

1992

# POPULATION STATUS, HUNTING REGULATIONS, HUNTING ACTIVITY, AND HARVESTS OF MID-CONTINENT SANDHILL CRANES

David E. Sharp

*U.S. Fish and Wildlife Service*

William D. Vogel

*U.S. Fish and Wildlife Service*

Follow this and additional works at: <http://digitalcommons.unl.edu/nacwgproc>



Part of the [Behavior and Ethology Commons](#), [Biodiversity Commons](#), [Ornithology Commons](#), [Population Biology Commons](#), and the [Terrestrial and Aquatic Ecology Commons](#)

---

Sharp, David E. and Vogel, William D., "POPULATION STATUS, HUNTING REGULATIONS, HUNTING ACTIVITY, AND HARVESTS OF MID-CONTINENT SANDHILL CRANES" (1992). *North American Crane Workshop Proceedings*. 282.

<http://digitalcommons.unl.edu/nacwgproc/282>

This Article is brought to you for free and open access by the North American Crane Working Group at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in North American Crane Workshop Proceedings by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

# POPULATION STATUS, HUNTING REGULATIONS, HUNTING ACTIVITY, AND HARVESTS OF MID-CONTINENT SANDHILL CRANES

DAVID E. SHARP, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, 730 Simms, Golden, CO 80401

WILLIAM O. VOGEL, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, 4401 N. Fairfax Drive, Arlington, VA 22203

**Abstract:** The mid-continent population of sandhill cranes (*Grus canadensis*) was protected from 1916 until 1961, when hunting resumed on a limited basis. Areas open to hunting were experimentally expanded during 1961–72, but during the subsequent 1975–90 period only minor changes were made in the 8 Central Flyway states that established hunting seasons. Annual spring surveys conducted during 1982–90 indicated the population was stable at objective levels, with spring populations estimated at about 540,000 and fall flights near 590,000. Special federal hunting permits have been required for all hunters participating in regular seasons in the Central Flyway since 1975, where an average of 15,589 permits has been issued annually and about 42% (6,487) of hunters have been successful in annually bagging 1 or more cranes. Estimated Central Flyway harvests during those 16 seasons averaged 11,530 cranes. The combined North American hunting mortality estimates (including crippling losses) averaged 22,026 cranes, but recently increased to levels near or exceeding the established objective of 25,000 during each of the past 6 seasons. In 1990, harvest rates were estimated to be about 5.4% of the fall population, which exceeded the harvest rate objective of 5%. Since 1975, average seasonal bags have increased while crippling loss rates have decreased in Central Flyway states. The cooperative management plan has been an effective guide in managing harvests, but it should be revised to reflect recent information (1982–90) on population status and harvests.

**Key Words:** *Grus canadensis*, harvest, management, population status, sandhill crane

PROC. NORTH AM. CRANE WORKSHOP 6:24-32

Sandhill crane hunting seasons in the United States (U.S.) and Canada were closed during the 45 years following the Convention for the Protection of Migratory Birds in 1916. In Alaska, hunting of cranes has been allowed since 1961, and in 1964 hunting seasons were resumed in Canada (Lewis 1977). In the U.S. portion of the Central Flyway, expansion of areas open to hunting occurred gradually over the decade following resumption of hunting. During 1961–62 only portions of New Mexico and Texas conducted seasons; portions of 4 more states were added in 1968, and portions of 2 more states were added in 1972 for a total of 8 states that currently participate in crane seasons. During the 1975–90 period, only minor changes in crane hunting regulations were made in the Central Flyway. These expansions undoubtedly contributed to the evolution of sport hunting for cranes, but also became a subject of considerable controversy. Fortunately that controversy (probably more than anything else) also fostered initiation of substantive efforts to learn more about sandhill cranes.

Central Flyway states have required a federal permit for the hunting of sandhill cranes since 1975. This permit allowed preparation of annual lists of names and addresses of all crane hunters and facilitated mailing of questionnaires and compilation of reported harvest and hunting activity information. In 1981, natural resource agencies in the Central Flyway developed a cooperative management

plan for the mid-continent population of sandhill cranes, which is composed of 3 subspecies, *G. c. canadensis*, *G. c. rowani*, and *G. c. tabida* (Central Flyway Council 1981). This plan recommended a population objective for a stable spring population that would not differ substantially from the 1982 vertical-photo-transect survey estimate of about 510,000 cranes. The plan also recognized sport hunting as a primary tool for accomplishing that objective. Established harvest guidelines of an annual harvest mortality of 25,000 were based on a harvest rate of about 5% of the population. Among the monitoring needs identified in the plan were those to obtain estimates of hunting activity and harvests, along with concerted efforts to improve annual population surveys.

The purpose of this paper is to provide an update of the special sandhill crane harvest survey program that was presented by Miller (1987). In addition, we also summarize hunting regulations and results from spring population surveys during 1975–90.

We are particularly indebted to Office of Migratory Bird Management staff A. N. Novara and M. F. Sorrenson for conducting the special sandhill crane harvest surveys and to J. W. Solberg, A. N. Novara, and D. S. Benning for coordinating annual spring surveys for this population. We also thank R. J. Blohm, D. S. Benning, J. P. Taylor, and an anonymous reviewer for helpful reviews of this manuscript. Finally, we want to acknowledge biologists in the

Central Flyway states who coordinated the annual distribution of federal crane hunting permits.

