MANAGEMENT PLAN

OF THE

PACIFIC AND CENTRAL FLYWAYS

FOR THE

ROCKY MOUNTAIN POPULATION OF

GREATER SANDHILL CRANES

Prepared for the:

Pacific Flyway Council
Central Flyway Council
Secretaria de Medio Ambiente Recursos Naturales y Pesca
U.S. Fish and Wildlife Service

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This management plan is one of a series of cooperatively developed plans for managing various species of migratory birds of the Pacific and Central Flyways. Inquiries about this plan may be directed to member states of the Pacific and Central Flyway Councils or to the Pacific Flyway Representative, U.S. Fish and Wildlife Service/MBMO, 911 N.E. 11th Avenue, Portland, OR 97232-4181, or to the Central Flyway Representative, U.S. Fish and Wildlife Service/MBMO, 755 Parfet Street, Suite 496B, Lakewood, Colorado 80215.

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MANAGEMENT PLAN
OF THE
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FOR THE
ROCKY MOUNTAIN POPULATION OF
GREATER SANDHILL CRANES

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I. INTRODUCTION

Five populations of greater sandhill cranes (Grus canadensis tabida) have been identified in North America. These include the Eastern, Rocky Mountain, Lower Colorado River Valley, and Central Valley populations (Braun et al. 1975, Lewis 1977), and more recently, the Gulf Coast subpopulation of Mid-continent sandhill cranes (Tacha et al. 1984). Recent research in Texas (Ballard et al. 1997) indicates the Gulf Coast subpopulation may contain up to 36,000 greaters. That would make the Gulf Coast subpopulation largest, followed by the Eastern, Rocky Mountain, Central Valley, and the Lower Colorado River Valley. The Rocky Mountain Population (RMP) numbered more than 20,000 in September 2005. Currently, hunting is allowed only on the Rocky Mountain and Gulf Coast populations.

The numbers and distribution of RMP cranes, while reduced from historic levels, expanded markedly from 400-600 birds in the mid-1940s (Walkinshaw 1949) to 10,000-15,000 birds by 1971 (Drewien and Bizeau 1974). Its current breeding range extends from central and western Montana south through central and eastern Idaho, western and central Wyoming, northern and central Utah, and northwestern Colorado (Fig. 1). Recent records confirm breeding in extreme southwestern Alberta, which probably involve RMP pioneers following the Rocky Mountain Front northward from Montana (Semenchuk in Drewien et al. 2001). The major spring and fall migration staging area is the San Luis Valley (SLV), Colorado, where virtually the entire population spends 3-4 months annually (Drewien and Bizeau 1974, Kauffeld 1982). Several important overnight stopovers are used by RMP cranes during spring and fall migration including Harts Basin and the Grand Valley, Colorado, and the Green River near Jensen to Ouray National Wildlife Refuge in Utah (Drewien and Bizeau 1974, Peterson and Drewien 1997) and Cochiti and Jemez reservoirs, New Mexico (Stahlecker 1992). The principal wintering area is the Middle Rio Grande Valley (MRGV), New Mexico. Smaller numbers winter in northeastern and southwestern New Mexico, southeastern Arizona, and the northern highlands of Mexico (Drewien and Bizeau 1974, Perkins and Brown 1981, Drewien et al. 1996). On winter areas, RMP cranes mix with the Mid-continent population (MCP), and cannot be managed separately from, Canadian (G. c. rowani) and the more abundant lesser (G. c. canadensis) sandhill cranes

(Lewis 1977, Drewien and Bizeau 1974, Drewien et al. 1996). Based on harvest data collected in Arizona and New Mexico, the proportion of Canadian cranes in the harvest has been about 6% and 8% respectively. Harvest in areas outside of the MRGV is mainly comprised of lesser sandhill cranes.

Attempts were made to introduce whooping cranes in the Rocky Mountain region. The first attempts used RMP greater sandhill cranes as foster parents. (Appendix C).

This plan is a revision of the July 1997 RMP crane plan. Its purpose is to establish guidelines for managing RMP sandhill cranes. The plan addresses habitats (breeding range, fall staging areas, migration routes, fall and spring stopover areas, and winter areas), status, uses, current management, problems associated with the population, and crane hunting guidelines.

II. NATURAL HISTORY

Physical Characteristics

Sandhill cranes are among the oldest existing species of birds (2.5 million years) (Tacha et al. 1992, Tacha et al. 1994). Sandhill cranes have heavy bodies and long necks and legs (Walkinshaw 1949, Tacha et al. 1992). Height extends to 1.2 m, wingspan to 2 m (Tacha and Lewis 1979), and weight may reach 6.85 kg (Schmitt and Hale 1997). The bill is elongate and strong. The feet have four toes with sharp hooked claws, while the hallux is small and elevated. Sexes are monochromatic gray and generally indistinguishable even with cloacal examination (Tacha and Lewis 1979). Juveniles have a feathered crown, brown nape feathers (Tacha and Vohs 1984) and buff-colored secondary wing coverts (Drewien et al. 1995). Adults have red, pappilos skin on the crown and gray nape feathers (Walkinshaw 1949, Tacha et al. 1992). The greater sandhill crane (greaters) is the largest subspecies. Female greaters weigh an average 4,928 g (10.9 lb) and males average 5,554 g (12.2 lb). Wing chord measurements for greaters average 514 mm for females and 538 mm for males. Posterior culmen measurements average 97.7 mm for females and 103.6 mm for males. The tarsus measurement averages 228 mm for females and 239 mm for males (Schmitt and Hale 1997). Morphological data collected in Wyoming female greaters averaged

4,845 g, wing chord 524 mm, tarsus 231 mm, and posterior culmen 99 mm. Greater males averaged 5,430 g, wing chord 545 mm, tarsus 239 mm, and posterior culmen 105 mm (Lockman et al. 1987).

Food Habits

Sandhill cranes are opportunistic foragers, which allows them to adapt to changes in food availability (Mullins and Bizeau 1978, Reinecke and Krapu 1986). The specific diet depends on food availability in different seasons and/or locations (Tacha et al. 1992). Sandhill cranes exploit foods by probing subsurfaces with bills and by gleaning seeds and other foods on the land surface or in shallow marshes (Walkinshaw 1949, Tacha et al. 1992). Cranes probe at a depth greater than 15 cm to obtain nut-grass tubers (Guthery 1975).

Food items eaten by marsh-nesting cranes include roots, browsed vegetation, snails (*Helisoma* spp.), crayfish (*Cambarus* spp.), small mammals, birds, frogs (*Hyla crucifer, Rana pipiens*), snakes, toads (*Bufo* spp.) and various insects (Walkinshaw 1973). Cranes will attempt to take any potential food item of the proper size, including waterfowl eggs, ducklings (Armbruster 1987), and lemmings (Reed 1988). Young cranes (colts) feed almost exclusively on animal food during the preflight period (Lewis 1977).

During migrations, cultivated grains are major food items (Lewis 1977, Kauffeld 1982, Tacha et al. 1994). Cranes often feed in grain fields in the spring before nest sites thaw and again in late summer after the young fledge (Armbruster 1987). Important grains include barley in Idaho and Wyoming (Drewien 1973, Lockman et al. 1987) and wheat in Colorado (Bieniasz 1979). Cultivated grains provide the necessary fat stores required during migrations and are accessible with minimum energy expenditures (Tacha et al. 1987). At staging areas macroinvertebrates (e.g., earthworms, snails, beetles) provide essential proteins and calcium not obtained from other sources and are the foods in shortest supply (Reinecke and Krapu 1986).

During winter, waste corn is the primary food of cranes in the MRGV and southwestern New Mexico. Other important foods eaten by cranes include chufa tubers, sorghum, alfalfa, grasshoppers, and isopods (Walker and Schemnitz 1987).

Reproduction

Sandhill cranes are perennially monogamous with pair bonds maintained outside the breeding season (Walkinshaw 1949, Tacha et al. 1992, Tacha et al. 1994). Greaters have successfully nested in their third year (Lewis 1977). However, the most productive RMP greaters were > 7-8 years old (Drewien et al. 2001). Pair bonds may form and dissolve before successful reproduction occurs (Nesbitt and Wenner 1987). Following successful reproduction, mate changes are rare unless a mate dies (Tacha 1988, Nesbitt 1989). RMP cranes arrive at Grays Lake, Idaho during late March or early April when the valley is still snow covered. In mid-April as weather moderates and snow levels decline, pairs disperse to breeding territories (Drewien 1973).

After arrival, most breeding pairs establish territories 2-4 weeks before nest building and egg laying starts (Drewien 1973). Pairs become aggressive toward their young of the previous year and proclaim their territory with loud, synchronized unison calls (Walkinshaw 1973). Pairs return to the same territory annually and both members assist in territorial defense. Pairs maintain mutually exclusive territories, and maximum aggressive behavior occurs during the prenesting period as adjacent pairs reestablish boundaries and drive off trespassing non-territorial cranes (Drewien 1973). The male is the most active in territory defense and females are less likely to retain the territory after loss of mates (Nesbitt and Tacha 1997).

Most daily requirements are found within territories, including nest, feed, roost sites, escape cover, and water. These components can be supplied by large marsh complexes (Drewien 1973); smaller, scattered marshes (Walkinshaw 1973; Armbruster 1987); bogs in northern boreal forests (Taylor 1976); intermittent streams in sagebrush parklands (Bieniasz 1979); and mountain meadows, beaver (*Castor*

canadensis) ponds, and subirrigated wet meadows along riparian zones (Drewien and Bizeau 1974). Families use territories partially or entirely during prenesting, nesting, brood, and post-brood periods (Drewien 1973). RMP cranes at Grays Lake, Idaho, have the highest reported nesting density with a mean territory of 17 ha (Drewien 1973). Isolation from human activity appears to be an important criterion for selection and use of nesting territories by cranes. Sandhill cranes have the propensity to desert their nests or territories due to human disturbances (Walkinshaw 1973, Drewien 1973, Boise 1976).

Nests may be established on dry-land sites with almost no nest material but are more often in water on piles of emergent aquatic plants, sticks, grass, mud, and sphagnum (Lewis 1977). Nest size and complexity vary by location; those on dry sites are small and contained little material while those in water were larger and usually contain considerable nest material (Drewien 1973). At Grays Lake, RMP greaters nest from late April through early July (Drewien 1973).

Clutches contain usually two, occasionally one, or rarely three eggs (Lewis 1977). Average clutch size is 1.9 but is smaller in more northern-breeding birds (Nesbitt 1989, Tacha et al. 1994). Incubation begins after the first egg is laid (Drewien 1973, Lewis 1977). Both sexes incubate; males and females share daylight incubation duties about equally, but the female is the primary nest attendant at night (Drewien 1973, Nesbitt 1989). Nest success varies among years and locations. It averages about 50% but has been as high as 78% (Tacha et al. 1992, Tacha et al. 1994, Drewien 1973). After 28-31 days of incubation, eggs hatch asynchronously (Drewien 1973, Lewis 1977). Sandhill cranes raise a single brood per year but will renest following loss of eggs in northern nesting populations or loss of eggs or young in southern populations (Tacha et al. 1994).

Hatching takes 24 to 36 hours. The precocial colt is dry in a few hours and is walking the next day. After the colt or colts hatch, the family moves to open uplands or meadows for feeding. The family returns to the marsh each night to roost, and it may return to the nest or the parents may build a platform for roosting (Lewis 1977). Both parents feed the young, but females do most post-hatch brooding (Tacha et

al. 1994). The colts' diet during the preflight period appears to be almost exclusively animal food, but fledged young feed readily on agricultural grains in autumn (Lewis 1977). RMP greaters fledge at 67-75 days (Drewien 1973). RMP greaters post-fledging brood size averages 1.31 (range 1.21-1.35) at Grays Lake, Idaho. Young are usually separated from the parental care at about 10 months of age (Drewien 1973, Drewien et al. 2001, Tacha et al. 1994).

Population Dynamics

The sandhill crane is the most abundant of the world's cranes (Meine and Archibald 1996). However, sandhill cranes have the lowest known recruitment (percent juvenile in fall) of any avian species hunted in North America (Drewien et al. 1995). For RMP greaters at Grays Lake, Idaho, nonbreeders comprise 31-39 percent of the total population annually (Drewien 1973).

Most sandhill cranes lay two eggs but usually raise only one young. Sibling aggression by the dominant colt increases when there is food stress. This enhances the survival of the dominant colt at the expense of its brood mate by dominating the food made available by the parents (Drewien 1973). The availability of food and water, weather and predation on the breeding grounds, not innate behavior, appear to primarily influence brood size (Drewien et al. 1995).

Annual fall recruitment in RMP greaters is 7.9% (Drewien 2005). The mean brood size is 1.35. About 20% of RMP recruitment comes from extra young in broods with 2 or rarely 3 young (Drewien et al. 1995).

Adult cranes are long lived, but mortality can be high for eggs and young. Crows (*Corvus brachyrrhynchos*) and striped skunks (*Mephitis mephitis*) are primarily egg predators while ravens (*Corvus corax*), raccoons (*Procyon lotor*), and coyotes (*Canis latrans*) prey on eggs and young (Armbruster 1987, Littlefield and Thompson 1987, Littlefield and Lindstedt 1992). Golden eagles

(*Aquila chrysaetos*) may be a significant mortality factor as attacks have been observed on sandhill cranes (Armbruster 1987, Drewien et al. 2001, Mitchusson 2003).

Estimated annual survival rates for RMP cranes from 1972-1985 was 95% (Drewien et al. 1995). With expanded hunting throughout the RMP range, current annual RMP crane adult survival is estimated at 89%. Most (>70%) mortality is due to human causes. Legal and illegal shooting accounts for 58.3% with hunting (53.9%) the single most important mortality factor. Other mortality factors are by unknown causes (24.4%), power line and fence collisions or entanglements (10.0%), and other factors (7.3%). The proportion of cranes lost to shooting increases with age, whereas non-shooting mortality declines with age, suggesting older cranes learn to avoid many forms of non-shooting mortality (Drewien et al. 2001).

Avian botulism (*Clostridium botulinum*) and avian cholera (*Pasteurella* spp.) are leading causes of non-hunting mortality (Windingstad 1988, Tacha et al. 1994). Avian tuberculosis (*Mycobacterium avium*), aspergillosis (*Aspergillus* spp.) and lead poisoning are other causes of mortality (Tacha et al. 1992, Tacha et al. 1994). Hail storms and lightning are notable but localized environmental causes of crane mortality (Windingstad 1988).

Since the 1980's, incidences of avian cholera and avian tuberculosis in cranes have increased in the MRGV, and have been associated with increases in winter populations of lesser snow geese (*Chen caerulescens*) and Ross's geese (*Chen rossii*) (Snyder et al. 1987, Taylor and Kirby 1990, Drewien et al. 2001). Outbreaks of avian cholera in cranes at Bosque del Apache NWR (Bosque) have occurred in 9 winters during 1984-1999 including a peak loss of 110 cranes in 1993-1994 (Drewien et al. 2001).

Maximum known age of a wild RMP greater sandhill crane is 35.5 years (R. Drewien, per. comm.).

Habitat Requirements

The single most-important factor regulating sandhill crane populations is habitat availability (Tacha et al. 1992). Thus, maintenance of essential habitats is the primary need for sandhill cranes (Tacha et al. 1994). Sandhill cranes are primarily birds of open freshwater wetlands and shallow marshes, but use a broad range of habitat types from bogs, sedge meadows, and fens to open grasslands and cultivated lands (Tacha et al. 1992).

Breeding – RMP sandhill cranes nest in isolated, well-watered river valleys, marshes, and meadows at elevations mainly above 1,500 m in the northern and central Rocky Mountain states (Drewien 1973, Drewien and Bizeau 1974). Most nests are in wet meadow-shallow marsh zones along the marsh edge (Drewien and Bizeau 1974). After hatching, broods tend to feed in moist areas along the water's edge or in adjacent meadows, using deeper water mainly for escape and occasional roosting (Drewien 1973). In Colorado, broods moved away from the willow drainage bottoms, upslope to the sagebrush ridges and the fringes of the aspen stands (Bieniasz 1978). Nonbreeding adults feed in wet meadows and grain fields adjacent to a roosting area. In August, cranes feed in alfalfa fields with large numbers of insects present. Use of grain fields increases during fall pre-migration staging where nearly all cranes observed are in grain fields (Rowland et al. 1992). Prior to migration, RMP greaters gather at staging areas near their summering site. The major attraction at staging areas is the availability of grain located in proximity to shallow lakes, marshes, and river bottoms that are used as roosting sites, and they feed primarily on barley near adjacent wetlands (Drewien and Bizeau 1974).

Migration- Habitats along migration routes tend to be large open palustrine and riparian wetlands near agricultural areas (Krapu et al. 1984). Wet meadows and native lowland grassland habitats are important as they provide an important source of macroinvertebrates for cranes (Reinecke and Krapu 1986). At the spring and fall staging sites in the San Luis Valley (SLV), Colorado, roosting locations

are ponds and sloughs where the birds use water up to 0.3 m deep. Loafing areas are wet meadows of baltic rush (*Juncus balticus*), sedges (*Carex* spp.), spikerush (*Eleocharis* spp.), greasewood (*Sarcobatus vermiculatus*) and a variety of grass species. These meadows do not have to be very wet to attract cranes; 2 to 4 cm of water is satisfactory. Cranes will sometimes use dry meadows as long as a ditch with water or a stream is nearby. Although some feeding activity occurs in meadows, they are primarily used for resting, preening, and other social activities. The other major habitat used is grain fields during morning and evening. Barley is the primary crop so cranes use it most frequently, but will also utilize wheat, field peas, and potato fields. Primary feeding activity in potato fields is searching for insects and grubs (Kauffeld 1982).

