must be given this species by wildlife agencies charged with their management.

The purpose of this management plan is to provide guidelines for cooperative management of the Four Corners population of band-tailed pigeons throughout the population's range in the United States. The plan provides a synopsis of life history and ecological information, and identifies information needs, management actions, and agency responsibilities necessary to effectively manage this species.

GOAL AND OBJECTIVES

The goal is to maintain the Four Corners band-tailed pigeon population at a level consistent with optimum distribution, density, and recreational uses.

Objectives:

A. Maximize the potential for sustained consumptive and nonconsumptive uses.

Strategies

1. Develop a population inventory technique.
2. Determine population range.
3. Obtain annual age-ratio estimates.
4. Determine age-specific recruitment rates.
5. Determine impacts of nonhunting mortality factors.
6. Develop a harvest management strategy.
7. Obtain annual estimates of hunter participation and harvest.
8. Evaluate the effect of early-season harvest.

B. Increase habitat quality and quantity.

Strategies

1. Identify distribution, types, and use of habitats in the United States.
2. Identify distribution, types, and use of habitats in Mexico.
3. Investigate food and nest site availability and the effects of land-use practices.
4. Investigate the use of mineral sites.

STATUS

Description

Band-tailed pigeons are about the size of a domestic pigeon and appear bluish gray overall. Inspection of adults reveals brilliant colors including: black wing tips; straw yellow legs and feet; straw yellow bill tipped in black; purplish brown head and breast; coral red eye ring; a white crescent atop an iridescent bronze green nape; and a long square-ended tail with a distinct pale gray band bordered above by a narrower black band. Males are larger and have more purple or pinkish coloration than the brownish-colored females (Braun 1994). Males average 36 cm in length and females average 34 cm (Ridgway 1916). Braun (1994) reported that band-tailed pigeons of the Four Corners population are somewhat smaller and have lower adult body mass (rarely >400 g) than of the Pacific coast population (adults usually >400 g). Immature band-tailed pigeons are gray with pale gray feet and bills, no neck crescent, and have buffy-edged wing coverts and primaries (Braun 1994).

Distribution

Four Corners band-tailed pigeons breed from northern Colorado and east-central Utah south through Arizona, New Mexico, and extreme west Texas into the Sierra Madre Occidental of Mexico; and winter from northern Mexico south to at least Michoacan (Braun et al. 1975, American Ornithologists' Union 1983) (Fig. 1). Migratory band-tailed pigeons wintering in Mexico mingle with resident birds of the same species (Braun 1994).

Habitat

Braun (1994) described the habitat of Four Corners band-tailed pigeons.

Band-tailed pigeons inhabit coniferous forests, especially pine-oak (*Pinus -Quercus*) woodlands (Neff 1947, Marshall 1957, Braun 1973, Braun et al. 1975, Pederson and Nish 1975). They nest in mountainous terrain with highest densities occurring at elevations of 1,600 to 2,700 m that are dominated by ponderosa pine (*P. ponderosa*) and varieties of oak, but also occur into lodgepole pine (*P. contorta*) and spruce-fir (*Picea-Pseudotsuga-Abies*) forests at higher elevations. Nesting occurs in all habitat types, and foraging frequently extends to cultivated fields, stream courses, and livestock feeding areas (Braun et al. 1975, Braun 1976, Kautz 1977). During migration stopovers, habitats similar to those used for foraging in summer and fall (especially areas where acorns are abundant) are commonly used. Band-tailed pigeons winter in Mexico, primarily in oak-pine woodlands and montane conifer forests along the Sierra Madre Occidental, but descend at times into the subtropical Sinaloan deciduous forest (Braun et al. 1975).

The availability of an ample food supply greatly influences the habits, range, distribution, and initiation and duration of nesting of band-tailed pigeons (Neff 1947, Gutiérrez et al. 1975, Jarvis and Passmore 1992). Diets are highly variable and depend on availability of locally abundant food items (Neff 1947). Most flowering and fruiting shrubs and trees within the range of the birds are used as a food source at some time (Neff 1947). Most important are buds, flowers, and

fruits of a variety of deciduous trees and shrubs including oak (*Quercus*), piñon (*Pinus*),
madrone



Figure 1. Breeding and winter range of the Four Corners population of band-tailed pigeons (after Braun et al. 1975).

(*Arbutus*), manzanita (*Arctostaphylos*), elder (*Sambucus*), cherry (*Prunus*), huckleberry (*Vaccinium*), and *Rubus* (Neff 1947, Braun 1994). Acorns and pine nuts may be the most important natural food items, and the availability of these nuts determines the distribution of band-tailed pigeons, especially during winter (Neff 1947).

Natural foods are preferred, but band-tailed pigeons readily exploit waste or stored grains and even bird feeders (Braun 1994). Braun (1973) speculated that the abundance of band-tailed pigeons in Colorado was dependent upon distribution of grain fields in mountainous areas. Braun (1994) reported that corn seemed to be the most preferred grain, possibly because of the size of the kernels, but field peas and wheat also are readily consumed. Barley and oats are used, but to a lesser extent (Braun 1994). Band-tailed pigeons tend to select and specialize on single food items of local abundance (Jarvis and Passmore 1992, Braun 1994).

Band-tailed pigeons generally nest in conifers within closed-canopy forests (Leonard 1998). The tree or shrub type and age selected for nest placement, however, vary greatly throughout the species range (Neff 1947, Glover 1953, MacGregor and Smith 1955, Peeters 1962, Curtis and Braun 1983a, Leonard 1998).

Band-tailed pigeons use free water, especially in conjunction with obtaining minerals (Neff 1947, Einarsen 1953, Smith 1968, Sanders and Jarvis 2000). The need for water appears to be greatest when feeding on grains and acorns and least when feeding on succulent berries (Braun 1994). Access to free water should not be a problem, however, because band-tailed pigeons are highly mobile (Braun 1994, Leonard 1998).

Band-tailed pigeons use “mineral sites” of natural and artificial sources, which are mineralized deposits or, more typically, mineralized water (Sanders 1999). Used mineral sites are characterized by an abundance of adjacent perching sites. Sanders and Jarvis (2000) hypothesized that band-tailed pigeons in western Oregon seek a sodium source to supplement their diet during the nesting season because of insufficient sodium intake and inefficient sodium retention associated with a berry diet. Use of mineral sites by band-tailed pigeons in the Four Corners population is known to occur, but much less than in the Pacific coast population (Braun 1994). Four Corners band-tailed pigeons may use mineral sites to a lesser extent because their mineral requirements are met by the availability of mineral-laden grit (Braun 1994) or through their diet.

Life History

Band-tailed pigeons migrate north from winter-use areas beginning in March-early April, and are assumed to complete spring migration by early June (Braun 1994). Early arrivals are observed primarily where non-natural food sources are abundant (e.g., livestock feeding areas, grain fields, suburban bird feeders). Fall migration begins in September and continues through October, but may vary with breeding activities and food availability (Braun 1994).

Band-tailed pigeons make coo vocalizations throughout the year, but cooing is most frequent during the breeding season and especially from June to early August (Sisson 1968, Keppie et al. 1970, Sanders 1999). Cooing peaks 10 minutes after sunrise during the breeding season, but is common from about -10 to 240 minutes after sunrise and from 210 to 45 minutes before sunset

(Keppie et al. 1970, Sanders 1999). Coo vocalizations are usually restricted to adult males; however, adult females are capable of cooing (Sisson 1968). Sanders (1999) reported that band-tailed pigeon coo-calls lasted about 8–9 seconds and had a maximum intensity frequency range of 200–500 Hz. Coo-call audibility ranged from 150 m in dense forest to >1,100 m in open forest, but was judged to average 300–400 m in most forest environments of the Oregon Coast Range. The acoustic characteristics of the coo-call appear well suited for long-range communication and correspond to the uniform distribution of band-tailed pigeons during the nesting season (Sanders 1999).

Band-tailed pigeons are monogamous, but the length of pair bonds is unknown. Band-tailed pigeons are well-dispersed, solitary nesters (Leonard 1998, Sanders 1999). Nests are loosely constructed twig platforms. North of Mexico, nests are initiated from early May through August (Braun 1994). Nests almost invariably contain one egg, but clutches of two have been reported, and two to three nestings may be attempted annually depending on food availability (Neff 1947, Braun 1994, Leonard 1998). The incubation period is 19 to 20 days and is shared by both pair members. Females attend nests until mid-morning and males attend nests from mid-morning until mid-afternoon (Braun 1994). Both sexes feed the nestling for 20 to 28 days until the young fledges. Both adults regurgitate crop milk, a curd-like substance, to feed their young for about one week after hatching and then in decreasing amounts mixed with other food items until fledging (March and Sadleir 1975, Griminger 1983). Females are able to initiate a second clutch about one week before the initial young has fledged (Leonard 1998).

Use

Sport hunting.—The Migratory Bird Treaty of 1916 and subsequent passage of the Migratory Bird Treaty Act in 1918 ended market hunting of migratory birds, provided the basis for Federal government-regulated sport hunting, and prohibited hunting of some birds including the band-tailed pigeon (Neff 1947). Because of the growing number of crop depredation complaints, the Secretary of Agriculture issued an order in 1924 that allowed permits to be granted for the taking of band-tailed pigeons depredating agricultural crops in California (Neff 1947). The order was amended in 1930 to include Arizona and Washington. Complaints of crop depredation continued to increase and the demand for permits grew until it was apparent that an open hunting season would be preferred (Neff 1947). Federal regulations have permitted regulated hunting of Four Corners band-tailed pigeons throughout their range in the United States, in whole or in part, from 1932 to 1950, following a 20-year moratorium, and since 1968 (Fig. 2, Appendix A).

Arizona and New Mexico had a hunting season from 1932 through 1950 that allowed a daily bag of 10 birds, with the exception of an 8-bird bag in 1950. The seasons were 15 days long before increasing to 30 days in 1943. Through 1950, there was no hunting season in Colorado except in 12 southwesterly counties in 1944 and 1945 (Neff 1947, 1951). The hunting seasons were 30 days long and allowed a daily bag of 10 birds. Utah did not have a hunting season until 1970 because band-tailed pigeons were so sparsely distributed within the state. Hunting seasons were closed in all Four Corners states beginning in 1951 based on the suspected decline in band-tailed pigeon numbers in Arizona, Colorado, and New Mexico (Neff 1952), and band-tailed pigeon life history information published by Neff (1947). Hunting seasons for Four Corners band-tailed pigeons remained closed from 1951 through 1967.