## METHODS

### Spring Population Surveys

Mid-continent sandhill cranes nest across vast, remote areas of interior and arctic regions of Canada and Alaska, as well as eastern Siberia. They migrate through the Central Flyway states and winter primarily in west Texas, eastern New Mexico, western Oklahoma, southeastern Arizona, and northern Mexico (Lewis 1977). The spring period (generally late March–early April) provides the best opportunity to conduct an annual survey of these birds because at that time their distribution is confined almost entirely to relatively small areas along Nebraska's North Platte and Platte River valleys (Buller 1979). At the time of the survey, a few cranes may still be present in wintering areas in Texas, or as far northward as the Dakotas, therefore simultaneous cooperative counts are conducted to the north and south of Nebraska (Solberg 1990).

Several efforts to improve spring survey methodologies have been attempted (Benning and Johnson 1987). During 1975–80, ocular-cruise counts provided an annual index of the mid-continent crane population. Because of variability among observers and years, an ocular-transect survey (Ferguson et al. 1979) replaced ocular-cruise efforts during the most recent period (1981–90). The use of photographic correction techniques has further improved consistency and accuracy of this survey technique and currently provides annual population indices necessary to assess trends in the population.

Results from a vertical-photographic-transect survey, conducted in 1982, provided the best estimate of the spring population (Benning and Johnson 1987). Although considered to be a minimum estimate of the spring population, comparisons with the annual photo-corrected-ocular-transect index provide insight into the annual status of the population, relative to the 1982 levels.

### Hunting Regulations

Each year (usually in March) the U.S. Fish and Wildlife Service (FWS) publishes preliminary proposals for the coming hunting season in the *Federal Register* and begins accepting comments. The Central Flyway Council meets in March to develop recommendations, and in June FWS staff consider those recommendations along with other public comments prior to developing proposed regulations. FWS then holds a public meeting to review

information about population status, announce proposals, and receive public testimony. Following the hearing, the proposed rules are published in the *Federal Register*. After the close of the comment period, FWS publishes the final regulatory frameworks and season selections for the upcoming season.

FWS annually completes a consultation under Section 7 of the Endangered Species Act and develops a biological opinion for the migratory bird hunting program. The relationship of sandhill crane seasons to whooping crane (*Grus americana*) distribution receives considerable attention in this process. Contingency plans for each of the 8 states allow the hunting of cranes to proceed while providing for monitoring and protective actions, such as temporary spot closure, if a whooping crane is discovered in an open hunt area.

### Harvest Surveys

All persons hunting cranes during regular seasons in the Central Flyway states during 1975–90 have been required to possess a valid federal sandhill crane hunting permit in addition to any licenses required by individual states. The permits provided by FWS have been issued free of charge and in unlimited quantities by the respective state wildlife conservation agencies. Hunters were only required to provide their name and address in order to obtain a permit, and thereby collectively created a sampling universe of potential crane hunters. A "hunting diary" was included with the permit for recording daily hunting activity and success, along with a message that a sample of permittees would be contacted following the season.

Questionnaires were mailed to hunters shortly after the seasons closed in each state. Follow-up questionnaires were sent to those who did not respond to initial contacts within approximately 3 weeks. Responses to the surveys have been accepted as presented, and there have been no adjustments for memory, exaggeration, or other possible biases. An identification code for each permittee contacted enabled elimination of duplicate responses in instances where follow-up questionnaires were mailed before responses to initial contacts were received. A complete description of the permit and the analytical procedures used for analysis were presented by Miller (1987).

## RESULTS

### Spring Population Surveys

Results from the uncorrected-ocular-transect surveys provided an index to trends for the spring population

Table 1. Coordinated spring surveys for the mid-continent population of sandhill cranes, 1975–90.

Year	Uncorrected ocular transect <sup>a</sup>	Vertical photo transect	Photo corrected ocular transect	
			Annual	3-yr $\bar{x}$
1975	227,500	No Survey	No Survey	NA
1976	152,500	No Survey	No Survey	NA
1977	220,000	No Survey	No Survey	NA
1978	198,700	No Survey	No Survey	NA
1979	209,300	No Survey	No Survey	NA
1980	265,500	No Survey	No Survey	NA
1981	290,400	No Survey	No Survey	NA
1982	367,800	509,900	437,100	NA
1983	317,800	No Survey	354,900	NA
1984	243,600	No Survey	282,700	358,233
1985	390,700	No Survey	530,463	389,354
1986	320,325	No Survey	356,340	389,834
1987	383,931	No Survey	416,408	434,404
1988	394,583	No Survey	471,187	414,645
1989	393,253	No Survey	393,895	427,163
1990	412,490	No Survey	438,694	434,592

<sup>a</sup> Ocular cruise surveys, 1975–77. Ocular transect surveys in Nebraska and point surveys elsewhere, 1978–90.

during 1975–81. In 1982, the vertical-photo-transect survey estimated almost 510,000 cranes during the spring period. That same year, the photo-corrected-ocular-transect survey showed an index of 437,100 cranes. The photo-corrected-ocular-transect survey provided the best index to assess trends in the population during 1982–90. All available survey information for 1975–90 (Table 1) suggests that the spring population increased during 1975–81 (Central Flyway Council 1981), but the 3-year running average has remained relatively stable since 1982.

The cooperative management plan suggests that as many as 540,000 mid-continent cranes may have been present during the spring of 1980. The results of the most recent (1990) photo-corrected-ocular-transect survey were remarkably similar to the 1982 index and indicate that the population remains relatively stable and at management objective levels. Although the total number of cranes in the spring population is unknown, it probably exceeds the number estimated in the vertical-transect survey and may be near the 540,000 estimated by Miller in 1980 (1987).