Winter - The quality of winter habitat is important because cranes congregate in high densities and are dependent on limited resources. Cranes are vulnerable to disturbance and habitat alteration caused by changes in water and cropland management (Iverson et al. 1985b). Cranes wintering in the MRGV roost in shallow river areas, lake areas, or artificial impoundments on state and federal refuges and spend most of the day in irrigated croplands and pastures. The riparian community is dominated by cottonwoods (*Populus fremonii*), Russian olive (*Elaeagnus angustifolia*), saltcedar (*Tamarix chinensis*), and willow (*Salix* spp.). State and federal refuges border the river and consist of riparian woodlands, cultivated fields, and artificial impoundments where water levels are manipulated for waterfowl and shorebirds. Impoundments having water throughout the year support plants such as hardstem bulrush (*Scirpus acutus*), spikerushes (*Eleocharis* spp.), rushes (*Juncus* spp.), and cattails (*Typha* spp.). Impoundments that are drawn down in spring produce above and below ground wetland food resources such as chufa (*Cyperus esculentus*), nodding smartweed (*Polygonum lapathifolium*), bearded sprangletop (*Leptochloa facicularus*), barnyard grass (*Echinochloa crusgalli*), yellow bristlegrass (*Seteria glauca*), cupgrass (*Eriochloa* spp.), Johnson grass (*Sorghum halepense*), and fall panicum (*Panicum dichotomiflorum*) (Taylor and Smith 2003). The remainder of the valley consists mostly of irrigated croplands. Cranes use the irrigated croplands for feeding and loafing. Common crops include alfalfa, chile, corn, cotton, and sorghum

(Walker and Schemnitz 1987). In the MRGV, the acreage of corn and small grains has decreased, causing cranes to concentrate on refuges and dairy farms where grains are raised. Wetlands are scarce because of drainage projects carried out by the Bureau of Reclamation (BoR) (Lewis 1977). Some of the RMP sandhill cranes migrate from the MRGV to areas in southwestern New Mexico, the Sulfur Springs Valley, AZ and the Northern highlands in Mexico (Drewien and Bizeau 1974). However, numbers wintering in southwestern NM are much reduced compared to the 1970's due to the loss of sorghum crops (Drewien et al. 1996, Mitchusson 2003).

Roosts sites used regularly by wintering birds generally are in shallow water several meters from shore. Physical features that characterize roosts are level terrain, shallow water bordered by a shoreline either lacking vegetation or only sparsely vegetated and an isolated location that reduces the chance of disturbance by humans. The ground slopes gradually into the water and a large area of 10 to 20 cm deep water is present several meters from the shore, providing standing room for a flock. The shallow water between the cranes and the shoreline, level terrain and sparse vegetation permit a clear field of vision that provides some protection against predators. Optimal roost sites are located within 16 km (10 miles) of feeding areas (Lewis 1976). However, cranes fly approximately 27 miles from Caballo Lake to cornfields in the Uvas Valley and return to roost on Caballo Lake (R. Drewien, per. comm., Mitchusson 2003).

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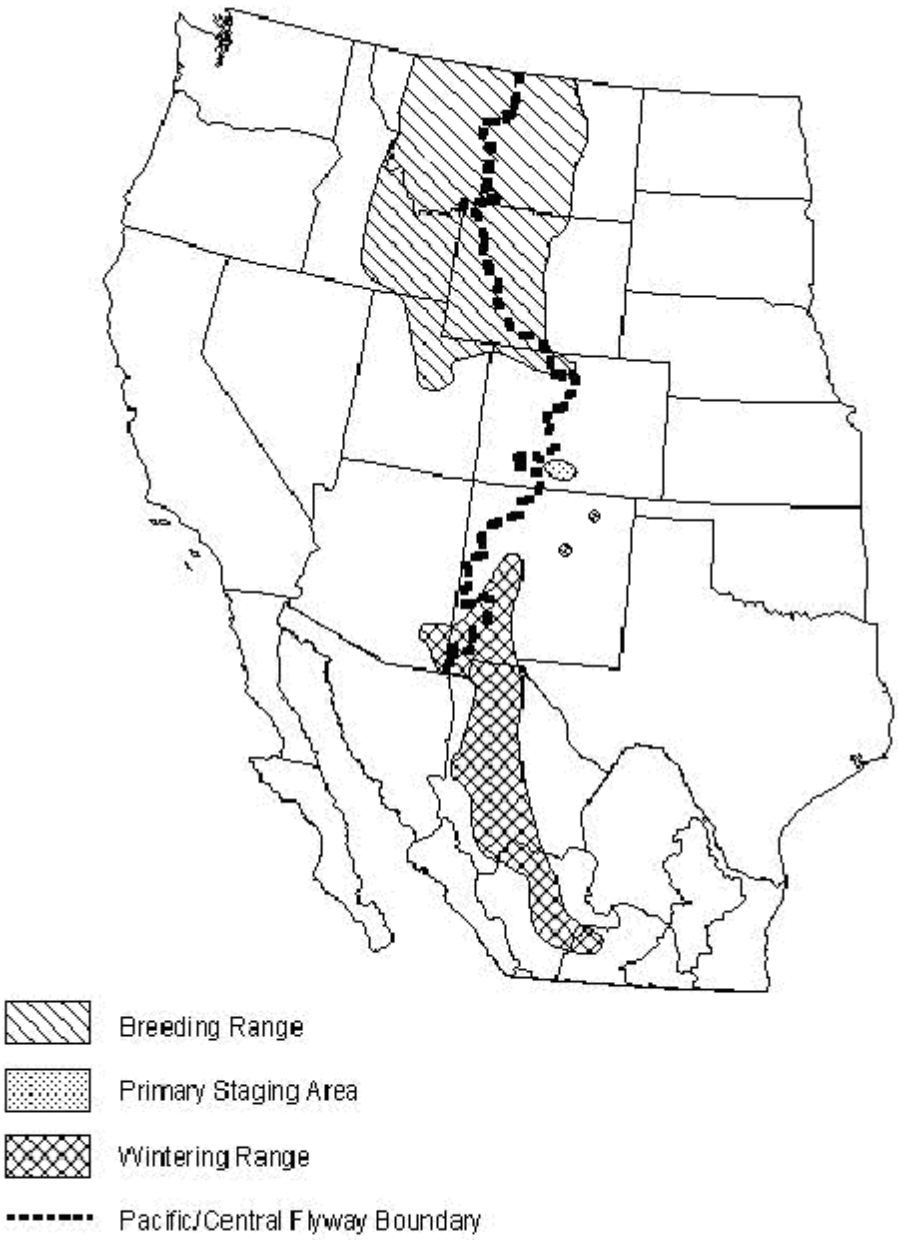


Figure 1. Distribution of the Rocky Mountain Population of Greater Sandhill Cranes (adapted from Drewien et al. 2001).

III. OBJECTIVES

The primary objective of this plan is to manage the RMP for numbers and distribution that will provide maximum direct benefits to the public and for the intrinsic values of the birds themselves. Objectives include:

A. Manage for a stable population index of 17,000-21,000 cranes determined by an average of the 3 most recent, reliable September (fall pre-migration) surveys (see Table 1).

Interpretation

A crane population of 19,000 (± 10%) provides numerous opportunities to view birds, recreational hunting, and does not result in intolerable crop damage in most areas. There is currently sufficient habitat to support the population objective. An RMP in excess of 21,000 cranes may significantly increase the probability of crop damage, disease and overcrowding, particularly in the primary MRGV winter area.

Most RMP cranes stage in specific locations throughout the summer range states during late August to early October, but migration chronology can vary between years. The September pre-migration survey is the best opportunity to survey the population. The objectives of this plan will be based on the September surveys. To minimize the potential effect of a poor count during a single year, population management decisions will be based on an average of the 3 most recent, reliable fall surveys. The survey team will provide insight into the reliability of the estimate based on survey timing, survey coverage and weather conditions. If a count is judged poor, it will be excluded from the average and the latest reliable 3-year average will be used for that year. All reliable surveys will be used towards the harvest allocation formula. However, if a prior survey is determined to be poor, such as if there was large decline in the population index followed the next year with a biologically unfeasible

population increase; the count estimated prior to the poor survey and current year survey will be averaged and used for the crane harvest allocation formula.

B. Maintain and protect suitable habitats in sufficient quantity and quality to support population objectives and spatial distribution, while encouraging population expansion where desirable.

Interpretation

Sufficient breeding, wintering, and migration habitat is required to maintain a stable population. Some areas of historic range suitable for nesting pairs are currently not occupied, and some staging and wintering areas are overcrowded. Breeding birds pioneering into unoccupied areas should be encouraged to expand, and migrating and wintering birds may be encouraged to use alternate areas through various management practices (e.g., creation of food plots, new roost sites, or protected areas). Cooperative management plan development between state management areas and federal refuges could significantly improve crane spatial distributions and habitat management across wide regions.

Increasing human impacts on crane habitats will likely result in short and long-term habitat loss. As habitat is lost along with changing agricultural practices and crops, cranes are restricted to fewer areas. Food supply, roost sites and overcrowding are becoming priority concerns for population maintenance, especially on winter areas.

C. Provide for recreational uses of RMP cranes.

Interpretation

Due to their large size and palatability sandhill cranes have long been hunted for food. Crane remains were found in ancient kitchen middens at Wupatki Pueblo, Arizona and in Rio Grande pueblos (Walkinshaw 1949). Crane hunting is the primary tool for reducing localized crop damage.

In most states demand exceeds the availability of permits (Lockman et al. 1987). Crane hunting alleviates many potential depredation complaints and garners support for crane management.

Interest in watching and photographing sandhill cranes is a popular activity. General wildlife watching and other nonconsumptive uses account for the majority of all wildlife associated recreation (U.S. Department of the Interior 1996). Crane festivals attract birders from across the country and other nations to view and photograph wildlife, and participate in other wildlife-related events contributing to the local economies (Mitchusson 2003).

D. Minimize crop depredations by RMP cranes.

Interpretation

Large numbers of sandhill cranes utilize private lands in the Rocky Mountain region. RMP cranes forage primarily in agricultural areas causing significant damage to agricultural crops. Some landowners tolerate crane use on private lands, while others have been quite vocal and have filed complaints with the U.S. Department of Agricultural-Animal Plant Health Inspection Service-Wildlife Services (Wildlife Services) and state agencies. Hunting seasons are the most effective means to reduce sandhill crane depredations, provide recreational opportunity and improve crane spatial distributions. Crane hunting along with hazing and timed crop manipulations on refuges can be used to encourage crane use on refuges and reduce agricultural damage (Taylor 1999).

While agricultural producers may be satisfied with the depredation control work, a growing number of landowners do not support the program. These are generally small landowners who do not derive the majority of their income from agricultural production and enjoy the sights and sounds of cranes on their property. Balancing depredation control work, particularly when such properties are adjacent to one another can be a delicate task for field personnel (Taylor 1999). Increasing urbanization will likely exacerbate this conflict.

IV. STATUS

Distribution

Summer Range

Historically, RMP cranes nested in suitable habitats throughout the central and northern Rocky Mountains and the Great Basin from northeastern Arizona, central Utah and western Colorado north through western Wyoming, Idaho, western Montana, and probably Alberta. Reports from explorers and settlers indicate cranes were common to abundant throughout this area until late in the nineteenth century (Drewien and Bizeau 1974). By the early 1900s, cranes had become uncommon to rare or were extirpated within this region. The dramatic decline is attributed to a combination of factors but was principally due to habitat alteration, increased human intrusion on breeding areas, and subsistence harvest. The current summer distribution is shown in Figure 1.

Numbers of RMP cranes increased from an estimated 150-200 breeding pairs in the mid-1940s (Walkinshaw 1949:134) to an estimated spring population of 20,382 in 1985 (Benning et al. 1997). The 2005 fall pre-migration survey estimated a population of 20,865 (Drewien and Thorpe 2005). Much of their former nesting range has been reoccupied, except western Colorado, northeastern Arizona and Alberta. Recent records confirm breeding in extreme southwestern Alberta, which probably involve RMP pioneers following the Rocky Mountain Front northward from Montana (Semenchuk in Drewien et al. 2001). During the 1970s-80s, Grays Lake NWR in southeastern Idaho supported the largest nesting concentration (on a per acre basis) with about 250-300 pairs. The population recovery was attributed to protection from unregulated hunting, expansion of small grain agriculture, and establishment of refuges and management areas throughout most of the RMP Range.

Observations indicate RMP cranes are returning to the marshes of the Great Salt Lake Basin, river valleys in south-central Utah, and suitable habitats in eastern mountain valleys in Utah and western Colorado. Nesting pairs have pioneered east of the Continental Divide in Wyoming, Montana, and Colorado.

We lack reliable estimates of breeding pair numbers over much of the summer range due to the difficulty of locating widely dispersed birds. Considering the estimated numbers of RMP cranes (about 20,000), their age structure, and recruitment rate, it is reasonable to expect at least 4,700 breeding pairs exist.

Also, considerable breeding habitat for RMP cranes is located in the Rocky Mountain "Over-thrust Belt," a primary gas and oil extraction area where human intrusion has increased greatly in recent years and continues to increase at a rapid pace.

Fall Pre-migration Staging Areas

Staging areas used in fall prior to migration have been identified in Idaho, Wyoming, Utah, Montana, and Colorado (Table 1, Fig. 2). Most staging areas are attractive to cranes because of the availability of grain crops and other forage. Damage to unharvested small grains is common and damage to unharvested seed potatoes is serious in some locations of eastern Idaho. Maintenance of staging areas will require specific plans for controlling and alleviating crop damage (see Problems and Recommended Management Procedures sections). Normally, crane numbers peak at specific staging areas in September but timing varies somewhat by area and year. Not all cranes migrate from their staging locations at the same time. Changing land uses and agricultural crops have altered staging areas resulting in some areas being less suitable as crane habitat (e.g., Star Valley and Bear River Valley, WY).

Migration Staging and Stopover Areas

During spring and fall migration, many RMP cranes stop overnight or for several days at locations in western Colorado, northern New Mexico and northeastern Utah. Sightings of color-marked cranes indicate many consistently use 4 locations in addition to the SLV, Colorado; (1) the Green River Valley between

Jensen and Ouray NWR, Utah, (spring and fall), (2) Hart's Basin near Eckert, Colorado (spring) (Peterson and Drewien 1997); 3) Grand Valley, Colorado (near Grand Junction); and 4) northern New Mexico (Stahlecker 1992). Smaller numbers of migrating cranes stop at other localities, notably sites in the Gunnison and White River Valleys, Colorado.

The SLV is the only major migratory staging area for the RMP. In the SLV, RMP cranes mix with other crane subspecies from the MCP. Peak use occurs from late September to early November (ranging from late August to mid-December) and from late February to early April (ranging from late January to early May). Most cranes concentrate on the western side of the Valley, near the Monte Vista NWR, the Higel and Rio Grande State Wildlife Areas, and private lands adjacent to the Rio Grande between the towns of Alamosa and Monte Vista (Drewien and Bizeau 1974, Kauffeld 1982, Drewien et al. 1995, 2001). Other areas in the valley, primarily the eastern and southern portions of the SLV, including the Alamosa NWR, are used to a lesser degree. Crane roosting and foraging is increasing in northern portions of the Valley, which is probably due to the increase in the number of shallow water wetlands now available as roosts. Crane use is increasing at Russel Lakes State Wildlife Area (SWA). Private wetlands around the towns of Hooper and Mosca provide crane habitat. Also there is more crane use north of the Alamosa NWR on the newly acquired Baca National Wildlife Refuge and The Nature Conservancy wetlands on the Zapata-Medano Ranch. Crane-use days on the Monte Vista NWR between 1976 and 1981 ranged from 281,000-509,600 and averaged 386,000 when the population was approximately 15,000 (Kauffeld 1982). Crane use days on the Alamosa NWR ranged from 8,900-53,100 and averaged 29,800. The majority of crane use on the 2 refuges occurs in the spring. Small grains are not harvested in the fall but left standing until spring to feed migrating cranes and other migratory birds when waste grain is in short supply elsewhere in the valley.

Table 1. RMP Pre-migration Staging Areas and Associated September Estimates.

