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The Rocky Mountain Population (RMP) is comprised exclusively of greater sandhill cranes (Grus canadensis tabida) that breed in isolated river valleys, marshes, and meadows of the U.S. portions of the Central and Pacific Flyways (Drewien and Bizeau 1974). The largest nesting concentrations are located in western Montana and Wyoming, eastern Idaho, northern Utah, and northwestern Colorado. The RMP migrates through the San Luis Valley (SLV), Colorado, and winters primarily in the Rio Grande Valley, New Mexico (with smaller numbers that winter in the southwestern part of that state), in southeastern Arizona, and at about 14 locations in the Northern Highlands of Mexico (Fig. 1).

The information provided herein on population status and recruitment for the RMP of sandhill cranes was used to determine allowable annual harvest of this population of sandhill cranes during 1981-2005.

METHODS

Population Surveys

During the period of 1984-1996, the RMP was monitored at a spring stopover site in the SLV. Aerial counts in the SLV conducted during the spring migration suggested that the number of RMP cranes was relatively stable (Table 1). However, survey biologists found that these estimates contained increasing numbers of the Mid-Continent Population (MCP) (Canadian [G. rowani] and lesser [G. canadensis] subspecies) of sandhill cranes, which confounded estimates of RMP abundance. An adjustment (proportion of lesser to greater subspecies) obtained from ground counts was made to annually correct for the lesser subspecies (Benning et al. 1996). Unfortunately, a similar correction could not be made for the mid-sized Canadian subspecies, and in 1996 the survey was discontinued. In 1997, an attempt was made to count these cranes from aircraft during the fall (October) in the SLV, but MCP sandhill cranes also were present at that time. Biologists concluded that neither a spring nor a fall aerial count in the SLV would result in a reliable index to the abundance of RMP cranes. As an alternative, a cooperative 5-state September pre-migration staging-area aerial cruise survey, experimentally tested in 1987 and 1992, has been operationally conducted during the fall since 1995. It was designated by the Central and Pacific Flyway Councils as the official count for the RMP in 1997 (Table 2).

A recruitment survey that obtains age ratio (index to recruitment) and brood size is conducted annually during the fall in the SLV. This survey has been conducted since 1972. The methods for this survey are described in Drewien et al. (1995).
The RMP of greater sandhill cranes was not hunted in the U.S. from 1916 until 1981, when Arizona initiated the first modern-day season. Since 1982, hunting programs have been guided by a cooperative flyway management plan, including a harvest strategy, which has been periodically updated and endorsed by the Central and Pacific Flyway Councils. Following Arizona, other states that initiated seasons included Wyoming (1982), New Mexico (1988), Utah (1989), Montana (1992), and Idaho (1996) (Table 3). The hunting seasons are guided by the federal frameworks as set by the U.S. Fish and Wildlife Service. The framework sets the outside dates as between 1 September and 31 January, the season may not exceed 30 days, and the bag limit is 3 daily and 9 per season. There are additional provisions that pertain to specific states for managing the harvest such as monitoring racial composition of the harvest, as these sandhill cranes co-mingle with sandhill cranes from other populations during the fall and winter.

The RMP Cooperative Flyway Management Plan (Pacific and Central Flyway Councils 1997) established population objectives, a survey to monitor recruitment, and harvest levels that were designed to maintain a stable abundance between 17,000-21,000 birds. The plan contains a formula for estimating allowable annual harvests to achieve the population objectives. All sandhill crane hunters in the range of the RMP must obtain a permit issued by the cooperating State Wildlife Agency to hunt cranes, which provides the sampling frame for independent state harvest estimates and allows for assignment of harvest quotas by state. Permit allocation by state is variable depending on specific hunt objectives for specific areas within states. In many areas, harvest estimates are supplemented by mandatory check-stations.

### RESULTS

#### Population Surveys

Although operational in 1995 and 1996, the survey was still experimental, which resulted in variable timing and survey effort. What appears to be lower population estimates in 1995 and 1996 is likely more an artifact of inconsistent survey effort. The 2005 fall survey resulted in an index of 27,089 RMP and Mid-Continent sandhill cranes being counted.

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*Incomplete survey efforts in years prior might have resulted in lower estimates; the official count began in 1997.

The RMP Cooperative Flyway Management Plan (Pacific and Central Flyway Councils 1997) established population objectives, a survey to monitor recruitment, and harvest levels that were designed to maintain a stable abundance between 17,000-21,000 birds. The plan contains a formula for estimating allowable annual harvests to achieve the population objectives. All sandhill crane hunters in the range of the RMP must obtain a permit issued by the cooperating State Wildlife Agency to hunt cranes, which provides the sampling frame for independent state harvest estimates and allows for assignment of harvest quotas by state. Permit allocation by state is variable depending on specific hunt objectives for specific areas within states. In many areas, harvest estimates are supplemented by mandatory check-stations.