### Hunting Regulations

Regulations governing the harvest of sandhill cranes

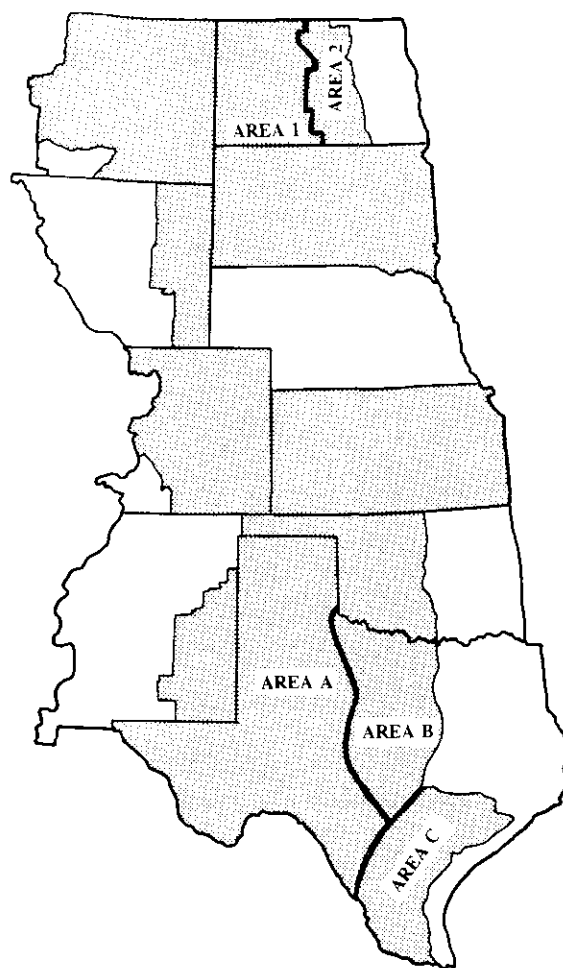


Fig. 1. Areas open to sandhill crane hunting by federal frameworks (shaded) in the U.S. portion of the Central Flyway, 1991.

are considered annually, but have been relatively stable. Miller (1985) described several changes in the hunting of mid-continent sandhill cranes during 1975–84. Other than the 1989 expansion of the open area in Texas, the frameworks have not been changed since 1983. The only other changes during 1983–90 were minor adjustments in season dates, and an expansion of hunter opportunity that included increased use of framework dates in North Dakota (Table 2).

The regulatory frameworks provided for regular sandhill crane seasons in portions of all Central Flyway states except Nebraska (Fig. 1). Although allowed to conduct a season, Kansas has not initiated one. The framework dates were 1 September–28 February with season lengths of up to 93 days in all or portions of New Mexico, Oklahoma, and Texas, and up to 58 days in all or portions of the remaining states. The daily bag limit was 3 sandhill cranes and the possession limit was twice the daily bag

Table 2. Regular season<sup>a</sup> dates for hunting sandhill cranes in the Central Flyway, 1975–90.