Survey Area	1992	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Colorado												
(**1**) Yampa Valley (includes Hayden area and Morgan Bottom)	412	955	463	584	1,200	401	526	641	778	693	223	318
(**2**) Lower Elk River (combined with Yampa V. from 1998-2002, possibly in 1996-97)		37								18	0	210
(**3**) Delta Co. - Fruitgrower's Res.\Hart's Basin	0										0	9
Delta Co. – other											52	
(**4**) San Luis Valley	2,769	1,292	792	1,020	73	701	223	25	577	34	1,135	515
Subtotal	3,181	2,284	1,255	1,604	1,273	1,102	749	666	1,355	745	1,410	1,052
Idaho												
(**1**) American Falls Reservoir	0	14	8	NS	44	74	97	104	66	168	96	67
(**2**) Ashton-St. Anthony (area combined in 1995)	898	1,076	1,659	1,844	987	1,516	1,405	1,485	1,876	1,180	1,337	716
(**3**) Bear Lake Valley (combined w/Bear River Valley in 2000)	594	116	476	403	416	439						
Bear River Valley		568	617	668	760	734	1,267	815	790	1,188	946	1,436
(**4**) Blackfoot Reservoir	310	2,110	1,388	1,232	1,626	1,188	1,168	698	441	773	228	467
(**5**) Camas NWR	131	229	212	418	268	192	429	257	331	347	381	532
(**6**) Camas Prairie (combined with Carey for 1995 survey)	0	0	0	2	93	25	17	137	0	0	0	0
(**7**) Carey Lake area (combined with Silver Creek in '92,'96,'97 and Camas Prairie in '95 surveys.	264		156	87	0	8	0	6	2	0	0	0
(**8**) Chesterfield Reservoir	0	196	249	273	218	355	149	170	86	38	7	138
(**9**) Grays Lake	343	636	606	747	1,156	1,144	1,529	1,734	1,467	1,430	1,728	1,384
(**10**) Henrys Lake Flats	0	139	633	539	532	695	436	31	102	21	58	35
(**11**) Island Park Reservoir	NS	30	0	4	5	2	0	0	13	2	0	2
(**12**) Kilgore	2	121	0	17	2	0	0	0	0	NS	NS	0
(**13**) Market Lake WMA	13	NS	2	0	0	0	2	2	2	0	1	0
(**14**) Marsh Valley	NS	182	45	172	244	324	284	192	277	202	120	245
(**15**) Mud Lake WMA	257	NS	50	50	130	62	105	94	172	371	164	100
(**16**) Oxford Slough-Swan Lake	0	330	47	316	52	418	94	143	242	93	220	145
(**17**) Silver Creek (combined with Carey Lake Area in '92, '96, '97 surveys, see Carey Lake Area for estimates)		111			486	115	524	385	327	466	240	567
(**18**) Teton Basin	2,989	1,006	2,186	1,360	1,048	1,470	1,831	907	1,504	1,543	1,626	1,834
Subtotal	5,801	6,864	8,334	8,132	8,067	8,761	9,337	7,160	7,698	7,822	7,152	7,668

Survey Area	1992	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Montana												
(**1**) Blackfoot/Ovando Valley (includes Helmville)	343	422	385	167	561	246	258	272	453	514	57	361
(**2**) Cascade-Ulm			0	NS	NS	NS	94	NS	146	87	135	124
(**3**) Centennial Valley	35	20	3	NS	33	3	2	8	12	46	0	2
(**4**) Deadman's Basin (may have been listed under Mussellshell R. in '99)	80				329	284	164	400	655	481	160	336
(**5**) Dillon-Twin Bridges	2,568	971	1,434	1,334	971	1,464	1,058	1,918	1,350	1,681	1,788	1,443
(**6**) Gallatin Valley (includes Belgrade)	200	229	258	213	232	35	327	273	340	411	412	NS
(**7**) Helena Valley	125	111	100	30	89	73	134	146	164	170	104	56
(**8**) Melville (Otter Cr. and Melville reported combined in '99)	257	224	NS		420	470	289	134	375	581	42	881
(**9**) Musselshell River (Includes Harlowtown) (Melville/Otter Cr./Musselshell River reported together in '97)	440	456	NS	1037	248	297	679	377	59	202	246	226
(**10**) Otter Creek (Otter Cr. and Melville reported together in '99, see Melville for estimate)							112	290	377	8	4	0
(**11**) Teton River - Eureka Res.											336	358
(**12**) Toston-Townsend	234	229	106	158	183	NS	NS	NS	297	306	544	577
(**13**) Upper Madison Valley (includes Ennis, Ennis estimate of 239 added to this estimate for 1992)	244	86	114	31	77	74	71	139	82	120	121	298
(**14**) Warm Springs	287	224	221	156	NS	139	261	116	137	71	40	180
(**15**) White Sulphur Springs	309	709	353	405	229	NS	NS	360	227	175	487	442
(**16**) Whitehall	142	NS	NS	64	43	56	149	152	169	111	161	304
Subtotal	5,264	3,681	2,974	3,595	3,415	3,141	3,598	4,585	4,843	4,964	4,637	5,588
Utah												
(**1**) Cache County	1,067	608	694	702	851	807	637	646	566	701	252	862
(**2**) Box Elder County	222	255	225	457	402	576	288	338	362	425	381	327
(**3**) Davis County	16	46	39	148	121	117	44	133	82	87	42	87
(**4**) Weber County	46	57	47	49	96	23	37	15	39	148	79	43
Rich County (see Bear River V. and Round Valley after '92)	599	418										
(**5**) Morgan County	31	6	NS	NS				18	NS	18	30	32

Survey Area	1992	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Utah												
(**6**) Bear River Valley			484	548	458	254	329	110	218	298	54	252
(**7**) Round Valley			65	31	16	7	8	9	30	52	59	43
(**8**) Summit County	135	138	121	113	102	24	80	78	108	39	55	32
Uintah County (see Jensen, Pelican Lake, Leland Bench after '98)	632	NS	174	402	139							
(**9**) Jensen (Uintah Co)						459	933	114	446	747	1,195	922
(**10**) Pelican Lake area (Uintah Co)						25	60	0	18	21	74	4
(**10**) Leland Bench (Uintah Co)								61	0	10	18	42
Utah County	62		0	0	NS	NS						
Subtotal	2,810	1,528	1,849	2,450	2,185	2,292	2,416	1,522	1,869	2,546	2,239	2,646
Wyoming												
(**1**) Baggs	60	NS	NS	10	NS	0	0	2	3	4	0	5
(**2**) Bear River Valley	526	197	83	102	73	133	115	324	246	233	149	96
(**3**) Greybull River-Otto	208	0	363	161	411	524	585	207	286	439	179	437
(**4**) Shoshone River-Ralston (see Powell, Park Co. in 1992)	429	365	476	258	466	1,023	802	268	414	742	680	938
Other Bighorn Basin				15								
(**5**) Big Piney	0	NS	NS	0	55	399	0	135	40	174	58	3
(**6**) Bridger Valley	NS	27	42	140	8	57	0	3	33	125	43	273
(**7**) Farson	388	323	806	895	1,192	889	1,367	890	1,051	813	1,256	1,382
(**8**) Hams Fork	73	NS	NS	0	NS	11	0	6	0	4	24	161
(**9**) Pinedale-Cora	2	NS	NS	5	6	17	29	12	2	2	2	35
(**10**) Seedskadee NWR	0	NS	2	10	12	5	5	6	6	2	3	0
(**11**) Saratoga (Upper North Platte Valley)	43	NS	NS	58	87	28	0	NS	0	193	85	2
(**12**) Jackson Hole	0	NS	NS	36	48	41	69	72	121	117	84	40
(**13**) Star Valley (includes Lincoln Co, Salt River)	477	543	493	254	549	515	519	408	304	316	234	191
(**14**) Hidden Valley (includes Boysen-Riverton area)	9	93	56	311	255	187	223	33	58	39	119	43
(**15**) Ocean Lake	8	123	205			234	176	240	433	229	113	96
(**16**) Riverview Valley						142	0	20	41	14	43	209
Yellowstone Park	25											
Subtotal	2,248	1,671	2,526	2,255	3,162	4,205	3,890	2,626	3,038	3,446	3,072	3,911
Totals	**19,304**	**16,028**	**16,938**	**18,036**	**18,102**	**19,501**	**19,990**	**16,559**	**18,803**	**19,523**	**18,510**	**20,865**

NS = no survey

A shaded cell indicates that the area was not listed in the report for that year, the name has been changed/discontinued, or the area has been dropped from the survey.

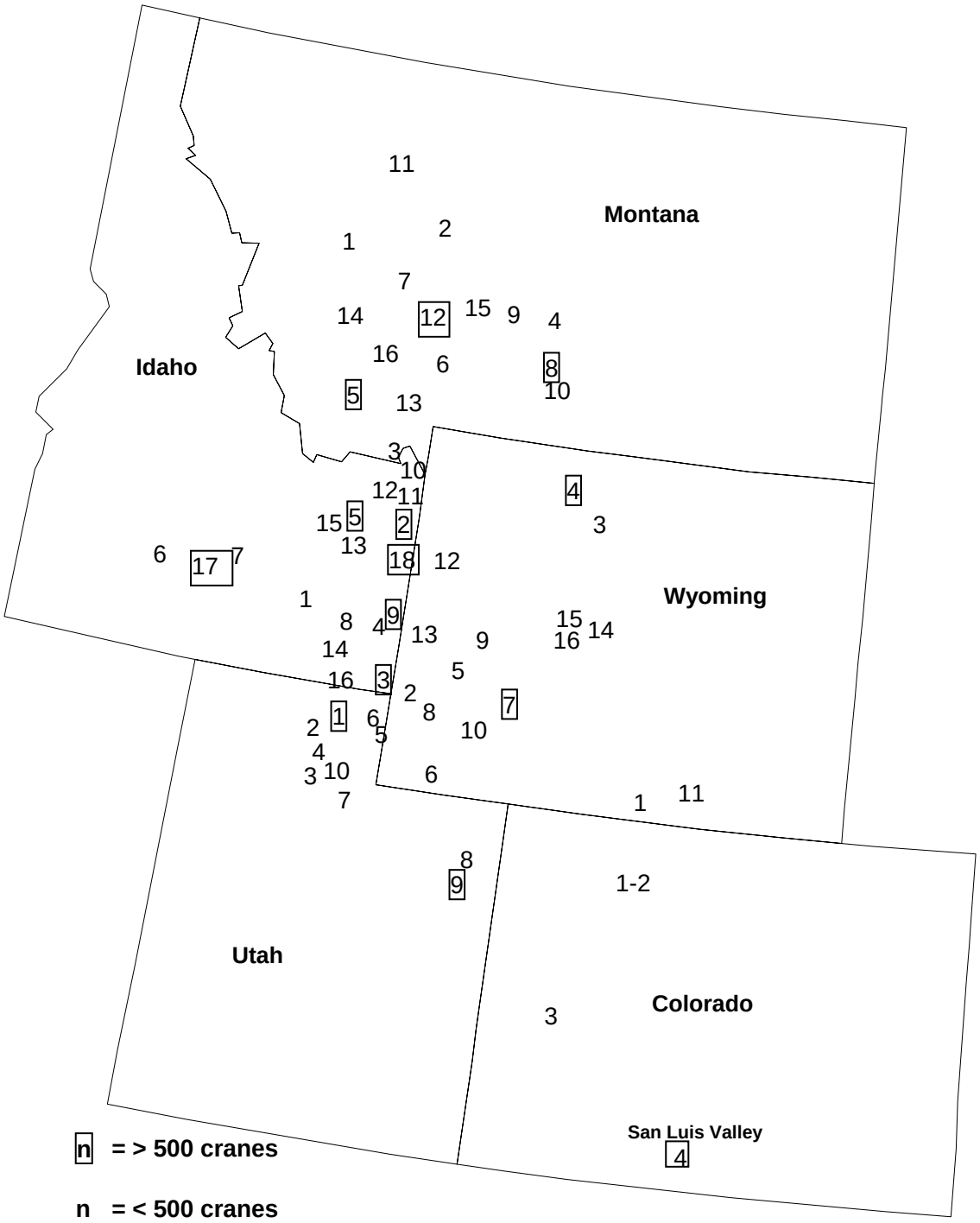


Fig. 2. September Survey Locations for the Rocky Mountain Population of Greater Sandhill Cranes. See Table 1 for location names and numbers (adapted from Drewien and Thorpe 2005).

Wintering Areas

From northern staging areas, most RMP cranes funnel through the SLV, Colorado, into the Middle Rio Grande Valley, New Mexico, southwestern New Mexico, southeastern Arizona, and northern Mexico (Fig. 1). Figure 3 shows the chronology of migration. Most RMP cranes terminate migration in Valencia and Socorro counties of the MRGV, New Mexico. Smaller numbers winter in southwestern New Mexico (Sierra, Grant, Dona Ana, and Luna counties) and the Pecos Valley in eastern New Mexico, including Las Vegas NWR, Maxwell NWR, and the Sulphur Springs Valley in Cochise County, Arizona. There appears to be an increasing trend of RMP cranes wintering on Las Vegas NWR and Maxwell NWR. About 10% continue into Chihuahua and Durango, Mexico, where they mix with the more abundant lesser and some Canadian sandhill cranes (Drewien et al. 1996).

On all winter areas, RMP cranes mix with other subspecies. In the MRGV, Gila River Valley, Las Vegas NWR and Maxwell NWR, RMP cranes comprise the majority of winter flocks. The proportion of lesser and Canadian sandhill cranes wintering in the MRGV has been increasing in recent years. In other winter localities, especially southwestern New Mexico, southeastern Arizona, and Mexico, smaller subspecies predominate. In 2004, Arizona counted 31,443 cranes in the Sulfur Springs Valley. Of those, 20-30% are estimated to be RMP cranes. The total number of RMP cranes wintering in this area has increased markedly in this area within the last 20 years although the percentage of RMP has remained relatively constant. Some of this may be due to declining habitat conditions in Mexico and changing agricultural crops in southwestern New Mexico. Current estimates of the number of wintering cranes vary between years in the middle Rio Grande Valley, New Mexico (Table 2).

Of the greater sandhill cranes that wintered in New Mexico and Arizona during the 1980s, 6,000-13,000 wintered on Bosque NWR. Peak winter counts in the MRGV are summarized in Table 2. Use of state waterfowl management areas varied from 5,000-19,000 cranes.

In some years, from 2,000-12,000 cranes winter from Sierra County, New Mexico southwest to the Mexican border. In the late 1980s, an average of approximately 2,500 cranes wintered in this region. Areas of heaviest use include Caballo Lake, Uvas Valley and the Gila River Valley (Schmitt and Hale 1997). Crane use in Luna County has declined substantially due to agricultural changes in crops from grain to cotton and chile (Mitchusson 2003). In 1970, nearly 8,000 cranes wintered near Columbus, New Mexico (Drewien and Bizeau 1974), where few are found today. Numbers vary widely among years, but they are predominately lesser sandhill cranes (76.9%), followed by greater (18.7%) and Canadian (4.3%) sandhill cranes, except in the Gila Valley where greaters predominate. Moving southwest from the Rio Grande Valley to the Uvas Valley and to Guzman Basin near Deming and Columbus, the percentage of lessers increases from 63.2% to 88.6%, while greaters decrease from 28.9% to 10.0% and Canadians decrease from 7.8% to 1.3% (Schmitt and Hale 1997). Recent crane harvest data from Arizona and southwest New Mexico indicate the percentage of Canadians has increased.

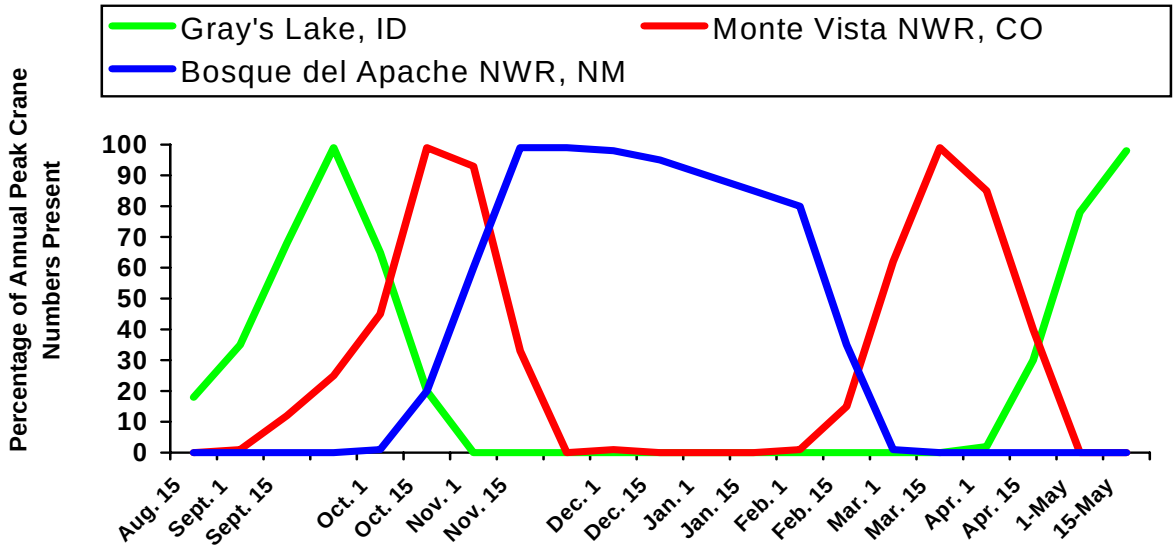


Figure 3. Migration Chronology of RMP Greater Sandhill Cranes From Breeding Grounds to Migration Stopover and Winter Ranges and Return (adapted from Drewien and Bizeau 1974).

Table 2. Peak Winter Sandhill Crane Counts (all subspecies) in the Rio Grande Valley, New Mexico. Counts include 3 subspecies from the Rocky Mountain and Mid-Continent Populations.