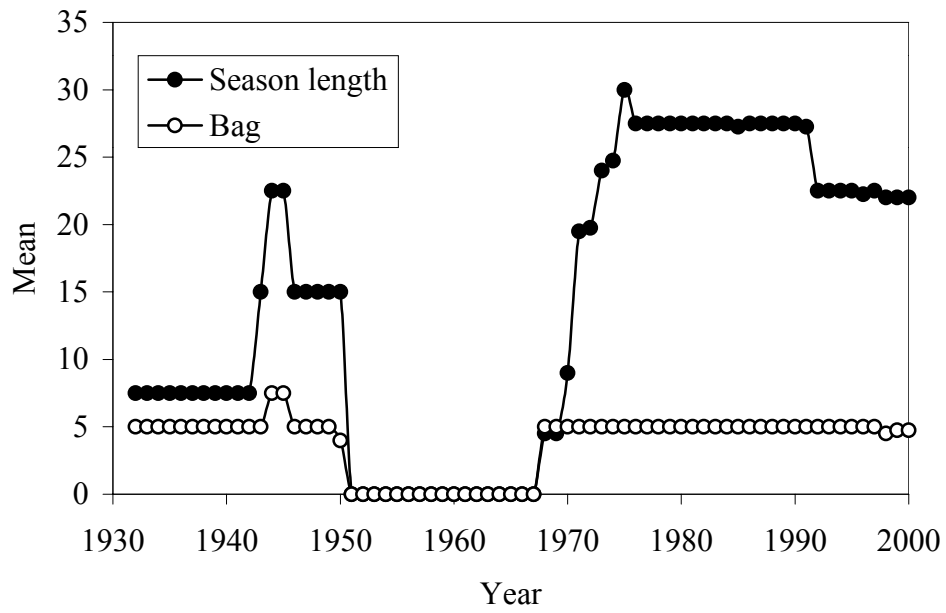


Figure 2. Mean annual band-tailed pigeon hunting season length and bag limit for Arizona, Colorado, New Mexico, and Utah.

An experimental hunting season for band-tailed pigeons was initiated in Arizona and New Mexico in 1968, and Colorado and Utah in 1970. Hunting seasons have continued without the experimental label since 1973. The daily bag has remained at five birds with the exception of Arizona, which reduced the bag to three and four birds in 1998 and 1999, respectively. Season lengths were 9 days before increasing to 23 in 1971 and 30 in 1973, except that New Mexico went to a 20-day hunting season in each of two zones in 1974. Arizona decreased hunting season lengths to 10 days in 1992 and 8 days in 1998 due to a suspected decline in the population size.

State wildlife agencies of the Four Corners states, in whole or in part, have obtained annual estimates of band-tailed pigeon hunter participation and harvest since 1968 (Appendices B–G). Between 1970 and 1996, total band-tailed pigeon harvest in the Four Corners states decreased 87% from a peak of 5,995 in 1975 to a low of 789 in 1996 (where estimates are reported for all four states) (Appendix C). Results from regression analyses indicated long-term (1968 to 1999) decreases in total harvest ranging from 3.3 to 83.2 birds per year ($P \leq 0.032$) in the Four Corners states (excluding Utah's abnormally high estimate in 1977) (Fig. 3, Appendix H). In the short-term (1988 to 1999), total harvest decreased in Arizona by 86.4 birds per year ($P = 0.033$), but there was no trend in harvest indicated for Colorado, New Mexico, or Utah ($P \leq 0.216$) (Appendix I).

Decreasing harvest between 1970 and 1996 has resulted, in part, from the decreasing number of hunters afield and the total number of days that sportsmen hunted (Appendices C–G). The total number of hunters in the Four Corners states decreased 72% from a peak of 1,953 in 1975 to a low of 551 in 1993 (where estimates are reported for all four states). The total number of days that sportsmen hunted band-tailed pigeons between 1970 and 1996 in Arizona, Colorado, and Utah decreased 66% from a peak of 2,957 in 1974 to a low of 1,015 in 1993.

Between 1970 and 1996, the mean number of band-tailed pigeons harvested per hunter day in Arizona, Colorado, and Utah decreased 80% from a peak of 5.5 in 1970 to a low of 1.1 in 1993. Results from regression analyses indicated long-term (1968–1999) decreases in the mean number of band-tailed pigeons harvested per hunter day by 0.02 to 0.04 birds per year ($P \leq 0.091$) in Arizona, Colorado, and Utah (excluding Colorado's abnormally high estimate in 1995) (Fig. 4, Appendix H). The mean number of band-tailed pigeons harvested annually per hunting day in New Mexico is unknown. In the short-term (1988–1999), Arizona, Colorado, and Utah failed to demonstrate a trend in either direction ($P \leq 0.113$) (Appendix I). The reason that fewer sportsmen hunted band-tailed pigeons annually between 1968 and 1999 and that those that hunted had less success is unknown, but may be related to population size.

Other uses.—Band-tailed pigeons are also popular with nonhunters. They are sought by birders and photographers, and are common visitors to backyard feeders and water stations in urban areas. This native species most likely plays an important ecological role, and adds to the biological diversity of landscapes. Also, wild-living band-tailed pigeons have many values to society including: esthetic, recreational, ecological, educational, scientific, utilitarian, and commercial.

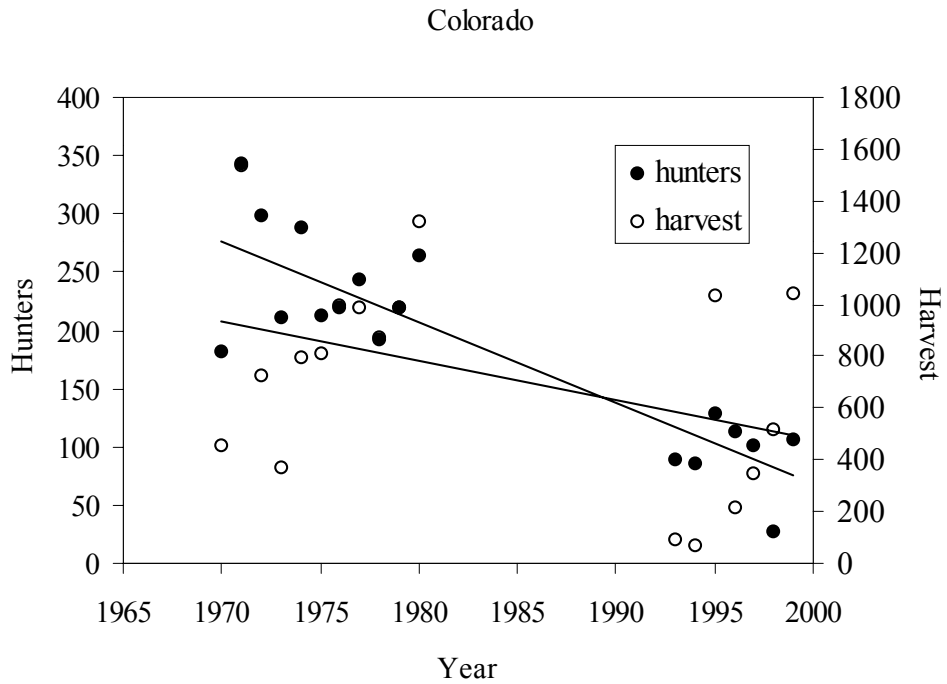
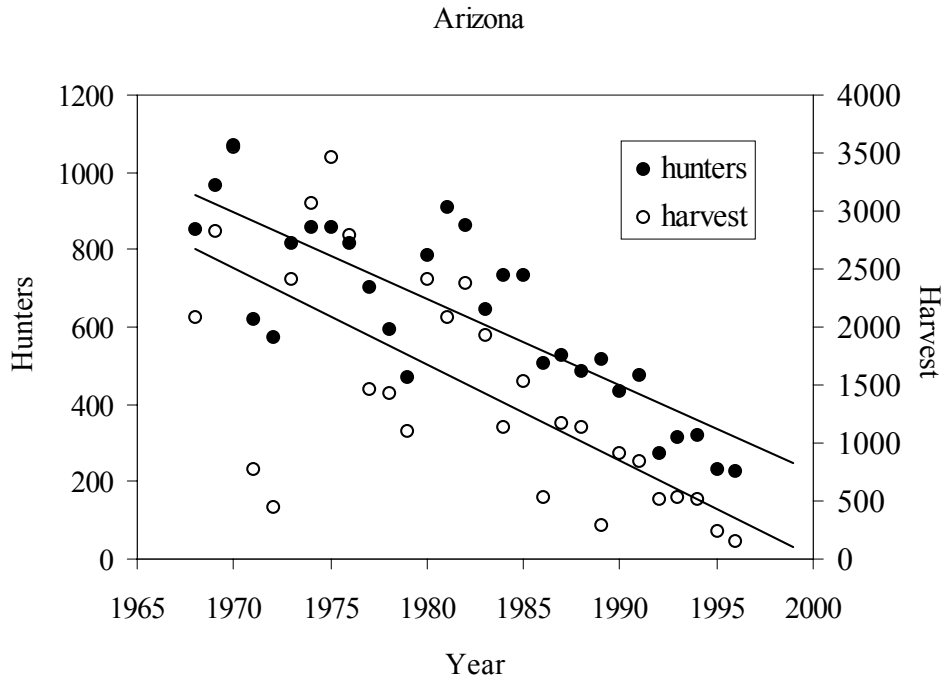
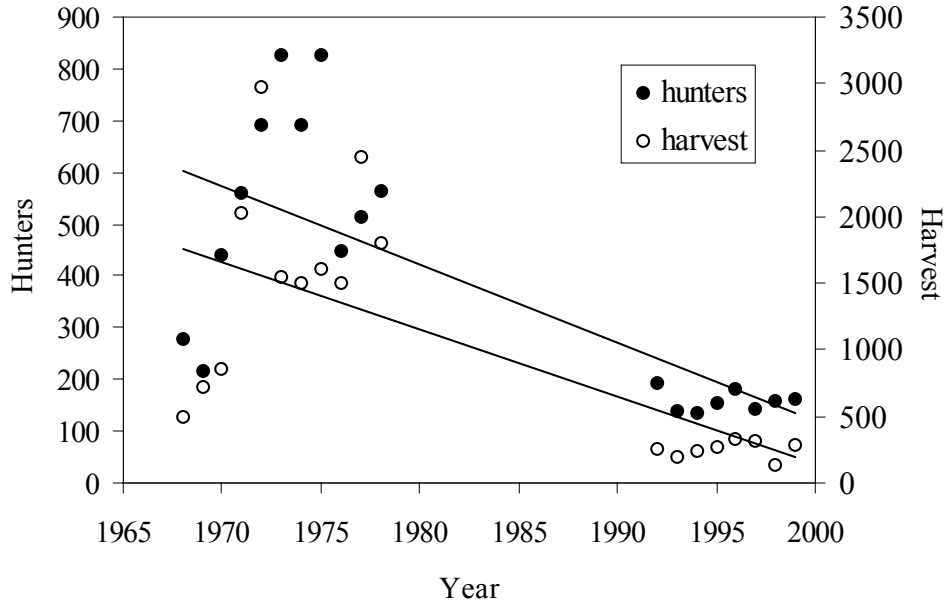