Year	Dates	Colo.	Mont. <sup>b</sup>	Mont. <sup>c</sup>	N.M.	N.D. <sup>d</sup>	N.D. <sup>e</sup>	Okla. <sup>f</sup>	S.D.	Tex. <sup>g</sup>	Tex. <sup>h</sup>	Tex. <sup>i</sup>	Wyo.
1975-76	Start	4 Oct	4 Oct		25 Oct	8 Nov	8 Nov	29 Nov	8 Nov	25 Nov	29 Nov		11 Oct
	End	8 Nov	9 Nov		25 Jan	8 Dec	8 Dec	25 Jan	7 Dec	25 Jan	25 Jan		9 Nov
1976-77	Start	2 Oct	2 Oct		30 Oct	6 Nov	6 Nov	27 Nov	6 Nov	30 Oct	4 Dec		9 Oct
	End	6 Nov	7 Nov		30 Jan	5 Dec	5 Dec	23 Jan	5 Dec	30 Jan	30 Jan		7 Nov
1977-78	Start	1 Oct	1 Oct		29 Oct	7 Sep	7 Sep	26 Nov	7 Sep	1 Nov	5 Dec		8 Oct
	End	6 Nov	6 Nov		29 Jan	11 Sep	11 Sep	22 Jan	11 Sep	31 Jan	31 Jan		6 Nov
1978-79	Start	30 Sep	30 Sep		28 Oct	7 Sep	7 Sep	25 Nov	7 Sep	31 Oct	5 Dec		7 Oct
	End	5 Nov	5 Nov		28 Jan	11 Sep	11 Sep	21 Jan	11 Sep	31 Jan	31 Jan		5 Nov
1979-80	Start	13 Oct	29 Sep		27 Oct	7 Sep	7 Sep	24 Nov	7 Sep	30 Oct	4 Dec		13 Oct
	End	18 Nov	4 Nov		27 Jan	11 Sep	11 Sep	20 Jan	11 Sep	30 Jan	30 Jan		8 Nov
1980-81	Start	11 Oct	4 Oct		30 Oct	6 Sep	6 Sep	22 Nov	20 Sep	31 Oct	5 Dec		11 Oct
	End	16 Nov	9 Nov		31 Jan	14 Sep	10 Sep	18 Jan	28 Sep	31 Jan	31 Jan		16 Nov
1981-82	Start	10 Oct	3 Oct		31 Oct	5 Sep	5 Sep	22 Nov	20 Sep	31 Oct	5 Dec		3 Oct
	End	15 Nov	8 Nov		31 Jan	20 Sep	13 Sep	18 Jan	28 Sep	31 Jan	31 Jan		8 Nov
1982-83	Start	2 Oct	2 Oct		31 Oct	4 Sep	4 Sep	23 Oct	2 Oct	30 Oct	4 Dec		25 Sep
	End	28 Nov	28 Nov		31 Jan	19 Sep	12 Sep	23 Jan	11 Nov	30 Jan	30 Jan		21 Nov
1983-84	Start	1 Oct	1 Nov	1 Nov	29 Oct	10 Sep	10 Sep	22 Oct	1 Oct	12 Nov	3 Dec	14 Jan	24 Sep
	End	27 Nov	27 Nov	27 Nov	28 Jan	6 Nov	30 Sep	22 Jan	6 Nov	12 Feb	12 Feb	12 Feb	20 Nov
1984-85	Start	29 Sep	29 Sep	1 Nov	27 Oct	8 Sep	8 Sep	13 Oct	29 Sep	10 Nov	1 Dec	12 Jan	22 Sep
	End	25 Nov	25 Nov	25 Nov	27 Jan	4 Nov	28 Sep	13 Jan	4 Nov	10 Feb	10 Feb	10 Feb	18 Nov
1985-86	Start	28 Sep	28 Sep	1 Nov	26 Oct	7 Sep	7 Sep	12 Oct	28 Sep	9 Nov	30 Nov	11 Jan	21 Sep
	End	24 Nov	24 Nov	24 Nov	26 Jan	3 Nov	27 Sep	12 Jan	3 Nov	9 Feb	9 Feb	9 Feb	17 Nov
1986-87	Start	4 Oct	4 Oct	1 Nov	25 Oct	6 Sep	6 Sep	11 Oct	28 Sep	8 Nov	29 Nov	3 Jan	20 Sep
	End	30 Nov	30 Nov	30 Nov	25 Jan	2 Nov	3 Oct	11 Jan	2 Nov	8 Feb	8 Feb	8 Feb	16 Nov
1987-88	Start	3 Oct	3 Oct	3 Oct	24 Oct	5 Sep	5 Sep	10 Oct	26 Sep	14 Nov	28 Nov	2 Jan	19 Sep
	End	29 Nov	29 Nov	29 Nov	24 Jan	1 Nov	2 Oct	17 Jan	1 Nov	14 Feb	7 Feb	7 Feb	15 Nov
1988-89	Start	1 Oct	1 Oct	1 Oct	22 Oct	10 Sep	10 Sep	22 Oct	24 Sep	12 Nov	26 Nov	7 Jan	17 Sep
	End	27 Nov	27 Nov	27 Nov	22 Jan	6 Nov	6 Nov	22 Jan	30 Oct	12 Feb	5 Feb	12 Feb	13 Nov
1989-90	Start	30 Sep	30 Sep	30 Sep	21 Oct	9 Sep	9 Sep	21 Oct	30 Sep	11 Nov	2 Dec	6 Jan	16 Sep
	End	26 Nov	26 Nov	26 Nov	21 Jan	5 Nov	5 Nov	21 Jan	5 Nov	11 Feb	11 Feb	11 Feb	12 Nov
1990-91	Start	29 Sep	29 Sep	29 Sep	20 Oct	8 Sep	8 Sep	20 Oct	29 Sep	10 Nov	1 Dec	5 Jan	15 Sep
	End	25 Nov	25 Nov	25 Nov	20 Jan	4 Nov	4 Nov	20 Jan	4 Nov	10 Feb	10 Feb	10 Feb	11 Nov

<sup>a</sup> 1982–85 special seasons in New Mexico not included.<sup>b</sup> Central Flyway portion of Montana, except that area south of I-90 and west of the Bighorn River and Sheridan County.<sup>c</sup> Sheridan County, Montana.<sup>d</sup> Area 1, North Dakota (see Fig. 1).<sup>e</sup> Area 2, North Dakota (see Fig. 1).<sup>f</sup> 1987–88 season closed during 21–27 November in Oklahoma.<sup>g</sup> Area A, Texas (see Fig. 1).<sup>h</sup> Area B, Texas (see Fig. 1).<sup>i</sup> Area C, Texas (see Fig. 1).

limit. The shooting hours were 1/2 hour before sunrise until sunset. Zoning has not been allowed for crane hunting; however, North Dakota and Texas independently restrict the hunting dates within allowed frameworks in certain areas.

### Hunting Activity and Harvests

The number of federal sandhill crane hunting permits issued in Central Flyway states during the first 16 regular seasons ranged from 11,352 to 22,720, averaged 15,589,

Table 3. Number of federal sandhill crane permits issued in the Central Flyway, 1975–90.

Year	Colo.	Mont.	N.M.	N.D.	Okla.	S.D.	Tex.	Wyo.	Total
1975	401	158	1,225	4,172	171	198	5,482	56	11,863
1976	341	117	1,195	4,137	265	200	5,060	37	11,352
1977	374	82	1,452	6,294	519	134	4,897	48	13,800
1978	343	209	956	5,798	620	98	5,198	52	13,650
1979	528	159	1,288	4,949	470	63	5,098	43	12,598
1980	437	118	1,082	5,754	510	240	5,239	33	13,413
1981	397	53	1,022	5,796	466	197	5,297	30	13,258
1982	528	147	962	4,714	750	579	4,650	40	12,370
1983	575	175	706	8,033	909	528	7,317	63	18,306
1984	538	113	721	7,436	1,187	544	6,838	43	17,420
1985	555	143	710	6,802	1,102	656	7,417	59	17,444
1986	617	99	595	8,926	1,073	705	7,258	25	19,298
1987	610	128	502	8,778	1,213	517	6,289	30	18,067
1988	512	162	480	6,214	1,472	437	7,053	38	16,368
1989	434	172	430	6,128	1,717	524	8,066	25	17,496
1990	389	143	533	7,268	1,725	646	11,994	22	22,720
$\bar{x}$	474	136	866	6,325	886	392	6,447	38	15,589