Year	Bosque del Apache National Wildlife Refuge	Off-Refuge Count	N D J[1] Total	Mean
1967	5,100	197	5,297	-
1968	5,500	661	6,161	-
1969	6,100	1,238	7,338	-
1970	9,800	2,171	11,971	-
1971	10,000	3,920	13,820	-
1972	10,500	2,476	12,976	-
1973	12,300	3,548	15,848	-
1974	8,500	4,951	13,451	-
1975	7,500	10,472	17,972	-
1976	9,900	5,549	15,449	-
1977	14,400	4,998	19,398	-
1978	11,800	2,747	14,547	-
1979	12,500	4,883	17,383	-
1980	13,928	5,409	19,337	-
1981	12,900	7,702	19,864	-
1982	12,000	10,864	22,864	-
1983	14,400	10,930	25,330	-
1984	10,900	5,529	16,429	*15,056
1985	11,000	6,029	17,029	*12,751
1986 [2]	4,629	18,430	23,059	*19,168
1987 [2]	8,334	20,282	29,126	19,421
1988 [2]	11,302	12,056	23,358	20,809
1989 [2]	6,196	10,357	16,553	15,383
1990 [2]	13,810	10,660	24,470	19,037
1991 [2,3]	12,900	10,280	23,180	17,064
1992 [2,3]	11,160	10,300	21,460	18,412
1993 [2,3]	10,570	15,200	25,770	23,030
1994 [2,3]	15,700	9,200	24,900	21,162
1995 [2,3]	15,312	10,200	25,512	19,753
1996 [2,3]	13,000	8,250	21,250	18,093
1997 [2,3]	10,440	10,740	21,180	17,133
1998 [2,3]	12,950	15,400	28,350	24,203
1999 [2,3]	11,900	15,240	27,140	21,103
2000 [2,3]	12,200	18,690	30,890	21,023
2001 [2,3]	11,090	21,065	32,155	23,510
2002 [2,3]	13,500	16,565	30,065	23,399
2003 [2,3]	12,490	19,560	32,050	22,685
2004 [2,3]	13,941	14,813	28,754	22,876
2005 [2,3]	12,000	15,250	27,250	23,093

[1] Average population during November, December, and January.

[2] Beginning in 1986, Bosque del Apache NWR was included in the Rio Grande transect. Previously, data consisted of ground counts by personnel of Bosque del Apache NWR.

[3] 1991-96 counts were based on weekly ground surveys during November-February.

* Denotes a year when data from ground count were used to determine the NDJ average.

Number and Population Counts

Historically, the SLV in March was the best location to census the RMP. Virtually the entire population is in the valley between 5-15 March. Beginning in March 1984, the U.S. Fish and Wildlife Service (FWS) annually counted cranes in the SLV using a systematic aerial transect survey with a photographic correction factor (Benning et al. 1997). Adverse weather conditions, including partial snow cover and high winds, occasionally reduced visibility, producing some counts of questionable accuracy. During 13 counts (1984-96) the estimated number of RMP cranes averaged 17,725 and during 7 years of good survey conditions, averaged 19,869 (Appendix B).

During early years of the March survey, a small number of Mid-Continent lesser sandhill cranes (<5%) mixed with the RMP. Ground surveys provided an index of the presence of lesser sandhills, and the RMP counts were adjusted accordingly. In recent years, lesser and Canadian sandhill cranes have increased to 22-33% of the March crane population. Due to our inability to accurately distinguish the mid-sized Canadian subspecies through ocular surveys or track measurements, a reliable estimate of the RMP is no longer possible in the SLV in March.

The Subcommittees concurred with the assessment by Drewien and Benning (1996, pers. comm.) that spring counts do not provide a reliable population estimate for the RMP. The spring survey was abandoned in 1997 and has been replaced with a September pre-migration survey in the summer range states. The time period in September for a reliable survey is relatively brief and is weather-dependent, and is not confounded by the presence of other subspecies. Coordinated surveys must be done within a minimal time frame to avoid duplicate counting or missing birds that move.

Carefully coordinated surveys of the RMP on fall pre-migration staging areas provide a minimum estimate of the population at that point in the biological year. Some hunting mortality has already occurred during early September seasons. Additional hunting mortality takes place during mid- and late September seasons,

and during later hunting seasons in winter range states. Limited overwinter mortality is also expected on wintering grounds and during spring return migration.

Population estimates derived from fall pre-migration surveys in 1995-97 ranged from 16,000-18,000, but are considered minimal due to organizational problems and protocol associated with initiating a new survey. Recent satellite telemetry research confirmed no other known crane population co-mingles with RMP cranes during the September pre-migration survey (G. Krapu, per. comm.). Mid-continent cranes are present in the SLV during October. Therefore, fall surveys in the pre-migration areas form a solid basis to derive population indices for management decisions.

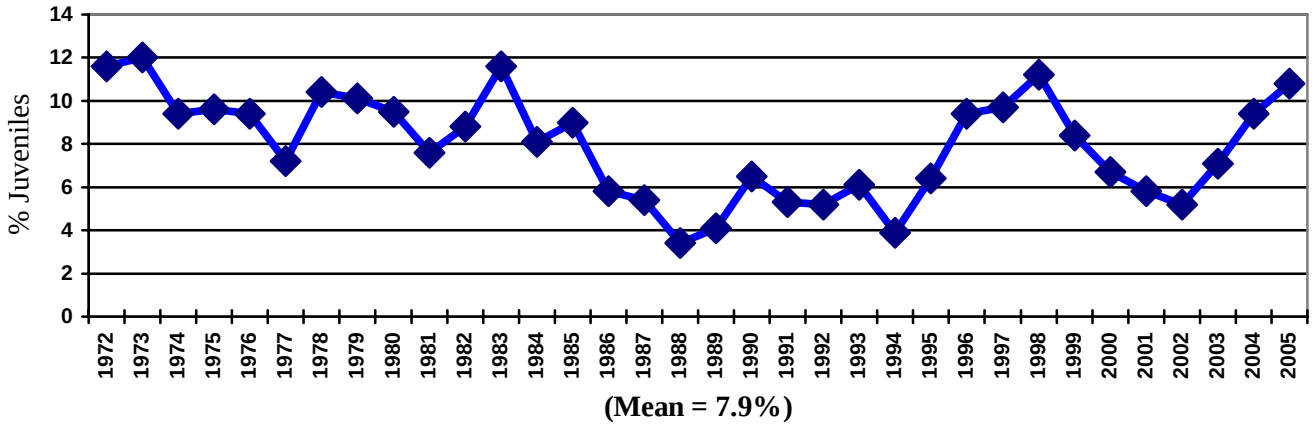
In a 1969-71 study of RMP cranes nesting at Grays Lake, Idaho, Drewien (1973) found that certain information on production could, with caution, be extrapolated to the population elsewhere. Clutches averaged 1.9 eggs, and nest success was 78%. Cranes were capable of renesting when clutches were lost prior to mid-incubation. Mean brood sizes at hatching and fledging were 1.77 and 1.35, respectively. RMP greaters post-fledging brood size averages 1.31 (range 1.21-1.35) (Drewien et al. 1995).

Recruitment rates at Grays Lake were high, 13-14% during 1961-71. However, population recruitment rates recorded in the SLV declined during the late 1980s-mid 1990s (Drewien et al. 1995). The 1982-85 average recruitment of young was 8.3% and the 1986-95 average was 5.2%. Drewien's studies indicate decreased production was caused by a drought in recent years, during which predation on young increased. An apparent increase of predation by coyotes coincided with changes in predator control practices including elimination of compound 1080 by the FWS beginning in 1972.

Below normal recruitment from 1986-1995 had reduced the population from the 1985 level of 20,382. Habitat deterioration (long-term drought and poor wetland conditions) and predation are cited as the primary factors impacting recruitment (Drewien et al. 1995). Changes in farming practices in the SLV may also be impacting food availability to pre-nesting cranes during the spring migration. However, recruitment

rebounded to 9.4% in 1996, in response to improved wetland conditions on breeding areas. Recruitment from 2000-2005 averaged 8.0%. Recruitment from 1972-2005 averaged 7.9% (Table 3). Hunting in the northern states occurs prior to the SLV recruitment survey in addition to other mortality factors occurring during migration. This may influence observed recruitment, as juveniles have higher mortality rates (Drewien et al. 2001).

Table 3. Recruitment (% juv.)in Rocky Mountain Greater Sandhill Cranes, San Luis Valley, CO, 1972-2005 (adapted from Drewien 2005).



Habitat

Breeding Areas

Typical nesting habitat occurs in the river valleys, marshes, and wet meadows of northern Colorado, northern and central Utah, western and central Wyoming, southeastern and central Idaho, and central and western Montana, particularly in ranching country where human populations are low, but increasing. Increases in home development and subdivisions are negatively impacting some habitats in portions of eastern ID, western WY, and southwestern MT (Drewien and Thorpe 2005). Suitable, vacant crane habitat may be available in western Alberta where the possibility for population expansion may exist.

Fall Pre-migration Staging Areas

Staging sites associated with production areas serve as gathering locations prior to fall migration. Necessary components of staging habitat are grain fields for feeding in close proximity to roosting sites in shallow lakes, marshes, or river bottoms (Drewien and Bizeau 1974).

Increases in home development and subdivisions are negatively impacting some premigration staging habitats in portions of eastern ID, western WY, and southwestern MT. The explosion of subdivisions adjacent to the Salt River crane and goose habitat in lower Star Valley, WY, has reached the point where it is becoming difficult to conduct an aerial survey. Numbers of cranes and Canada geese using this area have declined substantially in recent years. Several other premigration staging sites are following this trend (Drewien and Thorpe 2005).

Migration Stopover Areas

The major fall and spring migration stop for the RMP is in the SLV, Colorado. Most roosting areas are on the Monte Vista NWR, (up to 15,000), Higel SWA, Rio Grande SWA, the channel of the Rio Grande and private marshes and wet meadows along the river from the town of Monte Vista to the Alamosa NWR. In fall, most cranes feed in private, harvested small-grain (wheat, barley and triticale) fields; in the spring, many cranes feed on refuge grain fields at Monte Vista NWR.

Wintering Areas

The primary winter range is the Middle Rio Grande Valley, New Mexico. Cranes roost on sandbars in the river near grain fields on private lands, and in the river and managed wetlands on federal refuges and state waterfowl management areas (WMAs). Historically, the largest number wintered on Bosque NWR. Since 1997, the state WMAs and private lands have attracted more cranes, on average wintering 50% of the cranes in the MRGV. Smaller numbers winter in similar situations and on playas (closed basins) in other areas in New Mexico, southeastern Arizona, and in the Northern Interior Highlands of Mexico, primarily in Chihuahua, Mexico. Mexico's significance for wintering RMP cranes has greatly diminished due to wetland

drainage in the Galeana Valley and changing crops in the Ascencion Valley and elsewhere (R. Drewien, per. comm., Drewien et al. 2003).

Management and Research

Current Programs

Arizona. In 1996, the Arizona Game and Fish Department (AGFD) acquired a major sandhill crane roost site in the Sulphur Springs Valley near McNeal (White Water Draw Wildlife Area). In 2004 the Department finished a 40-acre moist soil project to provide food for cranes and waterfowl. Those units are flooded in the spring and fall. The AGFD also pumps water to maintain a roost near Willcox (Willcox Playa Wildlife Area) when the primary roost (Willcox Playa) is dry. AGFD has also enacted a cooperative agreement with a power company near the playa to ensure maintenance of another important crane roost site near the plant. With this activity substantial increases in roost sites have been made available for cranes. Production of both corn and sorghum present the greatest foraging opportunities for wintering cranes in the Sulfur Springs Valley. Changes in agricultural crops to alfalfa and altered management practices such as cutting grain crops for silage will reduce areas available for foraging.

The January count for cranes has increased from 4,300 in 1981 to 29,200 in 2006. In January 2004, a record count of over 31,000 was recorded. We speculate that efforts to assure consistent roost sites (addition of Whitewater Draw Wildlife Area, pumping water into Wilcox Playa) has short-stopped large numbers of cranes from Mexico. There is evidence that some cranes wintering in Arizona use Bosque del Apache in New Mexico as a stopover.

Arizona has conducted limited permit, recreational hunts on sandhill cranes each November since 1981. Permits, which allow each successful applicant to take 2 cranes per season, are allocated by random drawing. During the initial 4 years of the hunt, 100 permits were issued. Permits were increased to 150 in 1985, 300

in 1987, and 365 in 2005. Total harvest ranged from 42 in 1981 to 277 in 2005. Those harvests include MCP Cranes. Mean harvest of RMP cranes since the inception of the hunt is 30 cranes with a high of 61 RMP cranes harvested in 1993. In 2005, Arizona harvested an estimated 50 RMP cranes.

Colorado. Greater sandhill cranes were designated by the state as endangered on the nesting range and non-game throughout the remainder of the state. An increasing number of nesting pairs in the early 1990s has enabled the population to be down listed from endangered to threatened status. However, production has remained below the objective of the state recovery plan and must be improved before complete delisting of the population. The Colorado Division of Wildlife (CDOW) continues to work with land management agencies and private landowners on improving nesting habitat. Intensive surveys in the nesting range are conducted periodically.

Conditions on fall pre-migration staging areas have improved with The Nature Conservancy's (TNC) purchase of a ranch that includes a portion of a major roost for cranes along the Yampa River near Hayden. The cranes still forage in wheat and barley grown on private lands near the roosts. Cranes are counted on the fall staging areas in conjunction with the coordinated RMP fall population survey. Age ratios are determined periodically on the staging areas.

Managing habitat to support sandhill cranes is an objective of the Monte Vista and Alamosa NWRs in the SLV. At Monte Vista, practices include (1) planting small grains such as barley and wheat which remains standing through the fall to discourage use and is mowed in February for spring crane and migratory bird use and, (2) water management, often including pumping. Irrigating wet meadows and other wetland types to provide foraging and loafing sites as well as providing open water for roosting sites, particularly during periods of drought and/or in the spring when most other water in the valley is frozen.

Additionally, the FWS recently established the Baca NWR, in Saguache and Alamosa counties and has an approved acquisition boundary of approximately 92,500 acres. This refuge at the base of the Sangre de

Cristo Mountains and adjoining TNC's Medano-Zapata wetlands to the south, has a variety of wetland types conducive to sandhill crane roosting, foraging, and resting. Managing for a variety of healthy wetland types and conditions is a management priority, which will support the RMP (FWS, Conceptual Management Plan: Baca NWR, 2005). It is postulated by many biologists and mangers that wetland and upland habitat conditions found on the Baca NWR may best represent those used by cranes in the SLV prior to European settlement. Additionally with these habitats now under federal ownership there are excellent management opportunities to provide roost sites in the northern portion of the SLV, which may allow for cranes to feed on waste grain in private fields that are currently underutilized due to the long distance to traditional roost in the central portion of the SLV. It has been found in the SLV that most cranes do not travel more than 7 miles from the roost to foraging sites. Also management on Baca NWR may be able to provide and support the conditions conducive to the production of the "natural" foods cranes utilize versus the agricultural crops cranes have become dependent upon in other parts of the SLV. Incidental observations have indicated that cranes roosting on the Baca NWR may not leave the area to forage in neighboring farm fields, but are perhaps, foraging in refuge habitats. The Baca NWR, as a large, continuous piece of land with a mosaic of habitat conditions, may serve as an excellent test, and then opportunity, of being able to feed cranes in non-agricultural habitats.

Spring food for cranes is becoming a critical issue in the SLV. For one, the amount of waste grain on private lands is being reduced by the increase in fall tilling and irrigation of harvested grain fields. Farmers implement these practices to encourage the growth and then subsequent freezing of waste seeds to get a clean field for subsequent spring planting. Secondly the amount of acres in the small grain production has dramatically reduced beginning in the late 1990's by the replacement of alfalfa. It is unknown how cranes will or will not forage in alfalfa fields; incidental observations indicate that cranes may forage on insects and other invertebrates in alfalfa fields that are being irrigated. The reduction of waste grain availability in spring may be intensifying competition among RMP cranes, an increasing segment of lesser and Canadian cranes, and waterfowl populations. In March 1997, the Pacific Flyway Council requested the CDOW and FWS to address the issue of spring food supplies for the RMP.

In a response to the decline in food resources for spring migrating cranes, the FWS leased private farm fields around areas of high crane use (north and south of the town of Monte Vista). Farmers were paid by the acre to not till and irrigate stubble fields so that waste grain would be available through the fall and spring for sandhill cranes. Private farmers willingly participated; however, the funding for these efforts was unplanned and opportunistic, and therefore not always available especially during limited budgets. Refuge staff collected data on the amount of waste grain present before, during and after spring and fall migrations to document use of food by cranes and other migratory birds. In general, between 80-95% of the waste grain on leased fields in early September was gone by the end of the next year's spring migration.

The FWS' Partners for Fish and Wildlife Program has actively been promoting the development and management of shallow water wetlands on private lands throughout the SLV, but in particular areas commonly used by cranes, to provide more roost sites. Wildlife biologists and managers, have assumed that one of the limiting factors to dispersing high numbers of cranes throughout the SLV, is the lack of roost sites, therefore, the development of these roost sites has been encouraged. Since the development of a few private wetlands in the north-central part of the valley, there has been an increase in all migratory waterbird use and in particular cranes. It is believed that these cranes are able to forage on nearby wetlands and the waste grain in private fields that they would not normally use from more traditional roost sites on the Rio Grande to the south.