Figure 3. Estimates and long-term linear trends of band-tailed pigeon hunters and harvest in the Four Corners states from 1968 to 1999.

New Mexico



Utah

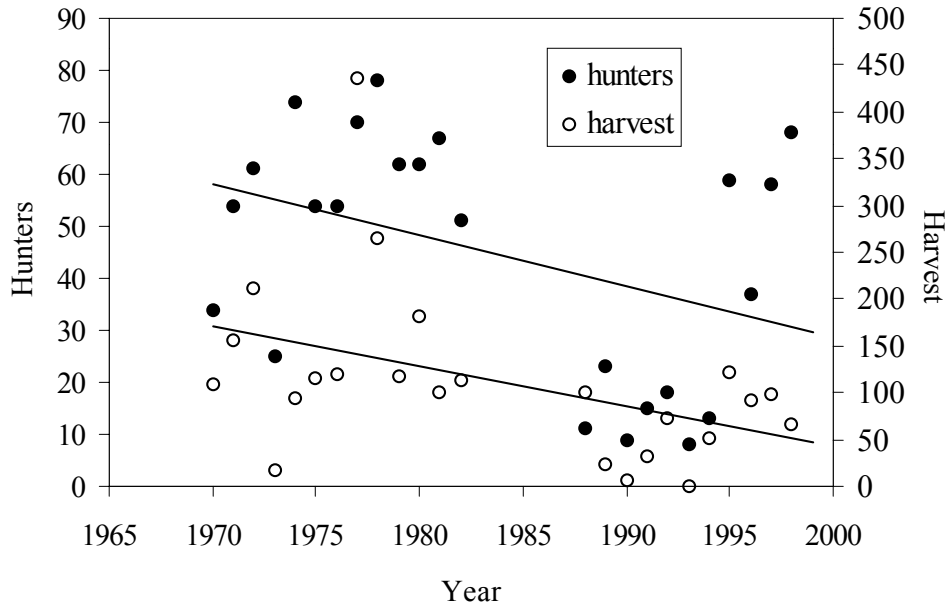


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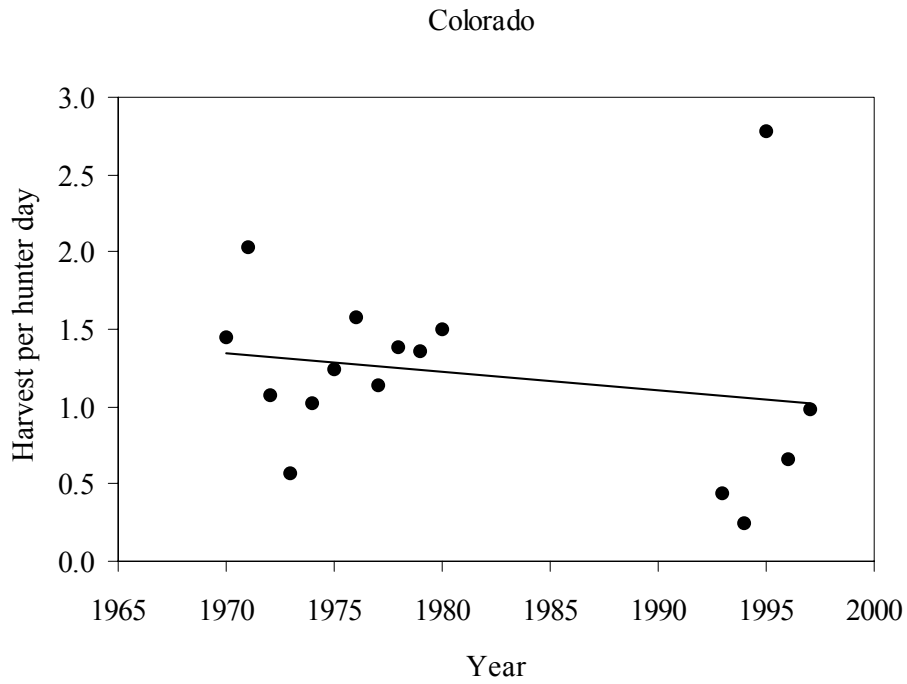
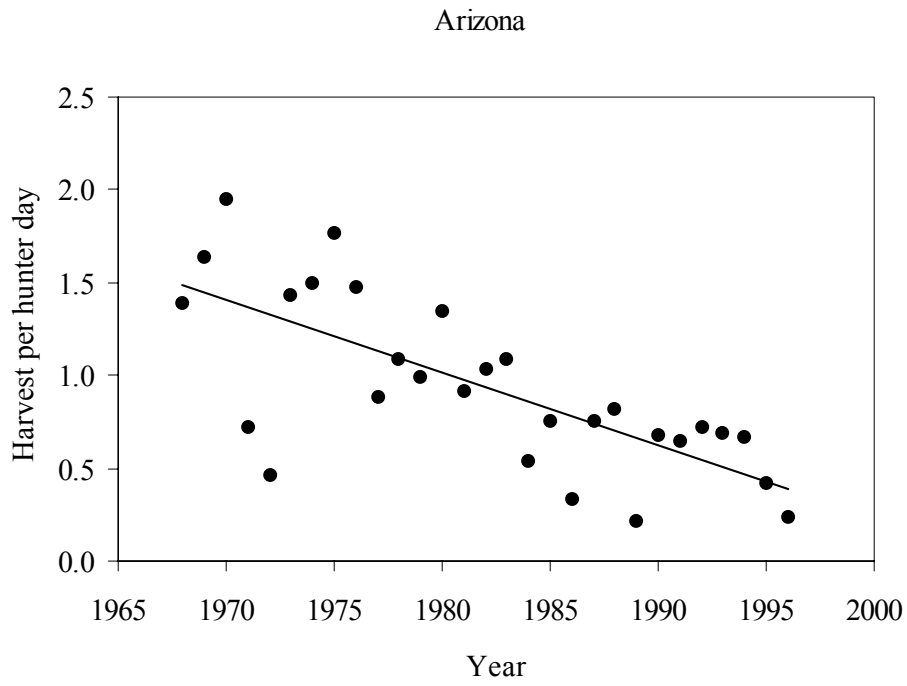


Figure 4. Estimates and long-term linear trends of band-tailed pigeon harvest per hunter day in Arizona, Colorado, and Utah from 1968 to 1997.

Utah

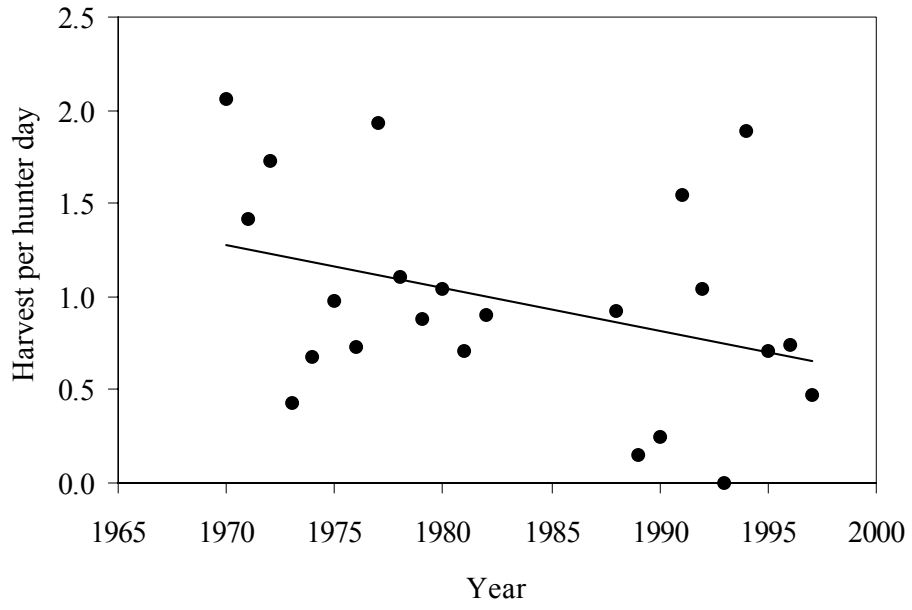


Figure 4. Continued.

Past Management and Research

Although band-tailed pigeons became legal game in 1932, little was known about numbers, distribution, and population biology of this species. The U.S. Fish and Wildlife Service (USFWS) conducted the first investigation of band-tailed pigeon abundance in Colorado in 1944 (Merovka 1944), which was little more than a tally of counts made by a corps of observers. In August 1945, Neff initiated a basic study of the habits of this species where the first two reported nests in Colorado were found (Neff and Culbreath 1947). Neff (1947) published the life history and naturalistic observations of band-tailed pigeons north of Mexico. A more comprehensive inventory of band-tailed pigeon abundance was conducted in Colorado in 1946 and 1947 (Neff and Culbreath 1947, Kinghorn and Neff 1948). These surveys were the first attempt at inventorying an area as large as a state. An inventory similar to Colorado's in 1946 and 1947 was conducted in Arizona, Colorado, and New Mexico annually from 1951 to 1956 forming the first cooperative study of band-tailed pigeons in the Four Corners states (Neff 1951, 1952; Branch of Game Management 1954, 1955, 1956, 1957).