and totaled 249,423 (Table 3). The number of permits issued for the 1990–91 season increased from 17,500 the previous year to a record high of 22,720. Within individual states, the number issued varied from year to year without pattern. In 1990, distribution of permits among states was similar to previous years: Texas (53%), North Dakota (32%), Oklahoma (8%), and collectively South Dakota, New Mexico, Colorado, Montana, and Wyoming about 7%.

Following the 1990 season, about 50% of permittees in Texas and North Dakota and all permittees in the remaining states were contacted. The response rate was 74% and averaged about 72% over the entire 1975–90 period. In 1990, 34% (7,631) of the respondents reported hunting sandhill cranes. These hunters averaged 2.68 recreational hunting days, and 60% (4,590) were successful in bagging 1 or more cranes.

During the 1975–90 period, the estimated numbers of active hunters ranged from a low of about 5,100 in 1976 to a high of just over 8,000 in 1977 and averaged 6,487 (Table 4). The number of active hunters had steadily declined during 1977–88, but successively increased in 1989–90. This increase occurred primarily in Texas (+65%) and North Dakota (+47%). During 1975–90, these 2 states reported 82% of all active hunters in the Central Flyway.

The reported seasonal bag of cranes per active hunter ranged from 1.3 in 1978 to 2.4 in 1987–90 and averaged

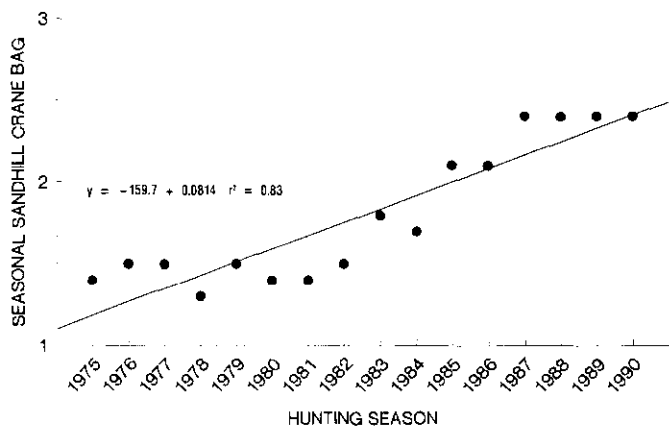


Fig. 2. Seasonal sandhill crane bag for hunters in the U.S. portion of the Central Flyway, 1975–90.

1.8 cranes during 1975–90 (Fig. 2). Seasonal bags during 1975–81 were relatively stable, then increased during 1982–88 before becoming stable at about 2.4 cranes per hunting season. The estimated harvests of cranes in Central Flyway states increased from a low of 7,393 in 1976 to a high of 18,041 in 1990 (Fig. 3) and averaged 11,530 during 1975–90 (Table 5). Collectively, harvests in Texas and North Dakota made up about 88% of the average harvests over the 16 regular crane seasons.

The number of active hunters was not directly related to the number of permits issued in the 16 regular seasons; however, potential associations may have been masked by changes in hunting seasons that influenced the demand for free permits. The numbers of active hunters appeared to decline from a high of about 8,000 in 1977 to about 5,000 in 1988, but rebounded to near 8,000 again in the 1990 season. In contrast, the average seasonal bag remained relatively stable during 1975–81, but increased from about 1.4 to about 2.4 cranes during 1982–86. During the same period, crippling loss rates (expressed as a percentage of retrieved harvest) declined from a high of near 20% in 1975 to a low of 12.7% in 1988 (Fig. 4). The number of days per hunter declined during 1975–90 (Fig. 5). The causal factors for these trends have not been described.

Mid-continent sandhill cranes are also harvested in other areas in North America. Harvests in Alaska, estimated from surveys of those buying duck stamps, ranged from 545 to 1,986 and averaged 1,138 during seasons when surveys were conducted (Table 6). Harvests in Canada ranged from 367 in 1977 (seasons in Saskatchewan were closed in 1977 and 1978) to a high of 6,946 in 1988. Harvest surveys have not been conducted in Mexico, but during the 1970's annual harvests of 500–1,000 were estimated by Baer (Lewis 1977). More recently, Mexican

Table 4. Estimated number of active sandhill crane hunters<sup>a</sup> in the Central Flyway, 1975–90.