Conservation for sandhill cranes is strong for the Natural Resources Conservation Service (NRCS) in the SLV because of issues involving changes in agricultural practices, loss of wetlands, and the fact that cranes utilize private lands extensively. Through U.S. Department of Agriculture (USDA) programs and partnership efforts, NRCS is able to provide technical and financial support to private landowners wishing to protect, restore, and manage lands for sandhill cranes. Projects on private lands include; restoration and enhancement of shallow wetlands as forage and potential roost sites, lands protection, securing unharvested small grain crops during drought, and by providing incentives to agricultural producers to

incorporate leaving more small grain crop residues into their long-term management operations. Eliminating conflicting strategies such as promoting fall tilling and irrigating harvested grain fields to germinate waste grain would benefit cranes.

Through 1996, cranes were censused in spring in the SLV by FWS personnel and the results utilized as the best estimate of population size for management purposes. These counts were discontinued in 1997. Early fall migrating RMP cranes are counted in the SLV during the coordinated fall count in September. The young:adult ratio (recruitment) is estimated for the entire population through classification counts in the SLV during late October. Mean recruitment from 1972-2004 is 7.9% (Table 3). Some mortality occurs prior to this survey due to hunting in the summer states and hazards during migration.

Idaho. During the mid-1990's, eastern Idaho farmers became increasingly intolerant of crane damage and on numerous occasions requested relief from the Idaho Department of Fish and Game (IDFG). In the Ashton area of Fremont County, damage occurs primarily in spring and summer before September 1. The damage is generally caused by family groups rather than large flocks. The crop most frequently damaged is potatoes, usually seed potatoes. Small grain crops are also damaged at times, but damage is generally minor. Crop damage in the remainder of eastern Idaho typically occurs in late summer and early fall, generally early to mid-August until mid-September. Family groups and non-breeders in small to large groups cause the damage. The crops most frequently damaged are small grains, mainly barley. Damage can range from very minor to severe.

In July, 1996, the IDFG reclassified the sandhill crane from "protected nongame" to "migratory game bird" and established the State's first recreational hunt using a 20-bird harvest allocation and 30 randomly-selected permittees.

Since 1995, the IDFG has gathered data on summer populations and September staging areas to comply with management plan requirements. Since 1996 the IDFG has offered sport hunting seasons with annual harvest averaging about 200 cranes.

Crop damage complaints are serviced by both the IDFG and Wildlife Services. A memorandum of understanding directs the IDFG to service minor complaints involving less than 100 cranes between 1 May and 15 August, and directs Wildlife Services to service all other complaints.

The FWS manages approximately 200 acres of grain planted as supplemental feed at Bear Lake, Camas, and Grays Lake NWRs to help alleviate crop damage on adjacent private properties. Most often, barley is planted as supplemental feed.

Mexico (Chihuahua and Durango). Details of any specific management practices should be solicited from *Secretaria del Medio Ambiente y Recursos Naturales* (SEMARNAT). Minimal information is available on harvest rates of RMP cranes in Mexico. Lafón and Soto (1991) estimated a 2.3% harvest rate among all sandhill crane subspecies. At Laguna de Babicora the harvest rate may be 3% but, in other areas, harvest is insignificant. Drewien et al. (1996) observed more incidents of subsistence hunting than recreational hunting during winter crane surveys from 1970-1993. Local residents attempted to take cranes with rifles and pistols making them very wary and more difficult to approach than on winter grounds in New Mexico and Arizona. Mid-continent lesser subspecies comprise most cranes wintering in Mexico, and the majority of the harvest. On average, 88.9% of the cranes counted on 6 study sites in Chihuahua, Mexico, were lessers. Drewien et al. (1996) postulate 25% of the cranes classified as greaters were actually Canadians. This means about 8% of the cranes on the 6 study sites may have been greaters. Although the primary wintering area in Mexico includes the Northern Interior Highland states of Chihuahua, Durango and Zacatecas only small numbers of RMP greaters are found south of central Chihuahua; most occur in northwestern Chihuahua near the New Mexico border. Currently, the most important winter site for RMP cranes is the Ascension Valley, Chihuahua. Formerly the Santa Maria river valley near Galeana, Chihuahua

was an important winter area for RMP cranes (Drewien et al. 1996). However in the 1990's the primary crane roost site, a large marsh near Galeana, was drained and only a few cranes currently winter in the area.

Crane distribution has shifted markedly since the 1950s and early 1960s in response to changing agricultural practices and wetland degradation caused by deforestation, overgrazing, water diversions, water pollution, and other effects of human population growth (Drewien et al. 1996). Most crane wintering habitats in Mexico are vulnerable to further, adverse habitat modifications. In the 1990's, the Mexican federal government proposed to drain much of the Babicora Basin to improve agriculture and flood control (Drewien et al. 1996). This important wetland area in west-central Chihuahua supports the highest winter concentrations of cranes, primarily lesser subspecies, in Mexico (Buller 1982, Drewien et al. 1996)($\bar{x}$ = 12,614, range 1,470 – 25,680). From 1995-1998, the University of Chihuahua, with funding and support from other partners, developed a conservation management plan for Laguna de Babicora (A. Lafón per. comm., Drewien et al. 1996). Currently, the drainage proposal has been deferred. Drainage of this wetland would eliminate the most important sandhill crane wintering site in Mexico.

Montana. Pre-migration staging counts are annually conducted by personnel from Montana Fish, Wildlife and Parks (MFWP), the FWS, and private volunteers on occasion. Hunting seasons on the RMP were initiated in 1992 and currently include 3 hunt units in the Pacific Flyway portion of the state and 1 hunt unit in the Central Flyway portion of the state. In 2004, the Dillon hunt area was expanded north along the Jefferson River to Whitehall. In recent years, there have been approximately twice as many crane-hunting applicants as available permits.

Intermountain West and Prairie Pothole Joint Venture partners have identified flood plains and other wetland habitats as priorities for enhancement and conservation. These ongoing conservation efforts will continue to benefit RMP crane breeding habitats.

New Mexico. Populations of sandhill cranes are monitored by the New Mexico Department of Game and Fish (NMDGF) during monthly aerial surveys conducted from mid-October through early January. FWS personnel on Maxwell NWR and Las Vegas NWR conduct weekly ground counts monitoring cranes.

MRGV sandhill crane management is guided by a cooperative agreement, *A Plan for the Management for Waterfowl, Sandhill Cranes, and other Migratory Birds* (MRGV Plan), between the NMDGF, FWS, and Wildlife Services. The MRGV Plan goal is maintain a mean monthly population of 17,000- 22,000 sandhill cranes during November- February. This population level ensures viability within food supplies and depredation complaints that are not excessive. The objectives are to maintain a refuge distribution of 60% of the wintering birds at Bosque NWR and 40% on NMDGF WMAs, and minimize problems associated with sandhill crane crop depredations. Weekly ground surveys are conducted by the FWS to monitor the population and a FWS aerial survey is conducted in December to assess crop depredation potential on private lands (Taylor 1999). In 2005, the FWS aerial survey counted 79% of the MRGV wintering crane flocks on federal or state refuges and 21% on private lands. The 1999-2001 MRGV mean population was 21,879 wintering sandhill cranes. The 2001 average population was 23,510 cranes with a peak count of 32,156 (Mitchusson 2003). The 2005 average population in the MRGV was 20,926 cranes with a peak count of 27,250. The proportion of sandhill cranes wintering on refuges during 1999-2001 averaged 50% on Bosque NWR and 50% on NMDGF WMAs (FWS, Bosque del Apache, 2002). Flock distribution objectives have not been met since 1989 (Taylor 1999, Mitchusson 2003). The proportion of sandhill cranes wintering on refuges during 2005-2006 averaged 57% on Bosque NWR and 43% on NMDGF WMAs.

An objective of Bosque NWR is to manage habitat for wintering greater sandhill cranes. Management activities include growing about 290 acres of corn and more than 750 acres of alfalfa for sandhill cranes and waterfowl. An additional 70 acres are being developed to grow cereal crops. Open shallow water marshes are maintained for feeding, roosting and loafing. Moist soil impoundments grow chufa providing another

food source for sandhill cranes. River roost sites have been recreated through salt cedar removal and mechanically widening the river channel.

Management of agricultural crops on NMDGF WMAs was originally directed primarily at waterfowl. Recent management actions have increased the emphasis towards sandhill cranes. The Ladd S. Gordon Complex composed of 4 WMAs in the MRGV totals approximately 5,900 acres of irrigated agricultural land and wetlands. An annual goal of 1.2 million pounds of grain (primarily corn) are produced on the WMAs to provide sufficient food reserves to support wintering cranes and light geese. Wetland developments are providing additional crane roost sites.

An experimental hunting season for sandhill cranes in the MRGV was first conducted during October 1986. This experimental hunt has been conducted annually and became operational in 1990. Experimental hunting seasons for sandhill cranes in southwestern New Mexico were conducted in 1982, 1983, 1984, 1989, and 1991-1996. Schmitt and Hale (1997) summarized these hunts. The crane season in southwestern New Mexico is operational. An experimental sandhill crane season in the Estancia Valley began in 2001 and soon will become operational. Scheduling the southwest and Estancia Valley hunts in late October limits the RMP crane harvest while offering sport crane hunting and minimizing crane depredation complaints. The majority of the harvest is comprised of MCP lessers taking advantage of peak migration periods prior to the arrival of RMP cranes. January southwest hunts have a higher percentage of RMP cranes in the harvest but are buffered by the lessers that winter in this region and those returning north from Mexico (Mitchusson 2003).

Large numbers of sandhill cranes winter on private lands in the MRGV. Some landowners have tolerated crane use on private lands, while others, particularly in the Socorro area, have been quite vocal and have filed complaints with Wildlife Services. In 1993, complaints reached an all time high prompting congressional response and informal hearings. Annual agricultural damage caused by sandhill cranes in the MRGV was in excess of $100,000 per year. As a result, Wildlife Services received funding

specifically to provide more personnel to answer depredation complaints in the MRGV. Wildlife Services personnel use pyrotechnics to disperse flocks and assign crane hunters to private lands with depredation complaints. MRGV sandhill crane hunting seasons are scheduled to reduce depredation and provide recreational opportunity. These methods along with timed crop manipulations on the refuges are used to encourage cranes remain on the refuges and reduce agricultural damage (Taylor 1999). The average annual confirmed depredation loss in the MRGV since 1993 is approximately $500 (A. May, Wildlife Services, per. comm.). The proportion of sandhill cranes using private lands during 1989-2001 has ranged from 9% to 35% and averaged 23% (USFWS, Bosque del Apache, 2002). The proportion of sandhill cranes using private lands during 2005-2006 was 21%.

In 2003, the NMDGF developed a state sandhill crane management plan to direct agency activities regarding sandhill cranes (Mitchusson 2003). Suitable and potential sandhill crane habitat has not been quantified in New Mexico but appears to be declining. Geographic Information Systems (GIS) technology and habitat suitability models will be used to obtain this information.

Utah. The Utah Division of Wildlife Resources (UDWR) annually collects data on crane recruitment, summer and fall population numbers, and hunter harvest. Control of crop damage is necessary each year in all northern counties and in portions of the Uintah Basin, and supplemental food crops are being planted on several UDWR-controlled management areas. Damage is greatest in spring when cranes consume germinating corn crops, but some damage occurs to unharvested grain crops in fall. Breeding pairs as well as non-breeding flocks are responsible for the damage and are present throughout the summer months in most northern Utah counties.

Since 1989, the UDWR has held a crane hunt in Cache and/or Rich counties, with the exception of 1992 when the Utah Wildlife Board suspended the hunting of cranes for 1 year. In subsequent years the hunt expanded into Box Elder and Uintah counties, and interest is growing for a hunt in several central Utah counties.

Wyoming. Since 1982, the Wyoming Game and Fish Department (WGFD) have held a hunting season on RMP cranes (Lockman et al. 1987). Hunting, supplemental feed crops, and conventional methods of controlling crop damage were evaluated from 1979 to 1984.

Since 1982, the WGFD has documented and mapped spring, summer, and fall crane distribution. All crane observations have been logged using the Department's computerized "Wildlife Observation System." Historically, annual data were collected on distribution, staging area densities, fledged chick recruitment, habitat use, harvest, hunter effort, and crane distribution during the hunting season. In recent years, data collection has been confined to fall premigration staging surveys and harvest surveys. Pre-migration staging counts are conducted by personnel from the WGFD, FWS and private volunteers on occasion. Occurrence continues to be documented opportunistically throughout the year.

Marking studies to determine migration and movements were conducted in cooperation with the Idaho Wildlife Research Institute, Moscow. The characteristics of seasonal crane habitats and other data have been summarized by Lockman et al. (1986) and Rowland et al. (1992).

The WGFD initiated an experimental crane hunt in Park and Big Horn counties in fall, 1996. Twenty-five permits were made available for the new hunt through a redistribution of permits from 4 existing hunt areas. The redistribution did not affect Wyoming's overall harvest allocation.

Cranes nesting in Yellowstone and Grand Teton National Parks are passively managed in that their habitat is preserved. Surveys were initiated in 1984 to determine the status of birds in these areas. Preliminary findings were summarized by Drewien et al. (1987, 2001).

Wyoming has documented that staging cranes shift their distribution in response to hunting (Lockman 1988). This behavior is apparently learned over a period of 3-4 years once hunting begins in an area.

Cranes displace outside the hunt area and move to other staging locations. By the time formal pre-migration surveys are done in mid to late September, much of this redistribution has already taken place. Therefore, surveys conducted at that time may not accurately reflect the distribution of resident birds in summer range states. Thus, additional surveys (possibly pre-hunt) may be required.

There is concern by some with declining fall staging counts in the Bear River Valley and Star Valley. It is believed that the major cause for the decline is due to changes in habitat. The main factor being these areas are changing from agricultural to urban use. If flocks continue to decline, permit numbers will be reduced or the hunt eliminated in these two areas.

V. PROBLEMS

Problems affecting RMP cranes vary among regions. The various seasonal habitats continue to be impacted from a variety of causes, including housing and industrial developments, changing agricultural practices, oil and gas exploration and development, drought, flood control projects, and wetland drainage. Competition for limited resources on wintering areas by RMP cranes, high snow and Ross's goose populations, and other crane populations have caused agricultural damage in some regions. Shrinking habitats in fall staging and wintering areas, particularly wetland roosting areas, increase the risk of disease outbreaks due to overcrowding of birds. Avian tuberculosis, cholera, botulism, and lead poisoning have caused crane mortality in wintering areas and in the SLV, Colorado (Kauffeld 1987, Snyder et al. 1987, Drewien et al. 2001). Hazards, such as transmission lines (Brown et al. 1987, Brown and Drewien 1995, Drewien et al. 2001) and even stock fences, contribute to annual mortality. While predators may influence recruitment in some locations, predation is not considered a significant problem for the population. Increases in population densities, whether produced by normal recruitment or forced concentrations of birds due to shrinking habitats, contribute to increases in damage to private agricultural crops. Some of these problems are alleviated by habitat improvement projects on state and federal lands and through carefully-designed and regulated sport hunting programs in the United States' portion of the RMP range.

More specific problems by state follow:

Arizona. With the success in providing roost sites, a potential exists for cranes to damage newly-planted grain crops and to exhaust limited supplies. Additionally, there is a shift from grains, corn, and sorghum towards alfalfa and cotton. Cranes consume alfalfa only when the plants are small; cotton is of no value to cranes. Arizona has implemented a cooperative agreement with several local farmers to grow corn and leave stubble for cranes. There remains a concern that should agricultural practices change, forage availability could become a problem in the future. Under current conditions, roosting habitat is secure, but forage supplies may become limiting.

Botulism is potentially a problem on the Willcox Playa, the major roost area. A minor outbreak occurred in 1980. The Department has attempted to mitigate this problem with additional roost areas at Crane Lake (within Wilcox Playa itself) and Whitewater Draw.

Colorado. Much of the crane nesting habitat on private land is located in areas that are attractive to home development. Programs informing private landowners about the needs of nesting cranes must be continued. Crane food supplies on premigration staging areas in northwestern Colorado are unstable, limited, and subject to crop depredation.

The lowering of the water table in the SLV has resulted in loss of foraging wetlands, forcing cranes to become primarily dependent on grain crops for nutrition. Fall tilling and irrigation of harvested small grain fields in the SLV has reduced the supply of grain available in the spring for cranes and waterfowl. Additional food sources may be developed to maintain body condition and reproductive potential of cranes returning to nesting areas.

Idaho. With a major segment of the RMP nesting in eastern Idaho and nearly 40% of the population staging there in September, grain and potato farmers are becoming increasingly intolerant of damage caused by cranes. Some operators claim farming economics are such that they can no longer afford to feed cranes. On numerous occasions, they have requested relief from the IDFG as well as the Idaho Congressional delegation. Urban development in the Teton Basin, Teton County, is consuming habitat traditionally used by RMP cranes; this is reducing the area's capacity to support summering and staging cranes and is increasing the potential for crop damage complaints. In addition, crane use of the Grays Lake NWR has declined over the past 10-15 years because of changes in habitat management. This decline in crane use contributed to crop damage problems in the Blackfoot Reservoir area in the 1990's.