In 1967, the Four Corners Cooperative Band-tailed Pigeon Technical Committee (FCPC) was formed to coordinate research and management activities in the Four Corners states (Braun et al. 1975). The committee consisted of one person responsible for directing pigeon research activities from each of the Four Corners states. Research was initiated in Arizona in 1967, New Mexico in 1968, and Colorado and Utah in 1969 (Braun et al. 1975). Experimental hunting seasons, necessary to facilitate research efforts, were requested and approved in Arizona and New Mexico in 1968 and Colorado and Utah in 1970 (Braun et al. 1975). During the experimental seasons, each band-tailed pigeon hunter was required by the USFWS to have a band-tailed pigeon hunting permit issued by the respective state. This requirement enabled a mailing list to be compiled of all hunters for the distribution of questionnaires pertaining to hunter activity and harvest. The FCPC collected information on the distribution, habitats, migration chronology and patterns, survival, hunting pressure, harvest, hunter success, crippling loss, and age composition of the harvest during experimental seasons from 1968 to 1972, and recommended continuation of hunting seasons without the experimental label (Braun et al. 1975).

The FCPC reported research results from June 1967 through October 1972 in Braun et al. (1975). A total of 25,730 band-tailed pigeons was banded, 2,878 of which were young-of-the-year. Two major southward migration routes in the United States were identified: one from south-central Colorado southwest across New Mexico to extreme southwestern New Mexico and southeastern Arizona; the other southwest from central and western Colorado to east-central Arizona, where a route from Utah converged, then south along the New Mexico and Arizona boundary. The direct recovery rate was 1.5% for adults and 2.2% for juveniles. Thus, depending on actual reporting rates, hunting mortality appears to be low. Mean annual harvest rates were lowest in New Mexico (1%) and Colorado (2%) and highest in Utah (3%) and Arizona (2%). Mean annual survival rate was 64% for adults and 58% for juveniles. An estimated 29% of the harvest occurred in Mexico.

Information has been published on Four Corners band-tailed pigeon parasites and diseases (Olsen and Braun 1976, Olsen and Braun 1980, Stabler and Braun 1975, Stabler and Braun 1979,

Stabler and Stromberg 1981, Stabler et al. 1977), contaminants (Braun et al. 1977), counting methods (Curtis and Braun 1983b), description of nest sites (Curtis and Braun 1983a), reproductive biology (Gutiérrez et al. 1975), age and sex characteristics (White and Braun 1978), movement and philopatry (Schroeder and Braun 1993), and survival information (Kautz and Braun 1981). Little information on population status, however, has been gathered, except that state wildlife agencies of the Four Corners states have collected information on band-tailed pigeon hunter participation and harvest (Appendix B). Season lengths and bag and possession limits have, for the most part, remained unchanged since 1973 (Appendix A, Fig. 2).

In 1992, concern over the unknown status of the Four Corners band-tailed pigeon was voiced by biologists and other field personnel in the respective state conservation agencies and the USFWS. This concern prompted the five management agencies to form the Four Corners Band-tailed Pigeon Subcommittee of the Western Migratory Upland Game Bird Technical Committee. The Subcommittee's purpose was to re-examine the status of the band-tailed pigeon population, to prepare a management plan, and to collaborate and cooperatively manage the Four Corners population of band-tailed pigeons.

By directive of the USFWS, each band-tailed pigeon hunter in all Four Corners states was required to have a band-tailed pigeon hunting permit issued by the respective state beginning in 1993. A sample of permit holders were mailed 10 postage-paid envelopes for collecting wings as part of the USFWS's Cooperative Migratory Bird Parts Collection Survey. Wings were used to annually estimate age composition of the harvest (Appendix J and K). The hunter was instructed to remove one wing from each band-tailed pigeon harvested for each day successful, enclose all wings from those harvested that day in one of the envelopes provided, and mail the pre-addressed envelope. Beginning in 1998, the USFWS required band-tailed pigeon hunters to register with the Migratory Game Bird Harvest Information Program (HIP) in place of the permit.

Population Demographics

Population size.—Little is known about the demographics and status of the Four Corners band-tailed pigeon population, and especially the fundamental parameter of population size. Size of the Four Corners band-tailed pigeon population is unknown because pigeon habits, visibility, and inaccessibility are such that comprehensive counts of individual birds are impractical. The difficulty in locating and observing individuals has also resulted in unreliable estimates of absolute and relative abundance (Casazza et al. 2000). Information on abundance has, however, been obtained by three methods: 1) an extensive corps of observers who watched for and recorded counts of band-tailed pigeons when they were found (typically in late summer when the birds concentrated at favored feeding areas), 2) a mark-recapture study, and 3) The North American Breeding Bird Survey (BBS), which provides the only current data on abundance.

The USFWS investigated the abundance of band-tailed pigeons in Colorado in 1944 in response to the Colorado Game and Fish Commission's request for a hunting season on this species (Merovka 1944). Investigators relied on observations of band-tailed pigeons made by personnel from state and federal natural resource agencies and other qualified individuals. Reviewing records as far back as 1928, Merovka (1944) concluded that: (1) the population in Colorado was similar to that in Arizona and New Mexico, (2) the population has shown no substantial increase

or decrease in recent years, and (3) he was unable to obtain any evidence that these birds were ever numerous in these states.

A more comprehensive inventory of band-tailed pigeons was conducted in Colorado in 1946 and 1947 (Neff and Culbreath 1947, Kinghorn and Neff 1948). Personnel from state and federal natural resource agencies and other qualified individuals documented the location and number of band-tailed pigeons inhabiting Colorado. A similar inventory was conducted cooperatively in Arizona, Colorado, and New Mexico annually from 1951 to 1956 (Neff 1951, 1952; Branch of Game Management 1954, 1955, 1956, 1957). Utah was included in the inventory in 1953. Counts of band-tailed pigeons from these inventories indicated that the population size probably decreased between 1946 and 1956 (Appendix L), with pigeons being widely distributed and occurring at low densities except when gathered at preferred feeding areas.

The fall population size in Colorado was estimated at 70,000 band-tailed pigeons in 1972 based on recapture rates of banded birds (Braun 1994). Braun (1994) speculated that the total size of the Four Corners population north of Mexico was <250,000 birds.

An index to breeding population size is obtained annually from BBS surveys (Peterjohn and Sauer 1993, 1994). Since 1968, a total of 7 to 36 BBS routes have been surveyed annually in Arizona, Colorado, New Mexico, and Utah where band-tailed pigeons were detected. The BBS data fails to demonstrate statistically significant trends in either direction for the Four Corners band-tailed pigeon population, but sample sizes are low and variances are high. The population is estimated to have increased long-term (1968–1999) by 0.6% annually ($t_{24} = 0.3$, $P = 0.777$) using the route-regression method (Geissler and Sauer 1990, Link and Sauer 1994). A 95% confidence interval for the estimated annual change is -7.6 to 10.8. The mean number of band-tailed pigeons heard or seen per BBS route between 1968 and 1999 was 0.54. The population is estimated to have increased short-term (1991–1999) by 0.7% annually ($t_{18} = 0.6$, $P = 0.540$) with a 95% confidence interval of -10.9 to 24.6.

Assessments of hunter participation and harvest data indicate that the Four Corners population of band-tailed pigeons may have declined since initiation of the experimental seasons in 1968. Results from regression analyses indicated long-term (1968–1999) decreases in the total number of hunters afield annually and the mean number of band-tailed pigeons harvested per hunter day (see “Sport hunting” section). These phenomena may be a result of hunters encountering fewer birds or hunters being denied access to areas of high pigeon density. Since most band-tailed pigeon hunting occurs on public lands, except in Colorado, access likely has not changed over this time period. Thus, declining success per hunter day and declining interest in band-tailed pigeon hunting may indicate that fewer birds are available for harvest. Harvest estimates were found to be significantly and positively correlated with relative abundance for the Pacific coast population of band-tailed pigeons (Western Migratory Upland Game Bird Technical Committee 1994).

The band-tailed pigeon population, at least in Colorado, may have been especially large during the late 1960’s–early 1970’s because of increased availability of food associated with grain crops. Szymczak and Funk (1993) reported the distribution, and perhaps the abundance, of band-tailed pigeons in Colorado has changed considerably since the early 1970’s. Many of the

band-tailed pigeon feeding and trapping sites described by Braun (1976) during 1969 to 1975 were associated with grain crops of spring and winter wheat, barley, oats, corn, and sorghum. In 1993, Szymczak and Funk (1993) revisited those sites used by Braun (1976) and reported that band-tailed pigeons were found at only 41% (17 of 42) of the sites. They also reported that substantial acreage of grain were planted to winter wheat, oats, and corn in 1970, but by 1987 had declined to about one-half of 1970 levels. No grain was reported planted from 1989 to 1991 in Huerfano County where 2,204 band-tailed pigeons were banded in or near grain fields from 1969 to 1975 (Braun 1976).

Survival, age structure, age ratio, and recruitment.—Kautz and Braun (1981) reported mean annual survival rates of 73% (95% CI = 65–80) for adults and 66% (95% CI = 45–88) for juveniles in Colorado. The percentage of males and females in the Four Corners population was 53.3 and 46.7 (male:female, 1:0.88) determined from 21,292 band-tailed pigeons trapped and sexed from 1967 to 1972 in the southern Rocky Mountain region (Braun et al. 1975).

Of 25,730 pigeons trapped and aged in the southern Rocky Mountain region, 89% (22,852) were classified as adults and 11 % (2,878) were classified as young of the year (juveniles) (Braun et al. 1975). The average proportion of juveniles in the harvest was 23% per year (range 18–32%) in the Four Corners states from 1968 to 1972 based on 11,723 individual wings collected from hunters (56% of the retrieved harvest). The greater proportion of juveniles in the harvest than in trap samples was most likely a result of juveniles being more vulnerable than adults to hunting (Braun et al. 1975, Kautz and Braun 1981). The USFWS's Migratory Bird Parts Collection Survey indicates a mean of 27% juveniles in the annual harvest from 1993 to 1999 (Appendix J).