Year	Colo.	Mont.	N.M.	N.D.	Okla.	S.D.	Tex.	Wyo.	Total
1975	226	69	806	2,896	80	117	2,733	22	6,949
1976	203	68	752	1,328	148	80	2,497	16	5,092
1977	189	40	921	4,126	339	77	2,329	27	8,008
1978	190	86	836	3,776	334	50	2,390	21	7,683
1979	275	61	745	3,225	307	29	2,356	13	7,011
1980	216	50	625	3,387	275	160	2,439	12	7,164
1981	216	23	598	3,315	269	103	2,543	14	7,081
1982	138	56	386	2,429	342	260	1,553	8	5,172
1983	211	64	253	3,551	384	225	2,435	20	7,143
1984	206	51	301	3,189	467	208	2,380	19	6,821
1985	187	37	216	2,383	372	168	2,613	12	5,988
1986	106	17	178	3,095	299	149	1,991	5	5,840
1987	113	29	133	2,529	358	120	1,942	5	5,229
1988	117	48	171	1,779	531	78	2,497	11	5,232
1989	74	52	152	2,018	492	153	2,805	6	5,752
1990	101	33	180	2,614	395	172	4,130	6	7,631
$\bar{x}$	173	49	453	2,853	337	134	2,477	12	6,487

<sup>a</sup> Those permittees reporting hunting cranes 1 or more times.

harvests have probably increased, but probably remain relatively low and are thought to be about 10% of the combined reported harvests in the U.S. and Canada (Central Flyway Council 1981). Crippling losses due to hunting are not known for all areas and years; however, a rate of 20% of retrieved harvests is assumed to be representative for most hunting seasons (Central Flyway Council 1981). Annual mortality associated with hunting (retrieved harvest and crippling losses) in all areas in North America ranged from a low of 12,759 in 1982 to a high of 31,705 in 1990 and averaged 22,026 during the 1975–90 period (Table 6).

## DISCUSSION

### Population Status

The mid-continent sandhill crane population has been relatively stable during 1982–90. The cooperative management plan for this population advocates the use of the photo-corrected transect as the most reliable survey for the spring population. The current population index as depicted by the latest (1988–90) 3-year running average of the photo-corrected-ocular transect is 434,592. This level is similar to the 1982 count of 437,100 which corresponded

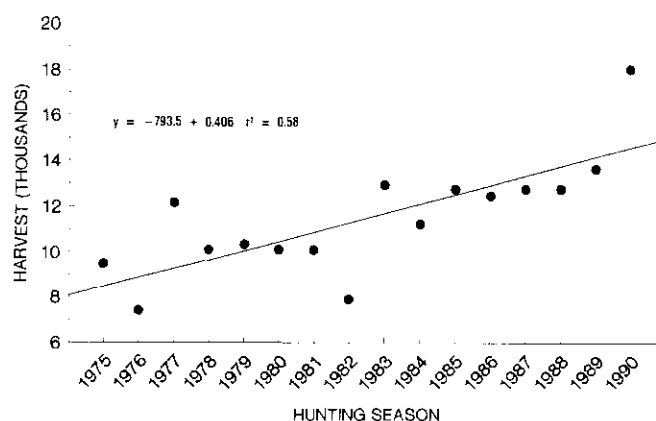


Fig. 3. Sandhill crane harvests in the U.S. portion of the Central Flyway, 1975–90.

to a vertical photo transect estimate of about 510,000. This value is a minimum estimate, consequently the actual number of cranes in the spring population was probably about 540,000 during this period (Miller 1985). Fall populations vary according to annual production and summer mortality, but have contained an average of about 10–13% young (Buller 1979, Tacha and Vohs 1984, Tacha et al. 1986).

Average production rates, multiplied by average spring populations less summer (April–September) mortality (2%) (Miller 1985), would result in average fall flights of about 589,000 for this population, i.e.,

$$\text{Spring Population (540,000)} - \text{Summer Mortality (11,000)} + \text{Recruitment (60,000)} = \text{Fall Flight (589,000)}$$

The cooperative management plan for this population advocates sport hunting as a management tool to reduce depredations and stabilize populations at the 1982 level. Johnson (1979) suggested that a hunted, mid-continent sandhill crane population might be about 3/4 as large as one not hunted and provided the basis for development of the current harvest strategy. The relatively constant spring populations during 1982–90 suggest that annual mortality, including harvests, has been at a level appropriate for stabilizing the population at objective levels for the mid-continent population of sandhill cranes.

### Hunting Regulations

Annual regulatory frameworks have varied little during the past decade. Season dates selected by states have also been similar. Often the only changes in season dates were made by states in an attempt to open and close seasons

Table 5. Estimated harvests of sandhill cranes during regular seasons in the Central Flyway, 1975–90.

Year	Colo.	Mont.	N.M.	N.D.	Okla.	S.D.	Tex.	Wyo.	Total
1975	91	16	911	2,122	142	86	6,123	6	9,497
1976	106	29	858	52	200	12	6,122	14	7,393
1977	39	18	1,456	4,078	410	47	6,094	9	12,151
1978	106	36	1,089	2,777	389	19	5,720	10	10,146
1979	129	14	1,170	2,733	397	19	5,917	0	10,379
1980	68	16	1,019	2,245	363	130	6,305	6	10,152
1981	92	11	907	2,395	397	78	6,245	9	10,134
1982	49	21	335	2,469	535	212	4,295	0	7,916
1983	70	28	354	6,471	373	177	5,471	15	12,959
1984	85	15	414	4,367	433	139	5,811	7	11,271
1985	82	7	334	4,650	416	101	7,184	2	12,776
1986	33	1	250	6,563	392	99	5,149	0	12,487
1987	86	15	159	5,334	957	99	6,117	3	12,770
1988	68	18	372	3,815	1,061	100	7,330	8	12,772
1989	25	33	319	4,656	1,003	194	7,400	9	13,639
1990	87	44	377	6,804	698	165	9,865	1	18,041
$\bar{x}$	76	20	645	3,846	510	105	6,322	6	11,530

on a certain day of the week. This stability in regulations facilitates comparisons of other factors affecting harvest and hunter participation.