Mexico. Additional information for this section should be solicited from SEMARNAT. Crop damage during the winter period may be a problem. Though potential excessive subsistence and recreational harvests of cranes is unlikely, better harvest information is desirable. The loss of wetland habitats is likely to continue and increase from a variety of land developments. Principle causes of wetland degradation throughout Mexico include water diversions, pollution, deforestation, overgrazing, and other effects associated with human population growth (Drewien et al. 1996, 2003). The greatest threat could be the proposal by the Mexican government to drain much of the Babicora Basin in west-central Chihuahua, the most important crane wintering location in Mexico. Babicora Basin's importance is greatest for the lesser subspecies. However loss of this wetland would eliminate potential use by RMP greaters. The Galeana area in northwest Chihuahua was formerly an important RMP winter area during the 1970's-90's (Drewien et al. 1996). The primary roosting wetland was recently drained, resulting in greatly reduced crane use of this winter site.

Montana. Damage to unharvested cereal grain crops can be significant, especially in the vicinity of the higher-elevation pre-migration staging areas where harvest is often delayed until

September. Breeding areas especially in intermountain valleys are experiencing increased urbanization and subdivision encroachment. This results in additional power lines and greater potential for aerial collisions.

New Mexico. Increasing urbanization, changes in agricultural crops and water management have negatively impacted sandhill crane habitat. Urban development in portions of the MRGV from Los Lunas to San Antonio has eliminated many winter sites and more will be lost in the near future. In 2006, an important agricultural winter site near Los Lunas was sold and will be converted to housing. This property supported up to 1000 cranes and 7100 geese. These birds will be forced to use crowded state or federal refuges. As habitat is lost wintering cranes and waterfowl are restricted to fewer areas. Food supply and overcrowding are becoming priority concerns for population maintenance. Houses built on the MRGV floodplain now prevent the very large spring flows necessary to scour the riverbed and alter the river channel to maintain suitable unvegetated roost sites. As lands are converted from agricultural uses to urban areas more hazards for sandhill cranes in the form of power lines and fences will be created. Currently, urbanization does not pose as large threat to the other wintering areas, but there is the potential conflict as agricultural lands and water supplies are diverted from agricultural practices to urban uses.

Use of the San Acacia Diversion Canal has resulted in loss of roost habitat on the Rio Grande, which affects winter distribution of cranes. During many years this diversion plus irrigation demands de-waters the Rio Grande. Increasing water conflicts between urban, agricultural, interstate stream compacts and endangered species management, such as the silvery minnow (*Hybognathus amarus*); especially during drought periods, can adversely impact crane habitats. Without the regular high flows to scour river vegetation, roost sites become overgrown concentrating birds into fewer open areas. Spring floods occurred in 2005 improving crane roost sites in the MRGV.

Periodically depredations by cranes have been severe in Valencia, Socorro, Sierra, Dona Ana, and Luna counties. As habitat is lost and wintering waterfowl and cranes are restricted to fewer areas, food supply and overcrowding are becoming priority concerns for population maintenance. Changes in crop patterns in most locations has reduced feeding habitat in New Mexico (less grain and more alfalfa, cotton and chile).

Utah. Urban expansion along the Wasatch Front, Cache and Summit counties continues to consume natural and agricultural habitats important to breeding and staging crane populations. Depredations on remaining agricultural areas are consequently growing in some areas and tolerance for cranes can be problematic.

Wyoming. RMP cranes stage near several agricultural projects in central and western Wyoming during late summer to early fall, where crop damage can be a problem. The damage is often compounded by feeding activities of RMP Canada geese that also congregate in the same areas. Controlled hunts in September effectively disperse cranes and geese from grain fields. However, new damage situations occasionally arise as agricultural practices change and crane distribution shifts.

Agricultural interests have voiced concern about fall crop damage by RMP cranes in all hunt areas and the Bridger Valley. Food resources in pre-migration staging areas are limited and therefore crop depredations occur. Expansion of barley production in the Farson-Eden area, the last 7 years, has not resulted in an increase in crop damage by cranes and geese. Staging by several hundred to a thousand cranes along the Greybull and Shoshone Rivers in Park and Big Horn counties is a fairly recent development, which has caused some crop damage complaints in that region. During the last decade, the Boysen-Riverton area had the highest number of crop depredation complaints. . Except on the Ocean Lake Habitat Unit, the WGFD does not plant

supplemental feed to attract cranes or geese away from private grain fields. Farm operators continue to request additional permits and longer seasons to alleviate crop damage. Damage to newly planted row crops in the spring is a more difficult issue, which cannot be addressed by controlled hunting seasons.

Valley floor development throughout Wyoming seriously threatens many of the State's most limited and important wildlife habitats. Ongoing development in the Star Valley has impacted preferred crane roost sites. The explosion of subdivisions in the lower Star Valley, has reached the point where it is becoming difficult to conduct an aerial survey. Numbers of cranes using this area have declined substantially in recent years (Drewien and Thorpe 2005)(see Table 1).

VI. RECOMMENDED MANAGEMENT PROCEDURES

The following management procedures are recommended. The degree and timing of their implementation by the various lead agencies will be influenced by manpower and fiscal and legislative constraints beyond the scope of this plan. Whenever possible and appropriate, plans for other species and populations of Pacific and Central Flyway birds should also consider the management procedures in this plan. Improved coordination between state and federal refuges throughout the region would greatly enhance sandhill crane management.

Habitat

1. Habitat Conservation. Maintain and enhance important crane habitats as follow:

Arizona. Work with local landowners to assure that sufficient forage remains available for the large wintering population of sandhill cranes in the Sulfur Springs Valley.

Lead agencies: AGFD.

Priority: high.

Schedule: Ongoing.

Colorado. In recent years, changing agricultural practices in the SLV have diminished small grain availability and increased competition among the RMP, other crane subspecies, and waterfowl during the spring migration period. There is concern limited food supplies may impact body condition and reproductive potential of RMP cranes returning to their summer range. A baseline study conducted during 1997-2001 indicated that waste grain abundance on fields with typical post-harvest practices is substantially lower than on fields left in stubble (5.97 kg/ha versus >200 kg/ha), but RMP cranes appeared to gain fat reserves during the spring stopover period in the SLV (Gammonley and Laubhan, in review). The Councils encourage further investigation of this problem, including the extent to which limited food resources may be impacting maintenance and growth of the population. Another component of this research may include investigating the feasibility of augmenting food supplies by developing natural forage sites through wetland creation and enhancement. Increasing acreages of small grain production on refuges would augment diminished food availability on private lands.

Lead agencies: RMP Crane Subcommittees.

Participating: FWS, Monte Vista NWR, CDOW, academic institutions, and consultants with applicable expertise.

Priority: high.

Schedule: Continuing.

Communicate with local NRCS offices regarding their recommended farm practices on private grain fields. If appropriate or feasible, recommend that some fields in high crane use areas be encouraged to not till and irrigate fields after fall harvest to allow for adequate amounts of waste grain on soil surface through fall and early spring migration.

FWS, CDOW, NRCS, and other natural resource agencies continue to communicate and collaborate on habitat management techniques and conservation actions that support sandhill crane habitat. These techniques include; providing a mosaic of roost sites throughout the SLV to encourage a wider distribution of cranes throughout, and the production of foods in wetland and upland habitats to potentially offset current foraging dependency on small grains.

Continue to work with local utility companies to mark power lines to reduce lethal crane strikes. Of special concern recently developed shallow-water wetlands developed on private lands through the FWS' Partners Program and other agencies that then provide roost sites.

During range-wide drought when it is probable that waste grain supplies are limited, seek funding to lease stubble fields from private farmers to provide for waste grain.

Lead agencies: FWS, CDOW and NRCS

Provide about 500 acres of wet hay meadow and grain fields along the Yampa and Elk rivers in Routt County to ensure adequate staging and foraging habitats.

Lead agencies: FWS and CDOW.

Participating: Other state and federal agencies and citizen organizations will be invited to participate.

Priority: high.

Schedule: In progress.

Monitor new and/or underutilized habitats in the northern and southern portions of the SLV.

Lead agencies: FWS and CDOW.

Participating: Other state and federal agencies and citizen organizations will be invited to participate.

Priority: high.

Schedule: In progress.

Idaho. The IDFG, in cooperation with other state and federal agencies, nongovernmental organizations, and private parties, will work to annually provide 600-1,000 acres of supplemental feed crops in strategic locations to help alleviate crop damage. Funding for this program will come primarily from the interest earned by a Lure Crop Endowment established from private contributions. The IDFG, in cooperation with other agencies, nongovernmental organizations, and Teton County, will work to protect remaining crane habitat, including roosting sites, loafing sites, and feeding areas along the Teton River to alleviate depredations and provide adequate staging habitat.

Lead Agencies: IDFG and FWS.

Participating: Other state and federal agencies, nongovernmental organizations, and private parties.

Priority: high.

Schedule: Ongoing

Mexico (Chihuahua). Specific habitat needs or surveys to ascertain those needs should be identified through consultation with SEMARNAT. Four lagunas in the Ascension Valley, Chihuahua are of particular importance to wintering RMP cranes and deserves special protection. Wetland drainage in the Santa Maria River Valley near Galeana, Chihuahua has virtually eliminated this area's importance as crane habitat. A recent effort was developed by the University of Chihuahua, with funding and support from other partners, to improve and operate a conservation management plan for Laguna de Babicora (A. Lafón per. comm., Drewien et al. 1996). Laguna de Babicora importance is primarily

for the lesser subspecies, but is used by limited numbers of RMP greaters. The subcommittees support this effort.

Lead Agencies: SEMARNAT, University of Chihuahua, FWS and PROFAUNA A.C..

Participating: RMP Crane Subcommittees, nongovernmental organizations, and private parties.

Priority: high.

Schedule: Ongoing.

Montana. Work through the Intermountain and Prairie Pothole Joint Ventures, utilizing a variety of wetland protection and enhancement strategies to conserve and improve wetland complexes used by breeding cranes on both private and public land. Work with private landowners in the areas of the major premigration staging sites and implement strategies designed to reduce depredation problems when they occur. A majority of the crane habitat occurs on private land and trends in federal farm programs, intensity of agricultural activities, and urban development will in large measure determine long-term trends in crane numbers.

Lead Agencies: MFWP, FWS Partners for Fish and Wildlife

Priority: high.

Schedule: Ongoing

New Mexico. Protect crane habitat, including river sandbars, Bosque (riparian wooded areas), and well-drained irrigable cropland to perpetuate objective levels of use by cranes in the MRGV. Create additional roosting habitat on NMDGF WMAs and Bosque NWR.

Encourage water management agencies to allow occasional high flows in the Rio Grande to benefit roost sites and keep water in the riverbed instead of the San Acacia Diversion Canal. Siltation of Elephant Butte Reservoir in the future could preclude crop production on the Bosque NWR because of

a rising water table, and could reduce the area's importance to cranes. The latest drought and resulting low lake levels has reduced this potential problem.

Obtain maximum production of wildlife crops on NMDGF and federal agricultural lands. Investigate possible acquisition of additional agricultural lands and irrigation water rights to offset loss of habitat to urban expansion. Encourage programs that promote grain production on private lands. Continue to coordinate activities between federal and NMDGF properties in the MRGV.

Identify and quantify the amount and distribution of current suitable and potential sandhill crane habitat to protect and/or manage in order to support desired crane population goals.

Control non-native invasive vegetation to promote native wetland conditions suitable as crane habitat.

Lead agencies: FWS, NMDFG, NRCS, BoR, Middle Rio Grande Conservancy District and N.M. State Forestry.

Participating: Other state and federal agencies and citizen organizations will be invited to participate.

Priority: high.

Schedule: Ongoing

Utah. Through acquisitions, easements, or lease agreements, protect 500 acres of farmland along the Bear River in Rich County and an additional 500 acres in Cache Valley to provide staging and breeding habitat. Lead agencies will be responsible for identifying habitat presently important to cranes and locating willing sellers or those willing to enter into cooperative agreements to protect these lands.

Continue to provide cereal and food crops on state managed-wildlife areas in Cache, Box Elder, Weber and Salt Lake counties. Continue to coordinate with Wildlife Services and the agricultural

community to provide technical advice on dealing with depredation. Develop and improve the farming programs at Ouray NWR to provide habitat during spring and fall for migrating cranes and waterfowl. Protect key crane habitat in the Jensen area through land acquisition, cooperative agreements, and participation in local government planning activities.

Lead agencies: FWS, Wildlife Services and UDWR.

Participating: Other federal and state agencies and citizen organizations will be invited to participate.

Priority: high.

Schedule: Ongoing.-

Wyoming. Protect sufficient habitat on primary fall premigration staging areas, including roosting sites, loafing sites, and feeding areas to support 4,000 - 6,000 cranes. These areas include the Salt River, lower Bear River, Farson-Eden Agriculture Project; the Wind River Irrigation Project; the Shoshoni River in Park County, and the Greybull River in Big Horn County. This should be accomplished in cooperation with private landowners, county planning groups, etc.

Provide sufficient grain croplands annually on the WGFD's Ocean Lake Wildlife Habitat Management Unit to support 600-1,000 sandhill cranes in the fall premigration staging period (August 10-October 25).

In cooperation with private landowners, FWS and WGFD, develop a long-term strategy to protect and enhance wetlands on the lower Bear River and Salt River for crane production and staging, and continue to support development of Cokeville Meadows NWR on the lower Bear River.

Utilize recreational hunting to regulate crane numbers and to minimize fall depredation to private croplands.

Lead agencies: FWS and WGFD.

Participating: Other federal and state agencies and citizen organizations will be invited to participate.

Priority: high.

Schedule: Ongoing.

2. Inventory of Habitat. Encourage to identify, classify, rank, and catalog habitats used by the RMP throughout its range to facilitate the protection of important habitat through acquisition, easement, cooperative agreements, special-use permits, and mitigation exchanges and developments. Classification would include but not be limited to amount and quality of habitat, spatial distribution, relative importance, potential for enhancement, land use and ownership, and threats to continued suitability of habitat. Rationale should be developed to prioritize protection of specific parcels of lands. All interested agencies, groups, and individuals should be encouraged to participate in this effort. Currently, there is such an investigation being conducted by T. Perkins and L. H. Fredrickson evaluating RMP crane habitat conditions along the Intermountain West. This study's goal is to understand changes in the availability, distribution, and nutrient characteristics of wetland and agricultural habitats important to RMP cranes for foraging, loafing and roosting throughout their annual cycle. The focus of this study will be on habitats in Idaho, Colorado, New Mexico and Mexico's Northern Highlands.

Lead agencies: FWS, SEMARNAT and state wildlife agencies.

Priority: high.

Schedule: Ongoing.

Uses of Cranes

1. Interpretive Program. Observing greater sandhill cranes is an important recreation throughout the birds' ranges. "Crane festivals" are attended by thousands of people annually at several staging locations including Socorro, NM in November, Willcox, AZ in January and Monte Vista, CO in

March. Promoting increased awareness and understanding of cranes is essential to the well being of the RMP and is therefore an integral part of this plan. Individual state wildlife agencies and the FWS will cooperatively develop and distribute information on the life history of RMP cranes and important management issues.

Lead agencies/groups: State wildlife management agencies and FWS.

Priority: moderate.

Schedule: Ongoing.

2. Hunting (harvest allocation and guidelines). In addition to the other uses of RMP cranes, it is biologically feasible to allow recreational hunting. The population is hunted annually in Arizona, Idaho, Mexico, Montana, New Mexico, Utah, and Wyoming (Table 4 and Appendix A). In Mexico, subsistence and recreational hunters pursue cranes. Recreational hunting is allowed only in registered UMAS (Unidad de Manejo para la Conservacion de Vida Silvestre – Management Unit for the Conservation of Wildlife).

Fall pre-migration staging areas, fall migration stopover areas, and selected wintering areas provide the best opportunities to harvest cranes and are locations where hunting can help alleviate crop damage problems. Hunting can direct harvest at specific segments of the local population that damage crops. Any state within the range of the RMP may choose to hunt cranes provided the hunts meet the conditions of this plan.

Recreational hunting of the RMP will be permitted when the fall population index exceeds 15,000. A conservative harvest allocation is prescribed when the fall population index is between 15,000 and 18,000 cranes to allow for population growth. If the fall population index is less than 15,000, hunting may be permitted to meet specific management objectives, including alleviation of localized crop damage and distribution concerns. The fall population index will be the average of the 3 most recent,

reliable surveys (Objective A) conducted on September pre-migration staging areas in Colorado, Idaho, Montana, Utah, and Wyoming.

Because portions of the RMP range overlap with other subspecies, strategies intended to harvest RMP cranes will result in the harvest of other subspecies at some locations. States hunting mixed populations will estimate the racial composition of the hunted population based on measurements of wing chord, tarsus, and posterior nares to bill tip of harvested cranes (Schmitt and Hale 1997) or other appropriate methods. Other subspecies harvested will not be included in the RMP allocation described in this plan. States may monitor the racial composition of the harvest once every 3 years in operational hunt areas, and use that data for estimating the racial composition in the subsequent 2 years. States that consider all harvested cranes in a hunt area as RMP greaters are not required to monitor racial composition.