Annual recruitment into the population is unknown. Band-tailed pigeons almost invariably have one-egg clutches (Leonard 1998, Keppie and Braun 2000), but can raise three broods annually in favorably environments (Leonard 1998). Jarvis and Passmore (1992) estimated that second year band-tailed pigeons were about one-third as productive as adults. Leonard (1998) reported a nest survival probability of 0.689 (95% CI = 0.613–0.775) for band-tailed pigeons in western Oregon.

MANAGEMENT CONCERNS

Challenges associated with the effective management of the Four Corners population of band-tailed pigeons result from the lack of information on demographics, population status, effects of harvest and habitat alteration on population dynamics, habitats necessary to support stable populations, and inadequate funding for research and management (Braun 1994).

Population Status

1. The single greatest problem is the lack of information on absolute or relative abundance of Four Corners band-tailed pigeons. Presently, there is no inventory technique demonstrated to be effective in estimating population size or monitoring population trends.

Counts of band-tailed pigeons at mineral sites have proven effective in assessing short-term changes in breeding population size in Pacific coast states (Casazza et al. 2000). This same technique cannot effectively be applied to the Four Corners population, however, because these birds do not use or depend on mineral sites to the extent of coastal band-tailed pigeons (Braun 1994, Sanders and Jarvis, in press). Other sampling techniques developed to monitor Pacific coast band-tailed pigeon abundance, such as coo counts at points (Sanders 1999) and along transects (McCaughran and Jeffrey 1989), are likely of limited value in monitoring Four Corners band-tailed pigeons because of low population densities and the probable low number of birds per sample. The BBS survey is unreliable in detecting changes in band-tailed pigeon abundance over time because sample sizes are low, variances are high, pigeon detections per route are low, and coverage of pigeon habitat by BBS routes is poor.

The point count technique developed by Sanders (1999) for indexing abundance of Pacific coast band-tailed pigeons in combination with distance sampling techniques (Buckland et al. 1993) may have the best chance of success and should be tested experimentally (D. Anderson, Colo. State Univ., pers. comm.). Band-tailed pigeons are easily attracted to bait sites (Braun 1976). Counts at permanent bait sites were tested experimentally by Curtis (1981) and recommended for large-scale application by Curtis and Braun (1983). There is no evidence, however, that the number of pigeons at these sites is an accurate index of abundance, especially given confounding variables such as local availability of other native and exotic foods and the direct relationship between the amount of food at bait sites and visiting pigeons (Curtis 1981). Capture-recapture techniques at bait sites may also be effective in generating estimates of relative abundance (Kautz and Braun 2000), but the availability of native foods must be quantified to account for its influence on counts.

2. Information is lacking on the present distribution of band-tailed pigeons.
3. Information on survival rates, age and sex ratios, and recruitment are insufficient. Banding data were collected on the Four Corners band-tailed pigeon population from 1968 to 1972 (Braun et al. 1975). These data provided useful information on survival rates, age and sex ratios, distribution, and migration routes, but these estimates are now about 30 years old and parameters likely have changed. Age ratio information is obtained from the USFWS's Migratory Bird Parts Collection Survey, but estimates from the harvest may not represent the population because sample sizes and regional representation are inadequate.

4. Information is lacking on relative importance of nonhunting mortality factors. Band-tailed pigeons are susceptible to trichomoniasis caused by a protozoan parasite (*Trichomonas gallinae*) of the upper digestive tract. In at least two instances in California, hundreds of band-tailed pigeons have perished from trichomoniasis outbreaks (D. Yparraguirre, Calif, Fish and Game, pers. commun.). Mortality due to trichomoniasis could occur at low levels in the population and go unnoticed due to the dispersed distribution of pigeons. The use of pesticides in the United States and Mexico could cause direct pigeon mortality or indirect loss through decreased production.

Harvest Statistics

1. The USFWS's Migratory Bird Harvest Information Program (HIP), designed to produce annual estimates of migratory bird hunter participation and harvest, was fully implemented in 1998. HIP estimates of band-tailed pigeon hunter participation and harvest are not reliable, and there is no evidence that reliable estimates will be available in the near future. Wildlife agencies in Arizona, Colorado, and Utah discontinued surveys of hunter participation and harvest in 1998 with implementation of HIP, and Arizona and Colorado discontinued band-tailed pigeon hunting permit requirements. Braun (1994) recommended that efforts be made to ensure that the permit survey and HIP methods of obtaining hunter participation and harvest information be smoothly integrated so that these annual estimates can be compared over time to provide long-term trends.
2. Information on the relationship between sport harvest regulations and Four Corners band-tailed pigeon demographics is lacking. Especially needed are data on the effect of early season harvest (before 20 September) on annual production and survival of breeding adults (Braun 1994). Sport harvest in early September may coincide with nesting (Leonard 1998), and losses of productivity may occur (Zeigler 1971, Gutiérrez et al. 1975).

Habitat Suitability

1. Detailed knowledge of habitats essential for increasing or maintaining the population is largely unknown. Ensuring that adequate, high-quality habitat for band-tailed pigeons is maintained will undoubtedly have the most significant effect on maintaining and increasing population levels. Widespread destruction of foraging areas and nesting cover could lead to long-term population declines (Sanders 1999). Major habitat components include forested areas for nesting, suitable foraging sites, possibly mineral sites, roosting cover, and escape cover.
2. Information is lacking on the relationship of food availability to band-tailed pigeon density and productivity. There are strong possibilities for increasing population size of this species by planting or enhancing the production and availability of wild fruit and mast and agricultural crops for this species. The provisioning of natural and cultivated foods to band-tailed pigeons could be used to increase population size and change distribution, which may subsequently enhance opportunities for consumptive and non-consumptive uses.

Land-use practices may reduce natural food availability and adversely affect band-tailed pigeon abundance and distribution (Sanders 1999). The practice of removing natural food producing trees and shrubs or use of herbicides and thinning to promote growth of conifers may reduce availability of natural foods. Livestock grazing may, over the long-term, reduce abundance of berry-producing plants in the understory.

Funding

1. Funding from federal, state, and private agencies and individuals is inadequate to address most research and management needs outlined in this plan. The likely reasons are that band-tailed pigeons are sparsely distributed, declines in hunter participation and success have not been brought to the attention of administrators, and hunting band-tailed pigeons is not popular in comparison with other game birds such as waterfowl.

RECOMMENDED MANAGEMENT STRATEGIES

The following recommended management strategies provide a synthesis of management actions, assessment methods, and information needs that should be considered when developing a management program for the Four Corners population of band-tailed pigeons. These procedures should be implemented cooperatively by the Four Corners states (Arizona, Colorado, New Mexico, and Utah) in order of priority. Cooperative partnerships ensure that data are meaningful and comparable among states, and maximize effectiveness when making management decisions.

Objective: Maximize the potential for sustained consumptive and nonconsumptive uses.

Population Status

1. Population Inventory: Test techniques with the greatest likelihood of success in an effort to cost effectively and reliably monitor range-wide population size.

Priority: 1

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2001–2002 and implement project upon establishing funding.

2. Population Range: Determine present population range, maintain current distribution maps, and evaluate the present range relative to the historic range.

Priority: 1

Responsibility: Arizona, Colorado, New Mexico, and Utah.

Schedule: Solicit funding and proposals in 2001–2002 and implement project upon establishing funding.

3. Age ratio: Obtain annual age-ratio estimates to assess annual production. Currently available techniques include:

1. Trapping, and
2. Field bag checks, strategic placement of wing barrels on public land, and USFWS's Migratory Bird Parts Collection Survey.

Every effort should be made to ensure adequate sample size (>30) and representation from each Four Corners state.

Priority: 1

Responsibility: State wildlife agencies in Arizona, Colorado, New Mexico, and Utah in conjunction with the USFWS.

Schedule: Ongoing.

4. Survival: Estimate survival rates through a long-term (at least 5 years) banding program or radio telemetry. A banding program will also provide age and sex ratio data.

Priority: 1

Responsibility: Four Corners Band-tailed Pigeon Subcommittee in cooperation with the USFWS.

Schedule: Solicit funding and proposals in 2003–2004 and implement project upon establishing funding.

5. Recruitment: Determine age-specific recruitment rates.

Priority: 1

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2003–2004 and implement project upon establishing funding.

6. Nonhunting Mortality: Determine impacts of nonhunting mortality factors including disease, predation, and pesticides on demographics.

Priority: 2

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2004–2005 and implement project upon establishing funding.

Sport Hunting

1. Regulations: Develop a harvest management strategy for establishing annual sport hunting regulations.

Priority: 1.

Responsibility: Four Corners Band-tailed Pigeon Subcommittee in conjunction with USFWS.

Schedule: Initiate development of a strategy in 2001.

2. Hunter Participation and Harvest: Obtain annual estimates of hunter participation (hunters afield, hunter days) and harvest. Currently available techniques include:

1. State conducted survey of all hunters who obtain a special permit required to hunt band-tailed pigeons,
2. State conducted survey of a proportion of the small game hunters who obtain a hunting license,
3. State conducted survey of all or a proportion of the hunters who register for the Service's Migratory Bird Harvest Information Program (HIP), or
4. Service conducted survey of a proportion of the hunters who register for the HIP.

Past experience indicates that state-conducted surveys of all hunters who obtain a special permit required to hunt band-tailed pigeons produce the most reliable results. The Four

Four Corners states should adopt a common method and procedure for obtaining annual estimates of hunter participation and harvest.

Priority: 1

Responsibility: Arizona, Colorado, New Mexico, and Utah in conjunction with the USFWS.

Schedule: Ongoing.

3. Early Season Harvest: Evaluate the effect of early-season harvest (before 20 September) on population recruitment and survival of breeding adults.

Priority: 2

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2004–2005 and implement project upon establishing funding.

Objective: Increase habitat quality and quantity.