The cooperative management plan for this population has been a valuable guide in the regulation of harvests to achieve the desired population objective. The harvest levels identified in the management plan have been appropriate in the past and the FWS supports the continued use of management plans to guide future harvest management decisions. However, the existing plan, approved in 1981, should be revised using the most current population, harvest, recruitment, and mortality/survival information.

### Hunting Activity and Harvests

Federal sandhill crane hunting permits successfully served the purpose of identifying potential crane hunters. Reported harvests were assumed to be representative of cranes taken during regular hunting seasons in the Central Flyway. The proportion of active crane hunters among permittees (34% in 1990) was lower than usual among those who obtained federal permits (e.g., 87% of those who obtained "duck stamps" hunted 1 or more times during the 1989–90 season) (Martin et al. 1990). Such low participation probably reflected the availability of free permits, as opportunistic hunters may obtain a permit "just in case" an opportunity arose.

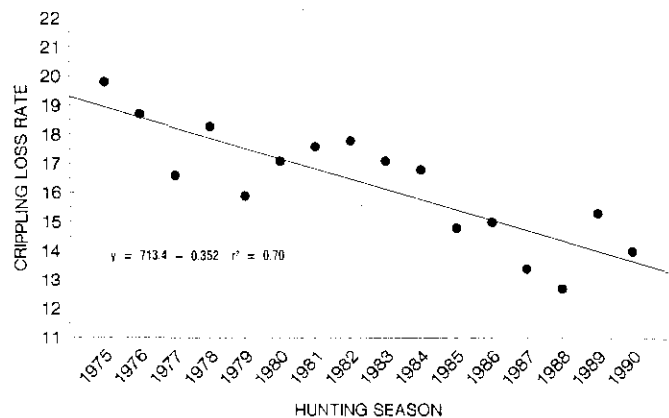


Fig. 4. Sandhill crane crippling loss rates in the U.S. portion of the Central Flyway, 1975–90.

Although federal sandhill crane permits remain free, North Dakota charged its hunters an additional \$5.00 fee for crane hunting privileges beginning in 1991. It is not known what effect this additional charge will have on the number of permits issued, the number of active hunters, or harvests.

The increasing trend in the Central Flyway's crane harvest generally appeared to be more related to observed increases in the average seasonal bags and lower crippling losses than to the numbers of active hunters. In response to demand, sporting goods manufacturers are now offering crane decoys and calls in their catalogs. Perhaps this indicates that crane hunters are becoming better equipped, more knowledgeable of crane behavioral patterns, or more proficient in their hunting skills during the regular hunting seasons. If hunters were improving hunting efficiency, then declines in crippling rates and increases in seasonal bags could readily be explained. However, harvests, seasonal bags, or crippling rates are the result of many interrelated events, including environmental conditions, that cannot be simply explained in a direct cause-and-effect relationship. These assessments show that the hunting process that was resumed in 1961 has evolved from a experimental tool to reduce local depredations into a management strategy to regulate population size.

In contrast, known harvests in Alaska and Canada have remained relatively stable during 1975–90. Although harvests in Mexico are unknown, they are thought to be relatively low and estimated to be only about 10% of the retrieved harvest in Canada and the U.S. (Central Flyway Council 1981). Crippling losses for all areas are estimated to be about 20% of retrieved harvests. Overall mortality associated with the hunting process may have remained near or exceeded (3-year running average of 28,207) the



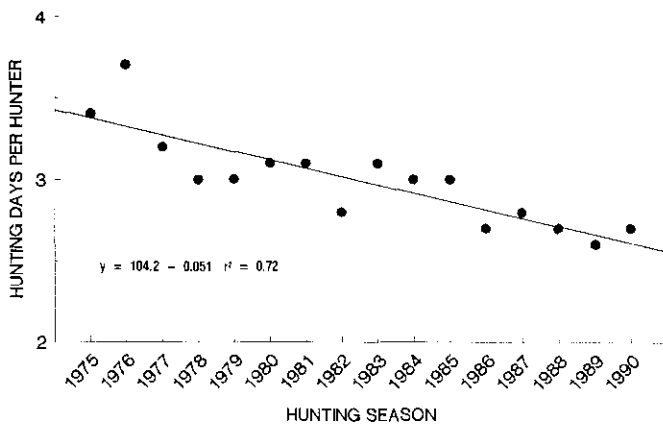


Fig. 5. Average sandhill crane hunting days afield in the U.S. portion of the Central Flyway, 1975–90.

harvest objective of 25,000 during the 1985–90 period.

The cooperative management plan recommends that total mortality associated with the hunting process not exceed 5% of the population, and it established a maximum annual continental harvest mortality (retrieved and unretrieved) of 25,000. This threshold was designed to achieve the objective of a stable population and was based upon (1) information that the fall population would be expected to average 11.3% young-of-the-year (Buller 1979) and that annual mortality would average 6% (Miller 1987) and (2) assumptions that 1/3 of annual mortality would occur between 20 March and 1 September (R. C. Drewien, pers. commun.) and that hunting kill would not be compensated by reductions in other mortality. Total mortality associated with the hunting process in 1990 was calculated to have been more than 31,700. This level of harvest would be about 5.4% of the fall population (5.9% of the spring population).

The cooperative management plan recommends that efforts should be made to reduce and then stabilize sandhill crane harvests at 25,000. In the Central Flyway states, information on daily activity and success of hunters indicates the probable effect of reductions in the daily bag limits as reported by Miller (1987). He suggested that a reduction of the daily bag limit from 3 to 2 would reduce the harvest by approximately 14%. Greater reductions in harvest levels would require the shortening of season length or other reductions in hunter opportunity, especially in the high harvest states of Texas and North Dakota.