The allowable annual harvest of RMP cranes will be calculated and allocated among hunting states based on the following procedure:

a. The total allowable harvest for the entire population will be based on the formula:

$$H = C \times P \times R \times L \times f$$

where:

H = total allowable harvest;

C = the average of the 3 most recent, reliable fall population indices. The fall population index will be the fall pre-migration staging survey (Colorado, Idaho, Montana, Utah, and Wyoming);

P = the average proportion of fledged chicks in the fall population in the SLV during the most recent 3 years for which data are available (see Appendix A);

R = estimated recruitment of fledged chicks to breeding age (current estimate is 0.5);

L = retrieval rate of 0.80 (allowance for an estimated 20% crippling loss based on hunter interviews); and

f = $(C/16{,}000)^3$ (a variable factor used to adjust the total harvest to achieve a desired effect on the entire population -- see Appendix D)

This formula will be reviewed every 2 years by the Subcommittees and revised as needed. It may require periodic adjustments based on practical application and accumulated data. The Subcommittees may seek alternate methods to determine the base allocation.

b. The allowable harvest will be allocated among states based on approximate, relative abundance by seasonal range as follows:

1) Summer range states - 55%, to be divided as follows:

	% of Summer Allocation	% of Base Allocation
Alberta	(potential)	0%
Colorado	5%	2.7%
Idaho	40%	22.0%
Montana	26%	14.3%
Utah	12%	6.6%
Wyoming	17%	9.4%

Any allocation not used by a state will be made available to summer range states.

2) Winter range and migration stopover states - 45%, to be divided as follows:

	% of Winter Allocation	% of Base Allocation
Arizona	13%	5.8%
Colorado (SLV)	13%	5.8%
New Mexico	62%	28%
Mexico	6%	2.7%
Utah	6%	2.7%

Any allocation not used by a state will be made available to winter range and migration stopover states.

3) This allocation will be reviewed every 5 years by the Subcommittee and revised as needed.

The Subcommittees evaluated the crane harvest allocation in March 2006, using 5 consecutive years (2001-2005) of fall pre-migration data.

Wyoming has documented that staging cranes shift their distribution in response to hunting (Lockman 1988). This behavior is apparently learned over a period of 3-4 years once hunting begins in an area. Cranes displace outside the hunt area and move to other staging locations. By the time pre-migration surveys are done in mid- to late September, much of this redistribution has already taken place. Therefore, surveys conducted at that time may not accurately reflect the distribution of resident birds in summer range states. Thus, additional surveys (possibly pre-hunt) may be required to adjust harvest allocations. The Subcommittees will investigate other methods to derive an unbiased assessment of crane distribution for harvest allocation.

c. Prior to the Subcommittee's approval of a state's first hunt for an area, the requesting state must provide, where applicable, at least 3 consecutive years of data (usually, the most recent 3 years) on RMP numbers in the proposed hunt area, The state must demonstrate a commitment to continued monitoring of pre-migration, staging and winter areas.

d. The following information for hunting seasons must be collected and reported to the Subcommittees at the March meeting following each hunt:

1) Number of cranes harvested;
2) Racial composition of the harvest (Schmitt and Hale 1997) unless all harvest is considered RMP;
3) Age composition of the harvest;
4) Crippling-loss rates (number of cranes lost/[number of cranes lost + retrieved]). Crippling loss will be defined as cranes knocked down, but not retrieved.
5) Number of hunters participating;
6) Number of hunter days;
7) Hunter success rate; and
8) An assessment of the effectiveness of the hunting season.

e. Hunting will be permitted in the states of Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming. State hunting seasons must:

1) Be between September 1 and January 31;
2) Have a daily bag limit not to exceed 3 cranes;
3) Be permitted only on a limited quota (permit) basis;
4) Be consistent with the goals, objectives, and harvest allocations identified in this plan; and
5) Be approved by both the Central and Pacific Flyway councils.

f. A state requesting a new hunting seasons, major changes in an existing season, or changes that would affect the harvest allocations identified in this plan, must notify the Subcommittees, Pacific Flyway Study Committee, and Central Flyway Webless Migratory Game Bird Technical Committee (CFWMGBTC) in writing of its intentions at least 30 days prior to the Subcommittee's March meetings.

h. At the annual March meeting of the RMP Crane Subcommittees, the total allowable harvest and the allocation by state for the coming hunt season will be determined using the formula and criteria presented above. The allocation will become a permanent record (Appendix A and meeting minutes).

Lead agencies: FWS and states.

Priority: high.

Schedule: Develop proposals and initiate seasons as appropriate

Table 4. Annual RMP Greater Sandhill Crane Base Allocation and RMP Harvest.

Year	Base Allot.*	AZ	ID	MT	NM	UT	WY	TOTAL
1981		20						20
1982		9					143	152
1983		35					154	189
1984		33					101	134
1985		40					138	178
1986		23					195	218
1987		60					190	250
1988		40			310		128	478
1989	800	51			483	54	125	713
1990	374	9			79	35	58	181
1991	800	44			47	48	101	240
1992	800	39		42	147		168	396
1993	780	61		45	297	28	115	546
1994	864	27		40	416	34	150	667
1995	547	33		41	270	27	77	448
1996	545	27	20	49	236	32	84	448
1997	632	22	136	62	114	30	82	446
1998	693	37	135	59	180	34	93	538
1999	974	21	190	71	198	54	124	658
2000	1141	37	193	91	257	69	163	810
2001	1175	26	278	87	288	77	142	898
2002	833	42	194	51	160	60	132	639
2003	668	34	146	50	169	57	72	528
2004	656	35	142	51	189	53	124	594
2005	906	50	189	49	236	62	116	702
2006	1321							

* Includes Mexico's portion of the base allotment.

Crop Damage Control

The Subcommittees will consider problem situations and recommend options to the appropriate state agencies for reducing or eliminating crop damage. Various individuals, nongovernmental organizations, and other agencies will be encouraged to suggest solutions. Options include:

1. Hunting Seasons. Hunting seasons should be conducted in a manner that will either reduce the number of cranes to management plan objective levels or harass problem cranes from areas of damage to areas where either damage is tolerated, food is specifically provided for cranes, or both. Hunting to control specific damage problems will be allowed even when the population index is below 15,000 birds; these hunts must be designed to relieve a specific problem and where necessary, coordinated among the states for effective dispersal. Limited quota permits will be required and issued for use only in those specific locations where hunting is desired. All other criteria previously detailed for "hunting" must be followed. Closely-regulated, hunting has been used effectively in Wyoming since 1982 to manage cranes and Canada geese causing crop damage (Lockman et al. 1987). Regulated hunting has greatly reduced depredation complaints in New Mexico. The timing of season dates and assistance from Wildlife Services personnel placing hunters in areas experiencing crane depredations reinforces hazing programs and encourages crane movements onto state and federal refuges (Mitchusson 2003).

2. Supplemental Feed Crop and Direct Feeding Programs. Use of supplemental feed crops (strategically located crops planted specifically as crane food) or directly feeding grain to cranes, either in conjunction with or without hunting seasons, can effectively reduce crop damage. State and federal refuges can have a major role towards contributing increasing grain crops for crane use. These programs are effective when used in conjunction with hunting seasons, hazing, harassment, etc. or when other methods are infeasible.

3. Hazing and Harassment. Aircraft, explosive devices, or other deterrents may be used to move birds from croplands and adjacent roost sites.

4. Habitat Manipulation. In certain situations, it may be possible to encourage landowners to change farming practices to reduce the attractiveness of crops to cranes, eliminate roosts, or make crop plantings available for cranes near roosts. Application of proven methods should be used in order to predict and alleviate problems.

5. Extension Services. State and federal agencies, in cooperation with key stakeholders, may find it beneficial to provide field demonstrations of methods available to reduce crop damage by cranes.

6. Lethal Control. Hunting is a management alternative that is available to every state in the range of the RMP. The available harvest allocation is very limited, even during years of high recruitment, and public demand exceeds the availability of permits in all states that hunt cranes. Therefore, the Councils believe the harvest allocation should be used to meet the public's demand for sport hunting. Permits for hunts must be distributed to the public through a random process. Non-lethal management alternatives are outlined in options 2-5 to help alleviate crop damage problems in states that for political or social reasons choose not to implement hunts. Other lethal control must be consistent with the following: 1) Depredation control programs are subject to RMP sandhill crane management plan objective levels and should include consultations with all affected agencies and stakeholders within the RMP sandhill crane range; 2) Public hunting is the preferred method of population control for reducing agricultural depredation; 3) When public hunting is not possible and non-lethal control options have been exhausted, other lethal control methods should be implemented. Other lethal population reduction methods should be determined on a case-by-case basis.

Population Surveys

1. Annual Recruitment Survey. Young:adult ratios are obtained each October in the SLV, Colorado, by ground surveys. Since 1972, the survey has been done by R. Drewien, who is reimbursed from Pacific Flyway funds. Survey methods are described in Drewien et al. (1995). Additional personnel should be trained to conduct this survey.

   Lead agencies: FWS.

   Priority: high.

   Schedule: Annually.

2. Fall Population Survey. Population surveys are to be done each September when peak numbers of cranes are present on pre-migration staging areas in summer range states. These fall surveys replaced the spring survey in the SLV to measure population trends. The average of the 3 most recent, reliable surveys, described in Objective A, will be used in the harvest allocation formula.

   The September survey will be done from both the air and ground, as appropriate, during a 5-day window between 5-25 September each year, as identified by the FWS consultant count coordinator. An effort will be made to complete the count during 3 consecutive days within the 5-day window. If conditions prevent a state cooperator from meeting this schedule, counts must be completed as soon thereafter as conditions permit. The 5-day window will be timed to obtain the maximum count possible and generally prior to any substantial crane movement from staging areas. The FWS will assign its Flyway Biologist and Division of Migratory Bird Management (DMBM) aircraft to conduct the survey over assigned staging areas. Cooperating states will conduct counts on the remaining staging areas during the same period. A qualified consultant will be retained by the DMBM, to assist the FWS biologist in conducting aerial surveys. The consultant's costs will be reimbursed from the FWS Administrative Fund.

The FWS crew will schedule the 5-day survey window by mid-August based on an evaluation of habitat conditions, breeding season chronology, climatic patterns, weather forecasts, and crane movements. The FWS's Flyway biologist will contact each state and specify the count period at the earliest possible date, but not later than 2 weeks prior to the survey. An effort will be made to select a 3-day target period within the 5-day window. States are encouraged to make an effort to count RMP cranes outside the identified staging areas to locate additional concentrations and to address distribution shifts, provided such surveys are also conducted within the 5-day count window.

The Flyway biologist will maintain a current list of state contacts for this crane survey. Unless indicated otherwise, these contacts shall be the respective Subcommittee members representing the cooperating states. State cooperators will forward results of any surveys they conduct to the FWS Flyway biologist by 30 September each year.

Lead agencies: FWS and all states with breeding cranes.

Priority: high.

Schedule: Annually. FWS will report to the Subcommittees by 1 December each year.

Staging areas to be surveyed annually are listed below. Areas designated for coverage by the FWS aerial survey crew are underlined. Surveys in the remaining areas are the responsibilities of the states, FWS refuge personnel and other cooperators.

3. Funding. The costs of the FWS portion of the fall pre-migration survey are shared among the FWS and states with RMP cranes. The FWS pays for an airplane and one pilot/observer. A consultant is retained by the FWS to assist with aerial surveys, ground counts, and data compilation. The consultant's costs are paid from the FWS Administrative Account.

States with assigned coverage areas during the fall pre-migration staging counts pay for their own personnel and equipment costs to complete the surveys. A consultant is retained by the Pacific Flyway Council to conduct the October recruitment survey and data compilation. The consultant's costs are negotiated periodically and paid from the Pacific Flyway Administrative Account.

Colorado

Lower Elk River
Yampa Valley *(includes Hayden)*
Delta Co. - other
(Fruitgrower's Res.\Hart's Basin, Delta Co.)
San Luis Valley

Idaho

Amer. Falls Res.
Ashton-St. Anthony
Bear Lake Valley
Blackfoot Res.
Camas NWR
Camas Prairie
Carey Lake area
Chesterfield Res.
Grays Lake NWR
Henrys Lake Flats
Island Park Res.
Kilgore
Market Lake WMA
Marsh Valley
Mud Lake WMA
Oxford Slough-Swan Lake
Silver Creek
Teton Basin

Montana

Blackfoot/Ovando Valley-
Helmville
Cascade-Ulm
Centennial Valley
Deadman's Basin
Dillon-Twin Bridges
Gallatin Valley- includes Belgrade
Helena Valley
Melville
Musselshell River - inc.
Harlowtown
Otter Creek
Teton River-Eureka Res.
Toston-Townsend
Upper Madison Valley – inc. Ennis
Warm Springs
White Sulphur Springs
Whitehall

Utah

Cache Co.
Box Elder Co.
Davis Co.
Weber Co.
Bear River Valley (Rich Co.)
Round Valley (Rich Co.)
Summit Co.
Jensen (Uintah Co.)
Pelican Lake area (Uintah Co.)
Leland Bench (Uintah Co.)
Morgan Co.

Wyoming

Baggs

Bear River Valley
Greybull River/Otto
Shoshone River/Ralston
Big Piney
Bridger Valley
Farson
Hams Fork
Pinedale-Cora

Seedskadee NWR
Saratoga (Upper N. Platte Valley)
Jackson Hole
Star Valley (Salt River)
Hidden Valley (Boysen-Riverton)
Ocean Lake
Riverview Valley

Research

As appropriate, the Subcommittees will develop research proposals, recommend needed research, and review research proposals. In these actions, the Subcommittees will give priority to research conducted on the RMP or regional flocks/subpopulations, rather than local projects. If sufficient resources are available, the flyway councils, on recommendation of the Subcommittees, may help fund such research.

1. Refinement of Adult and Juvenile Survival Estimates. Recruitment of fledged colts to breeding age is an important component of the formula used to calculate allowable harvest. The current figure, 0.5, is an approximation based on limited data. The Council encourages development of a more accurate recruitment estimate and better documentation based on an analysis of historic banding and color marking data.

   Lead agency/group: RMP Crane Subcommittees.

   Participating: FWS, academic institutions, and consultants with applicable expertise.

   Priority: High.

   Schedule: Continuing.

2. Spring Food Supplies and Wetland Availability in the SLV. In recent years, changing agricultural practices in the SLV have diminished food availability and increased competition among the RMP, other crane subspecies, and waterfowl during the spring migration period. There is concern limited food supplies may impact body condition and reproductive potential of RMP cranes returning to their summer range. Research indicates this currently is not a problem (Gammonley and Laubhan, in review). The Councils encourages further investigation of this problem, including the extent to which limited food resources may be impacting maintenance and growth of the population. Another component of this research may include investigating the feasibility of augmenting food supplies by developing natural forage sites through wetland creation and enhancement.

Lead agency/group: RMP Crane Subcommittees.

Participating: FWS, Monte Vista NWR, CDOW, academic institutions, and consultants with applicable expertise.

Priority: High.

Schedule: Continuing.

3. Techniques for Controlling Crop Damage. The Subcommittees encourages development and testing of techniques that will reduce or eliminate crop damage by cranes. If sufficient resources are available, the Subcommittees may help fund such research.

Lead agencies: Wildlife Services.

Participating: States having depredation problems.

Priority: high.

Schedule: Continuing.

VII. ANNUAL REVIEW OF PLAN AND REPORTING

The Subcommittees will meet annually or as needed to review progress toward achieving the goals and objectives of this plan and to recommend revisions to the Pacific Flyway Study Committee and the CFWMGBTC. The CFWMGBTC and the Pacific Flyway Study Committee will submit all proposed revisions to this management plan to both the Central and Pacific Flyway Councils for approval. As appropriate, the Subcommittees will also report on accomplishments and shortcomings of its cooperative management efforts to both councils, those state and federal agencies having management responsibilities, and those agencies and organizations either interested or cooperating in the management of cranes.

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IX. ACRONYMS USED

AGFD	Arizona Game and Fish Department
BoR	Bureau of Reclamation
Bosque	Bosque del Apache National Wildlife Refuge, New Mexico
CDOW	Colorado Division of Wildlife
CFWMGBTC	Central Flyway Webless Migratory Game Bird Technical Committee
FWS	U.S. Fish and Wildlife Service, Department of the Interior
IDFG	Idaho Department of Fish and Game
MCP	Mid-continent population
MFWP	Montana Fish, Wildlife, and Parks
MRGV	Middle Rio Grande Valley, New Mexico
MRGV Plan	A Plan for the Management for Waterfowl, Sandhill Cranes and other Migratory Birds
NMDGF	New Mexico Department of Game and Fish
NWR	National Wildlife Refuge
NRCS	Natural Resources Conservation Service
RMP	Rocky Mountain Population of greater sandhill cranes
SEMARNAT	Secretaria de Medio Ambiente y Recursos Naturales
SLV	San Luis Valley, Colorado
TNC	The Nature Conservancy
UDWR	Utah Division of Wildlife Resources
Wildlife Services	U.S. Dept. of Agricultural-Animal Plant Health Inspection Services
WGFD	Wyoming Game and Fish Department
WMA	Waterfowl Management Area
USDA	U.S. Dept. of Agriculture

APPENDIX A.