Habitat Suitability

1. Habitat in the United States: Identify the distribution, types, and use of habitats used by Four Corners band-tailed pigeons throughout their range in the United States to facilitate habitat acquisition, protection, and enhancement. Identify causes of habitat loss and degradation from all factors including, but not limited to: urban and industrial development, changing agricultural and forestry land-use practices, pesticides, grazing, loss of mineral sites, and others. After identifying causes for habitat loss and degradation, develop strategies for curtailing losses and degradation in cooperation with the U.S. Forest Service, Bureau of Land Management, Indian Reservations, and other land owners or managers.

Priority: 2

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2001–2002, and implement project upon establishing funding.

2. Habitat in Mexico: Identify distribution, types, and use of habitats used by Four Corners band-tailed pigeons throughout their range in Mexico.

Priority: 2

Responsibility: USFWS to encourage Mexican officials to implement projects individually and cooperatively.

Schedule: Ongoing.

3. Food and Nest-site Availability: Investigate the relationship of food and nest site availability to band-tailed pigeon distribution, density, and productivity; and the effects of land-use

practices (e.g. forestry management practices) on nest densities, nest success, and recruitment.

Priority: 2

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2004–2005, and implement project upon establishing funding.

4. Mineral Use: Investigate the use of mineral sites.

Priority: 3

Responsibility: Four Corners Band-tailed Pigeon Subcommittee to solicit funding and research proposals and implement project cooperatively in Four Corners states.

Schedule: Solicit funding and proposals in 2005–2006, and implement project upon establishing funding.

ANNUAL REVIEW

The Four Corners Band-tailed Pigeon Subcommittee shall meet annually, or as needed, to review progress in meeting the goal and objectives of this plan, and to recommend revisions. The subcommittee shall report on progress to the Pacific Flyway Council (through the Western Migratory Upland Game Bird Technical Committee), state and federal agencies, and organizations interested in cooperating in management of the Four Corners band-tailed pigeon population.

Chairmanship of the subcommittee shall be rotated annually among the USFWS and three Four-Corner states in the Pacific Flyway. New Mexico has chosen not to actively participate in meetings of the subcommittee, but has and will continue to be a part of the management of the Four Corners population of band-tailed pigeons. Term of Chairmanship is for two years from 1 October to 31 September.

Responsibility for chairmanship is:

USFWS	1999-2001
Utah	2001-2003
Colorado	2003-2005
Arizona	2005-2007

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APPENDICES

APPENDIX A. Hunting seasons (S = September, O = October, N = November, D = December) and daily bag and possession limits (B/P) for band-tailed pigeons in the Four Corners states.

Year	Arizona		Colorado		New Mexico			Utah	
	Season	B/P	Season	B/P	Season		B/P	Season	B/P
					North ^a	South ^a			
1913–31	closed		closed		closed			closed	
1932	D 1–15	10/10	closed		N 1–15		10/10	closed	
1933	D 1–15	10/10	closed		N 1–15		10/10	closed	
1934	D 1–15	10/10	closed		N 1–15		10/10	closed	
1935	D 1–15	10/10	closed		N 1–15		10/10	closed	
1936	O 16–30	10/10	closed		O 1–15		10/10	closed	
1937	O 16–30	10/10	closed		O 1–15		10/10	closed	
1938	O 16–30	10/10	closed		O 1–15		10/10	closed	
1939	O 16–30	10/10	closed		O 1–15		10/10	closed	
1940	S 16–30	10/10	closed		S 16–30		10/10	closed	
1941	S 16–30	10/10	closed		S 16–30		10/10	closed	
1942	S 16–30	10/10	closed		S 16–30		10/10	closed	
1943	S 16–O 15	10/10	closed		S 16–O 15		10/10	closed	
1944	S 16–O 15	10/10	S 16–O 15 ^a	10/10	S 16–O 15		10/10	closed	
1945	S 16–O 15	10/10	S 16–O 15 ^a	10/10	S 16–O 15		10/10	closed	
1946	S 16–O 15	10/10	closed		S 16–O 15		10/10	closed	
1947	S 16–O 15	10/10	closed		S 16–O 15		10/10	closed	
1948	S 16–O 15	10/10	closed		S 16–O 15 ^b		10/10	closed	
1949	S 16–O 15	10/10	closed		S 16–O 15 ^b		10/10	closed	
1950	S 16–O 15	8/8	closed		S 16–O 15 ^b		8/8	closed	
1951–67	closed		closed		closed			closed	
1968	S 28–O 6 ^a	5/10	closed		S 28–O 6 ^c		5/10	closed	
1969	O 11–19 ^a	5/10	closed		O 11–19 ^c		5/10	closed	
1970	O 17–25 ^a	5/10	S 12–20 ^{b,c}	5/10	O 17–25 ^c		5/10	S 12–20 ^a	5/10
1971	O 16–24 ^a	5/10	S 4–26 ^{b,c}	5/10	S 11–O 3 ^c		5/10	S 4–26 ^a	5/10
1972	O 14–23 ^a	5/10	S 9–O 1 ^{b,c}	5/10	S 2–24 ^c		5/10	S 1–23 ^a	5/10
1973	O 12–31 ^a	5/10	S 8–O 7 ^{b,d}	5/10	S 1–30 ^c		5/10	S 15–30 ^a	5/10
1974	O 12–31 ^a	5/10	S 7–O 6 ^{b,d}	5/10	S 1–20 ^c	O 12–31 ^c	5/10	S 2–30 ^{a,b}	5/10
1975	O 11–N 9 ^a	5/10	S 6–O 15 ^{b,e}	5/10	S 6–25 ^c	O 11–20 ^c	5/10	S 1–30 ^a	5/10
1976	O 9–N 7 ^a	5/10	S 4–O 3 ^{b,e}	5/10	S 1–20 ^c	O 2–21 ^c	5/10	S 1–30 ^a	5/10
1977	O 12–N 10 ^a	5/10	S 3–O 2 ^{b,e}	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1978	O 12–N 10 ^a	5/10	S 2–O 1 ^{b,f}	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1979	O 12–N 10 ^a	5/10	S 1–30 ^{b,g}	5/10	S 1–20 ^c	O 5–24 ^c	5/10	S 1–30 ^a	5/10
1980	O 10–N 8 ^a	5/10	S 1–30 ^{b,h}	5/10	S 6–25 ^c	O 4–23 ^c	5/10	S 1–30 ^a	5/10
1981	O 9–N 7 ^a	5/10	S 1–30 ^{b,h}	5/10	S 1–20 ^c	O 3–22 ^c	5/10	S 1–30 ^a	5/10
1982	O 8–N 6 ^a	5/10	S 1–30 ^{b,i}	5/10	S 1–20 ^c	O 2–21 ^c	5/10	S 1–30 ^a	5/10
1983	O 7–N 5 ^b	5/10	S 1–30 ^{e,i}	5/10	S 1–20	O 1–20	5/10	S 1–30	5/10
1984	O 11–N 10 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 1–30	5/10
1985	O 11–N 9 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 2–30 ^b	5/10
1986	O 10–N 8 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 1–30	5/10
1987	O 9–N 7 ^b	5/10	S 1–30 ^j	5/10	S 1–20	O 1–20	5/10	S 1–30	5/10
1988	O 7–N 5 ^b	5/10	S 1–30 ^j	5/10	S 1–20	O 1–20	5/10	S 1–30 ^a	5/10
1989	O 13–N 11 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 1–30 ^a	5/10
1990	O 12–N 10 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 1–30 ^a	5/10
1991	O 11–N 9 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 2–30 ^{a,b}	5/10
1992	O 13–22 ^b	5/10	S 1–30	5/10	S 1–20	O 1–20	5/10	S 1–30 ^a	5/10
1993	O 13–22 ^b	5/10	S 1–30 ^k	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1994	O 12–21 ^b	5/10	S 1–30 ^k	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1995	O 18–27 ^b	5/10	S 1–30 ^k	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1996	O 16–25 ^b	5/10	S 1–30 ^k	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 2–30 ^{a,b}	5/10
1997	O 15–24 ^b	5/10	S 1–30 ^k	5/10	S 1–20 ^c	O 1–20 ^c	5/10	S 1–30 ^a	5/10
1998	O 2–9 ^c	3/6	S 1–30 ^l	5/10	S 1–20 ^{c,d}	O 1–20 ^{c,d}	5/10	S 1–30 ^{a,b,c}	5/10
1999	O 1–8 ^c	4/8	S 1–30 ^l	5/10	S 1–20 ^{c,d}	O 1–20 ^{c,d}	5/10	S 1–30 ^{a,b,c}	5/10

APPENDIX A. Continued.

Arizona

^a Each band-tailed pigeon hunter must have a band-tailed pigeon hunting permit issued by the state.

^b Each band-tailed pigeon hunter must have a properly validated special bird permit stamp issued by the state.

^c Each band-tailed pigeon hunter must have properly registered with the Migratory Bird Harvest Information Program.

Colorado

^a In the drainage of the North Fork of the Gunnison River in Gunnison and Delta Counties and in La Plata, Montezuma, Dolores, San Miguel, Montrose, Ouray, San Juan, Archuleta, Huerfano, and Las Animas Counties.

^b Each band-tailed pigeon hunter must have a band-tailed pigeon hunting permit issued by the state.

^c In all lands west of U.S. Interstate 25 from the New Mexico state line to its intersection with U.S. Highway 24 at Colorado Springs; south and west of U.S. Highway 24 to its intersection with U.S. Interstate 70 to the Utah state line.

^d In all lands west of U.S. Interstate 25.

^e In all lands west of U.S. Interstate 25 and Small Game Management Unit 80.

^f In all lands west of U.S. Interstate 25 and Small Game Management Unit 80 and 82.

^g In all lands west of U.S. Interstate 25 and lands east of U.S. Interstate 25 bounded by U.S. Highway 50, State Highway 109, U.S. Highway 160, State Highway 389 and the New Mexico state line.

^h In all lands west of U.S. Interstate 25 and lands east of U.S. Interstate 25 south of U.S. Highway 50 and State Highway 96; west of Bent County Road 14, U.S. Highway 50, State Highway 109, U.S. Highway 160 and State Highway 389; north of Colorado-New Mexico state line.

ⁱ In all lands west of U.S. Interstate 25 and small game management units 80–83.