### Management Recommendations

1. The federal sandhill crane permit and harvest survey for the Central Flyway states should be continued until

Table 6. Estimated hunting mortality of mid-continent sandhill cranes in North America, 1975–90.

Year	Retrieved harvest				Crippling loss <sup>c</sup>	Total
	Central Flyway	Canada	Alaska <sup>a</sup>	Mexico <sup>b</sup>		
1975	9,497	6,165	1,094	1,676	3,686	22,118
1976	7,393	1,636	637	967	2,127	12,759
1977	12,151	367	1,138	1,366	3,004	18,026
1978	10,146	876	1,138	1,216	2,675	16,051
1979	10,379	3,798	1,138	1,532	3,369	20,216
1980	10,152	5,582	1,138	1,687	3,712	22,271
1981	10,134	2,961	1,138	1,423	3,131	18,788
1982	7,916	2,837	1,160	1,191	2,621	15,725
1983	12,959	3,098	1,540	1,760	3,871	23,228
1984	11,271	3,717	1,986	1,697	3,734	22,406
1985	12,776	5,159	1,197	1,913	4,209	25,254
1986	12,487	6,106	1,138	1,973	4,341	26,045
1987	12,770	5,268	836	1,887	4,152	24,914
1988	12,772	6,946	1,243	2,096	4,611	27,669
1989	13,639	4,985	545	1,913	4,208	25,246
1990	18,041	4,840	1,138	2,402	5,284	31,705
$\bar{x}$	11,528	4,021	1,138	1,669	3,671	22,026

<sup>a</sup> No survey data available for 1977–81, 1986, and 1990. The long-term average of 1,138 cranes was used for those years.

<sup>b</sup> Harvests are estimated to be 10% of harvests in Canada and the United States.

<sup>c</sup> Crippling losses are estimated to be 20% of retrieved harvests (Central Flyway Council 1981).

after the National Migratory Bird Harvest Information Program is fully implemented.

2. The cooperative photo-corrected-transect survey for the spring period provides a valuable index for determining the trend of the mid-continent sandhill crane population and should be continued.

3. Efforts should be made to obtain current harvest information for Mexico.

4. The cooperative management plan approved by the Central Flyway Council in 1981 should be expanded to include joint Pacific Flyway concurrence and updated to include current population, harvest, recruitment, and mortality information. In addition, current information regarding population status, harvests, and distributions of the 3 subspecies of sandhill cranes should be incorporated into comprehensive harvest management programs for this population.

5. Sandhill crane sport hunting equipment is improving, crippling rates are declining, and harvests in the Cen-

tral Flyway states are increasing. If these trends continue, efforts should be made to adjust hunting opportunity according to recommendations in the cooperative management plan for this population.

## LITERATURE CITED

- BENNING, D. S. and D. H. JOHNSON. 1987. Recent improvements to sandhill crane surveys in Nebraska's central Platte Valley. Pages 10-16 in J. C. Lewis, ed. Proc. 1985 crane workshop. Platte River Whooping Crane Maintenance Trust, Grand Island, Nebr.
- BULLER, R. J. 1979. Lesser and Canadian sandhill crane populations, age structure, and harvest. U.S. Fish Wildl. Serv. Spec. Sci. Rep. 221. 10pp.
- CENTRAL FLYWAY COUNCIL. 1981. Management plan for mid-continent sandhill cranes. Unpubl. Rep., Cent. Flyway Counc., Golden, Colo. 21pp.
- FERGUSON, E. L., D. S. GILMER, D. H. JOHNSON, N. LYMAN, and D. S. BENNING. 1979. Experimental surveys of sandhill cranes in Nebraska. Pages 41-49 in J. C. Lewis, ed. Proc. 1978 crane workshop. Colorado State Univ. Printing Serv., Fort Collins.
- JOHNSON, D. H. 1979. Modeling sandhill crane population dynamics. U. S. Fish Wildl. Serv. Spec. Sci. Rep. 222. 10pp.
- LEWIS, J. C. 1977. Sandhill crane (*Grus canadensis*). Pages 4-43 in G. C. Sanderson, ed. Management of migratory shore and upland game birds in North America. Int. Assoc. Fish Wildl. Agencies, Washington, D.C.
- MARTIN, E. M., P. H. GEISSLER, and A. N. NOVARA. 1990. Preliminary estimates of waterfowl harvest and hunter activity in the United States during the 1989 hunting season. Unpubl. Rep., U.S. Fish Wildl. Serv., Laurel, Md. 34pp.
- MILLER, H. W. 1987. Hunting in the management of mid-continent sandhill cranes. Pages 30-46 in J. C. Lewis, ed. Proc. 1985 crane workshop. Platte River Whooping Crane Maintenance Trust, Grand Island, Nebr.
- SOLBERG, J. W. 1990. Coordinated spring mid-continent sandhill crane survey. Unpubl. Rep., U.S. Fish Wildl. Serv., Kearney, Nebr. 9pp.
- TACHA, T. C., D. E. HALEY, and R. R. GEORGE. 1986. Population and harvest characteristics of sandhill cranes in southern Texas. J. Wildl. Manage. 50:80-83.
- \_\_\_\_\_, and P. A. VOHS. 1984. Some population parameters of sandhill cranes from mid-continental North America. J. Wildl. Manage. 48:89-98.
- \_\_\_\_\_, \_\_\_\_\_, and W. D. WARDE. 1985. Morphometric variation of sandhill cranes from mid-continental North America. J. Wildl. Manage. 49:246-250.