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<td>116</td>
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a RMP sandhill cranes (40) were also taken as part of a research project in the San Luis Valley, Colo.
b RMP sandhill cranes (20) were also taken as part of a research project in the San Luis Valley, Colo.
c Use of a harvest allocation formula did not begin until 1988 and in 1997 the formula was updated (Pacific and Central Flyway Councils 1997).

Figure 1. Approximate range of the Rocky Mountain Population of greater sandhill cranes (adapted from Drewien et al. 2000.)

population objectives (17,000–21,000) (Fig. 2). During 1997-2005 (i.e., the period in which surveys were operational and complete), we found no trend in the abundance of RMP cranes counted during the fall survey ($P = 0.28$). The September pre-migration survey for the RMP seems to be a good alternative to either a spring or fall survey in the SLV because no other cranes from other populations are known to co-mingle with them during that time.

The proportion of juveniles in fall has averaged 7.9% and ranged from 3.4 to 12% during 1972-2005 (Fig. 3). During 1986-1995, important breeding areas in the Intermountain West experienced extremely dry conditions and indices of recruitment (% juveniles) were low (generally 4-6%). A return to more favorable breeding conditions (i.e. improved quality and quantity of wetlands) during 1996-1999 resulted in higher index of recruitment rates (8-12%), but drier conditions returned and resulted in lower production during 2000-2002. There was some improvement in wetland conditions in 2003-2005 and the index of recruitment rates again increased to above-average levels.

Management and Harvest Regulations

Limited hunting seasons during 2005-2006 resulted in
an estimated harvest of 702 RMP sandhill cranes (Table 3), which was 18% higher than the previous year. The average annual harvest during 1981-2004 was 443 cranes. Based on current RMP population and recruitment indices management guidelines, contained in the Cooperative Flyway Management Plan, a maximum take of 1,321 birds during the 2006-2007 hunting seasons would be consistent with population objectives.

DISCUSSION AND RESEARCH IMPLICATIONS

The hunting of sandhill cranes in the U.S. was discontinued after the passage of the Migratory Bird Treaty Act of 1918. There was a lack of knowledge about the life history characteristics of sandhill cranes and no monitoring programs were available. A study of marked sandhill cranes allowed researchers to delineate RMP nesting areas which were isolated from other populations of sandhill cranes (Drewien 1973, Drewien and Bizeau 1974). After leaving breeding areas in the northern and central Rocky Mountain states (western Montana and Wyoming, eastern Idaho, northern Utah, and northwestern Colorado), this population was found to co-mingle with sandhill cranes from other populations as it migrated through the San Luis Valley, Colorado and wintered primarily in the Rio Grande Valley, New Mexico, with smaller numbers in southwestern New Mexico, southeastern Arizona and the northern Highlands of Mexico (Fig. 1). This information allowed sport-hunting seasons in the U.S. to resume with the first season in Arizona in 1981. The RMP hunting season has gradually expanded into Wyoming, New Mexico, Utah, Colorado and Idaho.

Sandhill cranes have the lowest recruitment (percent juveniles in the fall) of any migratory bird species hunted in North America (Tacha et al. 1994); however, a limited harvest that is consistent with population objectives is appropriate for this population. The annual level of harvest and distribution of that harvest is determined by use of a formula (based on recruitment and population size) contained in the Cooperative Flyway Management Plan and the recent harvest levels have been consistent with the objective of maintaining a fall population between 17,000–21,000. During 1997-2005, the average annual harvest in the U.S. for this population was 646 birds and the population was stable.

Survival rates estimated from leg-banded RMP cranes was attempted (Drewien et al. 2000). Although this information provided insight into distributions, fidelity, and mortality factors, the sample size was inadequate to estimate precise survival rates. A study has been initiated to estimate survival rates from approximately 10,000 resighting observations of RMP color-marked and neck-collared cranes, which may increase the precision of survival estimates from the leg-banded study (Drewien et al. 2002). Further, the researchers will attempt to develop a model of recruitment for these cranes. The overall goal is to develop a model of population dynamics, which would allow improvements in the harvest strategy for this population of sandhill cranes.

ACKNOWLEDGEMENTS

Information was compiled with the assistance of a large number of biologists; however, we specifically acknowledge the contributions of D. S. Benning, R. C. Drewien, P. P. Thorpe, and E. L. Boeker for conducting annual aerial population surveys and productivity surveys, and J. Bohne for compiling harvest information.

LITERATURE CITED

Benning, D. S. 1996. Spring Survey - Rocky Mountain Population


Lesser sandhill cranes being processed for hunters, Lagune de Babicora, Chihuahua, Mexico, January 1971. Photo by Roderick C. Drewien.