^j In all lands west of U.S. Interstate 25 and small game management units 128, 129, 133–136, and 140–142.

^k Each band-tailed pigeon hunter must have a band-tailed pigeon hunting permit.

^l Each band-tailed pigeon hunter must have properly registered with the Migratory Bird Harvest Information Program.

New Mexico

^a New Mexico used a zoned season beginning in 1974. The northern zone is defined as that area lying north of U.S. Highway 60 and the southern zone in that area lying south of U.S. Highway 60. The zones were redefined in 1975. The northern zone is that area lying north and east of a line following U.S. Highway 60 from the Arizona state line east to Interstate Highway 25 at Socorro and thence south along Interstate Highway 25 to the Texas state line. The southern zone is that area lying south and west of a line following U.S. Highway 60 from the Arizona state line east to Interstate Highway 25 at Socorro and thence south along Interstate Highway 25 to the Texas state line.

^b South of U.S. Highway 60.

^c Each band-tailed pigeon hunter must have a band-tailed pigeon hunting permit issued by the state.

^d Each band-tailed pigeon hunter must have properly registered with the Migratory Bird Harvest Information Program.

Utah

^a Each band-tailed pigeon hunter must have a band-tailed pigeon hunting permit issued by the state.

^b Utah law prohibits the opening day of a hunting season to be on Sunday.

^c Each band-tailed pigeon hunter must have properly registered with the Migratory Bird Harvest Information Program.

APPENDIX B. Methods used by state wildlife agencies to obtain estimates of band-tailed pigeon hunter participation and harvest in the Four Corners states.

Permit Survey

Hunters were required to have a state-issued permit prior to hunting band-tailed pigeons in Arizona (1968–1997), Colorado (1970–1982, 1993–1997), New Mexico (1968–1982, 1992–1999), and Utah (1970–1982, 1988–1999). Permits were obtained from designated state agency offices or license vendors. This requirement enabled a mailing list to be compiled of all potential band-tailed pigeon hunters within each state. Questionnaires pertaining to hunter participation and harvest were mailed to all registered hunters following the hunting season in each state where permits were required, except for Colorado in 1981–1982 and New Mexico in 1979–1982. Permit holders were mailed a second questionnaire if they did not respond to the first questionnaire. Hunters were questioned about the number of days they hunted and pigeons harvested, both retrieved and unretrieved. Estimates of hunter participation and harvest by permit holders that did not respond to either questionnaire were calculated from the responses of permit holders that completed and returned the questionnaire. Statewide hunter participation and harvest was calculated by combining numbers from hunter responses with projected estimates. In 1992, questionnaires were expanded to include the number and location of band-tailed pigeons seen.

Small Game Harvest Survey

Estimates of band-tailed pigeon hunter participation and harvest were obtained from state-conducted small game harvest surveys in Colorado in 1970–1977 and New Mexico in 1975–1999. Data pertaining to hunter participation and harvest were collected by mail questionnaire or telephone survey of a sample of small game license buyers. The small game surveys were designed to monitor state-wide harvest trends from year-to-year for extensively hunted species. Estimates of band-tailed pigeon hunter participation and harvest are highly imprecise, and are typically so for less popular game species. Because of the lack of precision, estimates from small game harvest surveys are not presented in this management plan.

Migratory Bird Harvest Information Program

Beginning in 1998, all Four Corners states were required to register band-tailed pigeon hunters with the U.S. Fish and Wildlife Service's Migratory Bird Harvest Information Program (HIP). Hunter addresses and telephone numbers were collected for the HIP in Arizona, Colorado, and Utah via a state-operated automated telephone system and the permit system in New Mexico. Hunters in Arizona, Colorado, and Utah were required to have proof of proper registration with the HIP prior to hunting band-tailed pigeons. State-collected information on potential band-tailed pigeon hunters was forwarded to the U.S. Fish and Wildlife Service where an annual telephone survey was conducted on a sample of hunters in each state to estimate hunter participation and harvest. Arizona, Colorado, and Utah have relied on the HIP to provide estimates of hunter participation and harvest since 1998, but this information is presently not available.

APPENDIX C. Estimated number of band-tailed pigeon hunters (Hunt) and total harvest (Harv) reported in the Four Corners states.

Year	Arizona		Colorado		New Mexico		Utah		Total	
	Hunt	Harv	Hunt	Harv	Hunt	Harv	Hunt	Harv	Hunt	Harv
1968	851	2085	0	0	278	500	0	0	1129	2585
1969	968	2820	0	0	218	719	0	0	1186	3539
1970	1069	3545	182	541	440	859	34	109	1725	4971
1971	622	782	344	1723	559	2027	54	156	1579	4502
1972	576	453	298	820	692	2981	61	211	1627	4374
1973	815	2419	212	363	828	1548	25	18	1880	4353
1974	858	3063	288	792	690	1501	74	95	1910	5451
1975	860	3469	213	809	826	1601	54	116	1953	5995
1976	817	2800	219	995	449	1496	54	119	1539	5410
1977	704	1473	243	988	515	2455	70	435	1532	5351
1978	594	1439	192	938	563	1800	78	264	1427	4378
1979	472	1102	220	1096	^a	.	62	117	754	2210
1980	788	2408	265	1273	.	.	62	182	1115	3909
1981	911	2082	.	.	.	.	67	101	978	2183
1982	865	2378	.	.	.	.	51	113	916	2491
1983	645	1931	.	.	.	.	.	.	645	1931
1984	736	1139	.	.	.	.	.	.	736	1139
1985	736	1534	.	.	.	.	.	.	736	1534
1986	505	532	.	.	.	.	.	.	505	532
1987	528	1180	.	.	.	.	.	.	528	1180
1988	486	1137	.	.	.	.	11	101	497	1238
1989	519	286	.	.	.	.	23	24	542	310
1990	432	917	.	.	.	.	9	7	441	924
1991	476	847	.	.	.	.	15	31	491	878
1992	276	522	.	.	195	261	18	73	489	856
1993	315	543	90	93	138	189	8	0	551	825
1994	321	523	86	71	134	247	13	51	554	892
1995	233	237	129	1037	155	274	59	121	576	1669
1996	228	151	114	220	183	326	37	92	562	789
1997	.	.	101	347	144	317	58	98	303	762
1998	.	.	.	.	158	128	68	67	226	195
1999	.	.	.	.	161	283	‡ ^b	‡	161	283

^a Data not collected.

^b Data unavailable at time of publication.

APPENDIX D. Estimated number of band-tailed pigeon hunters and harvest in Arizona.

Year	Hunters	Hunter days		Harvest	Harvest per hunter	
	afield	Total	Mean		Day	Season
1968	851	1498	1.8	2085	1.4	2.5
1969	968	1719	1.8	2820	1.6	2.9
1970	1069	1815	1.7	3545	2.0	3.3
1971	622	1076	1.7	782	0.7	1.3
1972	576	968	1.7	453	0.5	0.8
1973	815	1688	2.1	2419	1.4	3.0
1974	858	2039	2.4	3063	1.5	3.6
1975	860	1968	2.3	3469	1.8	4.0
1976	817	1902	2.3	2800	1.5	3.4
1977	704	1666	2.4	1473	0.9	2.1
1978	594	1323	2.2	1439	1.1	2.4
1979	472	1107	2.3	1102	1.0	2.3
1980	788	1794	2.3	2408	1.3	3.1
1981	911	2269	2.5	2082	0.9	2.3
1982	865	2291	2.6	2378	1.0	2.7
1983	645	1781	2.8	1931	1.1	3.0
1984	736	2128	2.9	1139	0.5	1.5
1985	735	2027	2.8	1534	0.8	2.1
1986	505	1611	3.2	532	0.3	1.1
1987	528	1562	3.0	1180	0.8	2.2
1988	486	1383	2.8	1137	0.8	2.3
1989	519	1345	2.6	286	0.2	0.6
1990	432	1354	3.1	917	0.7	2.1
1991	476	1321	2.8	847	0.6	1.8
1992	276	724	2.6	522	0.7	1.9
1993	315	789	2.5	543	0.7	1.7
1994	321	778	2.4	523	0.7	1.6
1995	233	571	2.5	237	0.4	1.0
1996	228	644	2.8	151	0.2	0.7

APPENDIX E. Estimated number of band-tailed pigeon hunters and harvest in Colorado.

Year	Hunters afield	Hunter days		Harvest	Harvest per hunter	
		Total	Mean		Day	Season
1970	182	374	2.1	541	1.4	3.0
1971	344	851	2.5	1723	2.0	5.0
1972	298	763	2.6	820	1.1	2.8
1973	212	642	3.0	363	0.6	1.7
1974	288	777	2.7	792	1.0	2.8
1975	213	653	3.1	809	1.2	3.8
1976	219	629	2.9	995	1.6	4.5
1977	243	872	3.6	988	1.1	4.1
1978	192	675	3.5	938	1.4	4.9
1979	220	804	3.7	1096	1.4	5.0
1980	265	848	3.2	1273	1.5	4.8
1981–92	^a	.	.	.	.	.
1993	90	213	2.4	93	0.4	1.0
1994	86	296	3.4	71	0.2	0.8
1995	129	373	2.9	1037	2.8	8.0
1996	114	336	2.9	220	0.7	1.9
1997	101	354	3.5	347	1.0	3.4

^a Data not collected.

APPENDIX F. Estimated number of band-tailed pigeon hunters and harvest in New Mexico.

Year	Hunters afield	Hunter days		Harvest	Harvest per hunter	
		Total	Mean		Day	Season
1968	278	^a	.	500	.	1.8
1969	218	.	.	719	.	3.3
1970	440	.	.	859	.	2.0
1971	559	.	.	2027	.	3.6
1972	692	.	.	2981	.	4.3
1973	828	.	.	1548	.	1.9
1974	690	.	.	1501	.	2.2
1975	826	.	.	1601	.	1.9
1976	449	.	.	1496	.	3.3
1977	515	.	.	2455	.	4.8
1978	563	.	.	1800	.	3.2
1979–91	.	.	.	.	.	.
1992	195	.	.	261	.	1.3
1993	138	.	.	189	.	1.4
1994	134	.	.	247	.	1.8
1995	155	.	.	274	.	1.8
1996	183	.	.	326	.	1.8
1997	144	.	.	317	.	2.2
1998	158	.	.	128	.	0.8
1999	161	.	.	283	.	1.8

^a Data not collected.