RMP SANDHILL CRANE POPULATION ESTIMATES, RECRUITMENT, AND HARVEST SUMMARIES, 1981-2005. *

	SURVEY					ARIZONA	
Year	March Total San Luis Valley	September Total Pre-migration	% Juvenile Fall, San Luis Valley	Recruitment Rate 5-Year Mean	Total Allowable Harvest	Harvest Allocation	Actual Harvest
1981	NC		7.6				20
1982	NC		8.8				9
1983	NC		11.6				35
1984	13,125		8.1				33
1985	20,429		9.0	9.0			40
1986	15,382		5.8	8.6			23
1987	15,121	17,481	5.4	8.0			60
1988	19,135		3.4	6.3		166	40
1989	17,303		4.1	5.5	800	96	51
1990	20,868		6.5	5.0	374	39	9
1991	16,519		5.3	4.9	800	85	44
1992	20,014 (ground count)	19,297	5.2	4.86	800	82	39
1993	17,597 (poor conditions)		6.1	5.4	780	76	61
1994	15,063		3.9	5.36	864	84	27
1995	11,939-18,557	16,028	6.4	5.34	547	65	33
1996	10,341-18,458	16,938	9.4	6.20	545	65	27
	October Total San Luis Valley	September Total Pre-migration		3-Year Mean			
1997	13,620-24,056	18,036	9.7	8.5	632	56	22
1998		18,202	11.2	10.1	693	50	37
1999		19,501	8.4	9.9	974	64	21
2000		19,990	6.7	8.8	1,141	75	37
2001		16,559	5.8	7.0	1,175	77	26
2002		18,803	5.2	5.9	833	55	42
2003		19,523	7.1	6.0	668	44	34
2004		18,510	9.4	7.2	656	43	35
2005		20,865	10.8	9.1	906	59	50

APPENDIX A. (continued)

* Appendix A includes the historic data used to calculate allowable harvest, as it was recorded in this plan. Appendix B is a rework of the SLV spring survey data by Benning et al. (1997). The discrepancies in spring survey data resulted from their application of correction methods.

✐ Ranges are minimum and maximum estimates of RMP greaters based on the numbers of cranes in the overlap range for RMP greaters and mid-size cranes.

	WYOMING		UTAH		NEW MEXICO		
Year	Harvest Allocation	Actual Harvest	Harvest Allocation	Actual Harvest	Harvest Allocation	Middle Rio Grande	Southwest
1981							
1982		143					
1983		154					
1984		101					
1985		138					
1986		195					
1987		190					
1988	212	128			793	190	120
1989	128	125	68	54	454	483	0
1990	70	58	49	35	184	79	0
1991	150	101	70	48	450	34	13
1992	154	168	80	0	388	126	21
1993	120	115	70	28	415	277	20
1994	152	150	73	34	401	406	10
1995	100	77	46	27	268	≅ 198	12
1996	100	84	50	32	252	236	4

						*MRGV	*SW	*EV
1997	100	82	45	30	198	111	3	N/A
1998	110	93	35	34	242	173	7	N/A
1999	140	124	69	54	305	189	9	N/A
2000	170	163	80	69	358	248	6	3
2001	170	142	83	77	386	290	9	0
2002	132	132	66	60	261	154	13	0
2003	106	72	53	57	210	169	3	0
2004	104	124	52	53	206	172	15	2
2005	144	116	74	62	284	225	10	1

* Middle Rio Grande Valley (MRGV), Southwest New Mexico (SW), Estancia Valley (EV)

APPENDIX A. (continued)

	MONTANA		COLORADO		IDAHO		
Year	Harvest Allocation	Actual Harvest	Harvest Allocation	Actual Harvest	Harvest Allocation	Actual Harvest	TOTAL HARVEST (excluding Mexico)
1981							20
1982							152
1983							189
1984							134
1985							178
1986							218
1987							250
1988							478
1989							760
1990							181
1991							240
1992	59	42					382
1993		45					704
1994	69	40					667
1995	44	41	0	0	0	0	388
1996	54	49	0	0	20	20	417
1997	66	62	0	0	148	136	446
1998	65	59	0	0	170	135	538
1999	78	71	40	40	248	190	698
2000	110	91	40	20	273	193	830
2001	110	87	40	0	273	278	898
2002	81	51	0	0	213	194	643
2003	64	50	0	0	171	146	528
2004	63	51	0	0	168	142	594
2005	88	49	0	0	231	189	702

APPENDIX B

SUMMARY OF EXPERIMENTAL SPRING SURVEYS CONDUCTED FROM 1984-96 IN THE SAN LUIS VALLEY, COLORADO *

Year/Date	Raw Aerial Estimate	Adjusted for Estimation Bias (Estimate-SE)	Crew Estimation Error	Proportion of Lessers	Adjusted to Remove Lessers [a] (Estimate-SE)	RMP Cranes Outside Survey Area	Aerial Survey Conditions	Population Index
1984/ 14-15	10,962	14,488 ± 918	-24.3 % n=42 [b]	6.4 % [c]	13,562 ± 859	550 (NM-500) (CO-50)	Poor	14,112
1985/ 13-14	18,393	21,773 ± 1,403	-15.5 % n=75	6.4 % [c]	20,382 ± 1,314	0	Good	20,382
1986/ 8-9	14,031	[d]	[d] n= 8	6.4 % [c]	13,135 ± 17	20 (WY)	Poor	13,155
1987/ 14	13,561	15,661 ± 778	-13.4 % n=21	6.4 % n=5,056	14,660 ± 729	0	Poor	14,660
1988/ 3-4	17,510	[d]	[d] n= 2	6.5 % n=7,617	16,381 ± 21	22 (UT)	Poor	16,403
1989/ 11	17,302	18,389 ± 963	- 5.9 % n=50	7.5 % n=6,795	17,004 ± 891	0	Good	17,004
1990/ 14	20,851	24,593 ± 1,341	-15.2 % n=83	13.7 % n=8,298	21,221 ± 1,157	275 (CO)	Good	21,496
1991 9	19,990	18,405 ± 685	+ 8.6 % n=69	12.8 % n=9,406	16,045 ± 598	175 (CO)	Good	16,220
1992/ 14	23,516 [e]	[d]	[d] n= 0	15.0 % n=5,998	19,999 ± 28	9 (CO)	Poor [e]	20,008
1993/ 11	17,576	[d]	[d] n=0	6.3 % n=5,698	16,478 ± 18	1,260 (CO-70) (NM-1,190)	Poor	17,738
1994/ 6	17,229	16,035 ± 884	+ 7.4 % n=33	6.1 % n=7,353	15,063 ± 831	203 (NM-137) (CO-66)	Fair	15,266
1995/ 7	25,276	23,390 ± 1,215	+ 8.1 % n=70	12.6 % n=7,448	20,229 ± 1,052	0	Good	20,229
1996/ 11	23,019	26,379 ± 1,780	-14.5 % n=47	13.8 % n=9,561	22,737 ± 1,535	1,010 (CO)	Good	23,747
x (13 yr) 10	18,401	19,902 ± 1,107	- 7.5 % n=38	10.1% [f] n=7,323	17,454 ± 696	271	All Years	17,725
x (7 yr) [g] 11	21,192	22,155 ± 1,231	- 6.1 % n=66	11.7 % n=7918,	19,660 ± 939	243	Good Years	19,869

[a] Calculated after removing estimation bias.

[b] Number of flocks in photographic sample.

[c] Adjusted with 1987 value as no surveys to determine proportion of lessers were conducted in 1984-86

[d] No adjustment made (sample too small).

[e] Ground counts on feeding sites (n=13).

[f] Years 1984 - 86 not included.

[g] Includes 7 years considered comparable (1985, 1989, 1990, 1991, 1992, 1995, and 1996).

* Source: Benning, D.S., R.C. Drewien, D.H. Johnson, W.M. Brown, and E.L. Boeker. 1997. Spring population estimates of Rocky Mountain greater sandhill cranes in Colorado. Proc. North Am. Crane Workshop. 7:165-172.

APPENDIX C.

WHOOPING CRANE EXPERIMENTS IN THE ROCKY MOUNTAIN REGION

In 1975, RMP sandhill cranes known to winter in the MRGV were used experimentally as foster-parents in an attempt to establish a second free flying, migratory population of whooping cranes (Drewien and Bizeau 1978). From 1975-88, 288 eggs were transferred to sandhill crane nests, 210 hatched and 87 fledged. The RMP whooping crane population peaked at 35 in 1984-85. Additional efforts to introduce captive female whooping cranes or chicks into male territories were unsuccessful. Failure to produce any chicks or mated pairs and high mortality resulted in discontinuing the program in 1994 (USFWS 1994).

In 1997, an experiment was conducted to evaluate the feasibility of imparting learned migration behavior to captive-reared whooping cranes by imprinting them on, and leading them with, an ultra-light aircraft and its pilot. This technique was later applied to reintroduction efforts within the central and eastern U.S. Antecedent to this research, a similar project was done in 1995-96 using surrogate sandhill cranes. Eleven sandhills were captive reared in 1995 at a location in southeast Idaho and led 800 miles to Bosque del Apache NWR in central New Mexico. Four survived and migrated north in spring. Three of the 4 returned to Bosque del Apache NWR in fall, 1996. The research was repeated using 8 sandhills in 1996 to refine the technique.

The whooping crane experiment began in summer, 1997, with 7 captive chicks (USFWS 1997). FWS published a final rule in the Federal Register on 21 July, 1997, designating the Rocky Mountain population of whooping cranes experimental/nonessential. The research proposal was to lead the cranes with an ultra-light aircraft following a migration route from southeast Idaho to Bosque del Apache in late summer/early fall, then to see if the birds migrate north independently in the spring. Four whooping cranes and 8 sandhills were part of the experiment following an ultralight aircraft to Bosque del Apache NWR. Two whooping cranes were lost to predators at Bosque NWR and two migrated north in the spring.

The last RMP whooping crane was seen the winter of 2001-02 in the Casa Colorada WMA, NM area. There are no plans to introduce additional whooping cranes into the Rocky Mountain region (U.S. Department of Interior, USFWS 2001).

The presence of whooping cranes required adjustments to the MRGV sandhill crane and light goose hunting programs and required hunters pass a bird identification course to participate. These education programs were successful, as no RMP whooping cranes were lost to hunting.

APPENDIX D.

RATIONALE FOR REVISING THE HARVEST ADJUSTMENT FACTOR "f" IN THE FORMULA TO CALCULATE ALLOWABLE ANNUAL HARVEST

The subcommittee discussed whether the population goals and thresholds formerly established for the spring survey would be appropriate for fall surveys. The committee recognized fall surveys would not provide complete counts because cranes are more dispersed and some ingress and egress can occur during the count. Therefore, fall surveys are considered a minimum estimate and more appropriately treated as an index. Accordingly, the committee felt revisions of the population goals, thresholds, and harvest criteria were warranted. The population objective range was changed from 18,000-22,000 to a fall survey index of 17,000-21,000. The minimum threshold for approving a hunting season was changed from 16,000 to 15,000. The harvest adjustment factor in the original allocation formula was initially revised as follows:

f = a variable factor used to adjust the total harvest to achieve a desired effect on the entire population (C) when:

Original Harvest Adjustments		Revised Harvest Adjustments	
C < 16,000	-- f = 0.0	C < 15,000	-- f = 0.0
C = 16,000-18,000	-- f = 1.5	C = 15,000-16,000	-- f = 1.0
C = 18,000-22,000	-- f = 2.0	C = 16,000-18,000	-- f = 1.5
C = 22,000-24,000	-- f = 2.4	C = 18,000-20,000	-- f = 2.0
C > 24,000	-- f = 3.0	C > 20,000	-- f = 2.4

This modification would have enabled some harvest at populations under 16,000, maintained the same allocation at 16,001 to 18,000, provided a 5 % more restrictive allocation between 18,001 and 20,000 (C = 19,000 instead of 20,000), and provided at least 20 % more liberal allocation above 20,000 (f = 2.4 instead of 2.0 and C = actual population instead of 20,000).

The original harvest adjustment factor and the above revision are step functions. The step function approach produces relatively stable regulations within discrete population ranges. However, drastic changes in allowable harvest happen at the break-off points. In addition, higher harvest rates are prescribed at the lower end of a population interval, and lower harvest rates at the upper end of the same interval. This is counterintuitive. On the other hand, a continuous, exponential harvest rate avoids the instability caused by sharp changes in harvest over very short population increments. The first approximation of a continuous "f" was developed by fitting a curve to the mid-points of the revised step intervals defined above. The continuous "f" function increased exponentially, reflecting the need for higher exploitation rates at higher population levels. The function was:

$$f = [C/15{,}000]^3$$

This function would have enabled the allowable harvest rate to gradually increase from 2.5 % at C=15,000 to 5.9 % at C=20,000. Based on 5-year average population parameters ending in 1996, this harvest function would have produced a population equilibrium around 17,400.

Recognizing the uncertainties involved with the new fall surveys and harvest formula, the subcommittee decided to define an "f" function which prescribed slightly more conservative harvest rates. A 2nd alternate formula (the one ultimately adopted) was developed using 16,000 instead of 15,000 in the denominator of the "f" function (Fig 1).

Table A. is a summary of potential harvest allocations comparing the original formula with the second (adopted) revision based on the following harvest factor:

$$f = [C/16{,}000]^3$$

Table A. Comparison of allowable harvests based on the original crane plan formula and the revised formula using a continuous, exponential "f" (harvest factor) function. [a]

C = Population Estimate or Index [b]	Fall Pop Estimate [c]	Original Crane Plan Formula			Revised Formula with $f = Fn(C) = (C/16{,}000)^3$ and C = Actual Count		
		f	H Allowable Harvest	Harvest Rate	f	H Allowable Harvest	Harvest Rate
15,000	(15,991)	0.00	000	0.00 %	0.82	307	2.01 %
16,000	(17,058)	1.50	632	3.71 %	1.00	397	2.42 %
17,000	(18,124)	1.50	632	3.49 %	1.20	506	2.89 %
18,000	(19,190)	2.00	992	5.17 %	1.42	636	3.41 %
19,000	(20,256)	2.00	992	4.90 %	1.67	789	3.99 %
20,000	(21,322)	2.00	992	4.65 %	1.95	969	4.62 %
21,000	(22,388)	2.00	992	4.43 %	2.26	1,178	5.31 %
22,000	(23,454)	2.40	1,309	5.58 %	2.60	1,419	6.06 %
23,000	(24,520)	2.40	1,369	5.58 %	2.97	1,694	6.86 %
24,000	(25,586)	3.00	1,786	6.98 %	3.38	2,009	7.72 %
25,000	(26,652)	3.00	1,860	6.98 %	3.81	2,365	8.64 %
26,000	(27,719)	3.00	1,934	6.98 %	4.29	2,767	9.62 %

[a] All calculations assume the 1996 5-year recruitment average @ 0.0620.
[b] Spring or fall count used in formula.
[c] Fall recruitment added to the spring count only.

APPENDIX E.

SUMMARY OF MAJOR JULY 2006 REVISIONS

Revision	Page
Update Central Flyway technical committee name…….	ii
References to the Gulf Coast subpopulation were changed to the Texas Coastal subpopulation to match literature citations…..……..	1
Include Alberta as confirmed RMP greater sandhill crane breeding range…….	1
Include RMP greater sandhill crane natural history…….……..	2-10
Remove section pertaining to the whooping crane experiment and included as Appendix C..	2
Update distribution map……..	11
Terminate the San Luis Valley fall population survey and direct efforts to the fall premigration survey to estimate the population and determine annual harvest allocation…….....	12
Define fall premigration survey reliability…….	12
Objectives B and C were combined into Objective B…….	13
Objective C included wildlife watching and other nonconsumptive uses in recreational uses..	13
Minimizing crane crop depredations was included as Objective D…….	14
Update population counts, locations and problems in the Distribution section……..	15-25
September premigration estimates in Table 1 were updated and includes current survey sites…….	20
Include map of September premigration survey sites as Figure 2……	23

Update peak MRGV winter counts in Table 2…… 26

Update Number and Population Counts section……..…… 27-29

Insert San Luis Valley annual recruitment estimates as Table 3……. 29

Update Habitat section…… 29-31

Update state sections under Management and Research…… 31-42

Update responsible Mexico agency…… 36

Update state sections under Problems……...…….. 43-47

Update state sections under Habitat……..…….. 47-54

Update Use of Cranes section…… 54-61

Changed requirement that states annually monitor racial composition in operational hunt areas to once every 3 years……..…… 56

Remove requirement that states monitor racial composition if 100% of the harvest is considered RMP greaters…….. 56

Eliminated the floating allocation with half going to summer states and half to winter/migration states…… 58

Revised formula for allocating unused state allocations……...…….. 57-58

Review state allocations every 5 years using the recent 5-year pre-migration surveys to determine summer state locations……..……. 58

Revised data that must be reported to the Subcommittees…….. 59

Standardized definition for crippling loss…… 59

Eliminate 30-day season and 9-crane season limit…….. 59

Delete reference to whooping crane contingency plan requirements…… 60

Update Crop Damage Control section……. 62-63

Deleted spring and October surveys in the San Luis Valley and midwinter surveys to monitor population…… 64

Updated fall pre-migration survey sites…… 66

Updated Research section……..…… 67-68

Deleted the whooping crane/ultra-light experiment under Research section and included under Appendix C……..…… 68

Removed Pacific Flyway subcommittee chairman rotation……. 68

Updated Appendix A. RMP sandhill crane population estimates, recruitment, and harvest summaries…… 77