APPENDIX G. Estimated number of band-tailed pigeon hunters and harvest in Utah.

Year	Hunters afield	Hunter days		Harvest	Harvest per hunter	
		Total	Mean		Day	Season
1970	34	53	1.6	109	2.1	3.2
1971	54	110	2.0	156	1.4	2.9
1972	61	122	2.0	211	1.7	3.5
1973	25	42	1.7	18	0.4	0.7
1974	74	141	1.9	95	0.7	1.3
1975	54	119	2.2	116	1.0	2.1
1976	54	162	3.0	119	0.7	2.2
1977	70	225	3.2	435	1.9	6.2
1978	78	238	3.1	264	1.1	3.4
1979	62	133	2.1	117	0.9	1.9
1980	62	175	2.8	182	1.0	2.9
1981	67	142	2.1	101	0.7	1.5
1982	51 ^a	125	2.5	113	0.9	2.2
1983–87	.	.	.	.	.	.
1988	11	109	9.9	101	0.9	9.2
1989	23	159	6.9	24	0.2	1.0
1990	9	28	3.1	7	0.3	0.8
1991	15	20	1.3	31	1.6	2.1
1992	18	70	3.9	73	1.0	4.1
1993	8	13	1.6	0	0.0	0.0
1994	13	27	2.1	51	1.9	3.9
1995	59	171	2.9	121	0.7	2.1
1996	37	125	3.4	92	0.7	2.5
1997	58	209	3.6	98	0.5	1.7

^a Data not collected.

APPENDIX H. Annual estimates from regression analysis of long-term (1968–1999) linear trends in band-tailed pigeon hunter participation and harvest in the Four Corners states.

Attribute	Estimate	SE	95% confidence interval		df	<i>t</i>	<i>P</i>	<i>r</i> ²
State								
Total harvest								
AZ	-83.21	16.40	-116.86	-49.56	28	5.1	<0.001	0.49
CO	-24.54	10.28	-46.59	-2.49	15	2.4	0.032	0.29
NM	-50.55	13.15	-78.30	-22.80	18	3.8	<0.001	0.46
UT	-4.40	2.07	-8.71	-0.10	22	2.1	0.045	0.18
UT (-1977)	-3.33	1.41	-6.27	-0.38	21	2.4	0.029	0.22
Total hunters								
AZ	-22.30	3.01	-28.49	-16.12	28	7.4	<0.001	0.67
CO	-6.64	1.14	-9.08	-4.21	15	5.9	<0.001	0.71
NM	-15.12	3.59	-22.69	-7.55	18	4.2	<0.001	0.51
UT	-1.29	0.49	-2.30	-0.28	22	2.7	0.015	0.25
Total hunter days								
AZ	-28.38	9.81	-48.51	-8.24	28	2.9	0.008	0.24
CO	-16.81	4.15	-25.71	-7.91	15	4.1	0.001	0.54
UT	-1.16	1.56	-4.41	2.09	22	0.7	0.466	0.03
Mean days per hunter								
AZ	0.04	0.01	0.02	0.05	28	6.0	<0.001	0.57
CO	0.01	0.01	-0.01	0.04	15	1.0	0.332	0.07
UT	0.06	0.04	-0.03	0.16	22	1.5	0.151	0.10
Mean harvest per hunter day								
AZ	-0.04	0.01	-0.05	-0.02	28	5.4	<0.001	0.52
CO	-0.01	0.02	-0.05	0.02	15	0.7	0.504	0.03
CO (-1995)	-0.03	0.01	-0.05	-0.01	14	2.9	0.013	0.39
UT	-0.02	0.01	-0.05	0.00	22	1.8	0.091	0.13
Mean harvest per hunter season								
AZ	-0.06	0.02	-0.09	-0.02	28	3.4	0.002	0.29
CO	-0.02	0.05	-0.12	0.08	15	0.4	0.690	0.01
NM	-0.05	0.02	-0.09	-0.01	18	2.8	0.013	0.31
UT	-0.01	0.05	-0.11	0.09	22	0.2	0.848	0.00

APPENDIX I. Annual estimates from regression analysis of short-term (1988–1999) linear trends in band-tailed pigeon hunter participation and harvest in the Four Corners states.

Attribute	Estimate	SE	95% confidence interval		df	<i>t</i>	<i>P</i>	<i>r</i> ²
State								
Total harvest								
AZ	-86.38	32.48	-163.19	-9.58	8	2.7	0.033	0.50
CO	65.70	140.18	-380.42	511.82	4	0.5	0.671	0.07
NM	1.32	11.00	-25.60	28.25	7	0.1	0.908	0.00
UT	6.10	4.54	-4.37	16.56	9	1.3	0.216	0.18
Total hunters								
AZ	-37.88	6.47	-53.19	-22.57	8	5.9	0.001	0.83
CO	5.00	5.79	-13.41	23.41	4	0.9	0.451	0.20
NM	-0.95	3.53	-9.60	7.69	7	0.3	0.797	0.01
UT	4.58	1.60	0.89	8.28	9	2.9	0.021	0.50
Total hunter days								
AZ	-116.03	19.89	-163.06	-69.01	8	5.8	0.006	0.83
CO	32.20	13.81	-11.75	76.15	4	2.3	0.102	0.64
UT	8.13	7.84	-9.95	26.21	9	1.0	0.330	0.12
Mean days per hunter								
AZ	-0.03	0.03	-0.10	0.03	8	1.2	0.259	0.18
CO	0.17	0.13	-0.24	0.58	4	1.3	0.279	0.37
UT	-0.50	0.25	-1.08	0.08	9	2.0	0.084	0.33
Mean harvest per hunter day								
AZ	-0.03	0.03	-0.10	0.04	8	1.0	0.374	0.11
CO	0.17	0.37	-1.00	1.34	4	0.5	0.675	0.01
CO (-1995)	0.17	0.06	-0.10	0.44	3	2.7	0.113	0.79
UT	0.01	0.07	-0.15	0.17	9	0.2	0.880	0.00
Mean harvest per hunter season								
AZ	-0.11	0.07	-0.28	0.07	8	1.4	0.202	0.22
CO	0.59	1.03	-2.68	3.86	4	0.6	0.606	0.09
NM	0.02	0.07	-0.15	0.19	7	0.3	0.785	0.01
UT	-0.30	0.29	-0.96	0.36	9	1.0	0.327	0.12

APPENDIX J. Age structure of band-tailed pigeons harvested in the Four Corners states from 1993 to 1999. Data are from analysis of wings collected annually through the U.S. Fish and Wildlife Service's Migratory Bird Parts Collection Survey.

Year	Adult		Subadult		Immature		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
1993	108	65.5	15	9.1	42	25.5	165
1994	72	63.7	10	8.8	31	27.4	113
1995	155	63.8	16	6.6	72	29.6	243
1996	30	57.7	5	9.6	17	32.7	52
1997	73	70.9	12	11.7	18	17.5	103
1998	31	62.0	1	2.0	18	36.0	50
1999	48	68.6	8	11.4	14	20.0	70
Total/mean	517	64.6	67	8.5	212	27.0	796

APPENDIX K. Age structure of band-tailed pigeons harvested within each Four Corners state from 1993 to 1999. Data are from analysis of wings collected annually through the U.S. Fish and Wildlife Service's Parts Collection Survey.

Year	Adult		Subadult		Immature		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Arizona							
1993	10	58.8	0	0.0	7	41.2	17
1994	38	65.5	7	12.1	13	22.4	58
1995	4	44.4	0	0.0	5	55.6	9
1996	0	0.0	0	0.0	0	0.0	0
1997	13	61.9	1	4.8	7	33.3	21
1998	15	48.4	1	3.2	15	48.4	31
1999	18	78.3	3	13.0	2	8.7	23
Total/mean	98	51.0	12	4.7	49	29.9	159
Colorado							
1993	22	71.0	0	0.0	9	29.0	31
1994	2	33.3	0	0.0	4	66.7	6
1995	106	64.2	11	6.7	48	29.1	165
1996	4	40.0	2	20.0	4	40.0	10
1997	15	55.6	5	18.5	7	25.9	27
1998	8	80.0	0	0.0	2	20.0	10
1999	12	66.7	0	0.0	6	33.3	18
Total/mean	169	58.7	18	6.5	80	34.9	267
New Mexico							
1993	76	65.0	15	12.8	26	22.2	117
1994	32	65.3	3	6.1	14	28.6	49
1995	41	70.7	4	6.9	13	22.4	58
1996	26	61.9	3	7.1	13	31.0	42
1997	45	81.8	6	10.9	4	7.3	55
1998	3	100.0	0	0.0	0	0.0	3
1999	18	62.1	5	17.2	6	20.7	29
Total/mean	241	72.4	36	8.7	76	18.9	353
Utah							
1993	0	0.0	0	0.0	0	0.0	0
1994	0	0.0	0	0.0	0	0.0	0
1995	4	36.4	1	9.1	6	54.5	11
1996	0	0.0	0	0.0	0	0.0	0
1997	0	0.0	0	0.0	0	0.0	0
1998	5	83.3	0	0.0	1	16.7	6
1999	0	0.0	0	0.0	0	0.0	0
Total/mean	9	17.1	1	1.3	7	10.2	17

APPENDIX L. Annual counts of band-tailed pigeons in the Four Corners states during inventories from 1946 to 1947 and from 1951 to 1956. A corps of observers totaling 150 to 200 people annually, including personnel from state and federal natural resource agencies, and other qualified individuals, were instructed to watch for and record counts of band-tailed pigeons when they were found from May through October. Beginning in 1953, surveys were of short duration lasting 5 days in mid-September. Consequently, indices of abundance from 1946 to 1953 and 1954 to 1956 are not comparable between the 2 periods.

Year	Arizona	Colorado	New Mexico	Utah
1946		9,000		
1947		4,473		
1951	4,588	4,256	13,233	
1952	3,332	2,221	6,062	
1953	3,431	2,877	8,560	572
1954	929	1,255	2,174	359
1955	526	557	2,634	223
1956	482	139	1,303	798