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SANDHILL CRANE HUNTS IN THE RIO GRANDE VALLEY AND SOUTHWEST NEW MEXICO

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Abstract: Annual limited permit hunting seasons for sandhill cranes (*Grus canadensis*) were initiated in southwestern New Mexico (SWNM) in 1982 and in the middle Rio Grande Valley (MRGV) in 1986. Within the MRGV and SWNM are wintering areas for 3 migratory subspecies, including the lesser sandhill crane (*G. c. canadensis*) (lessers), Canadian sandhill crane (*G. c. rowani*) (Canadians), and greater sandhill crane (*G. c. tabida*) (greater). We summarized annual season dates, bag limits, requirements for permits, procedures for examination of crane specimens at check stations, number of hunters, estimated harvest, mean harvest per hunter, subspecific composition, sex ratios, and percent juveniles in the harvest by hunt area. Mean values for hunt parameters in the MRGV were: annual harvest 458.8 ± 272.0 (1 SD), number of hunters 309.7 ± 121.8 , harvest per hunter 1.4 ± 0.8 , crippling loss $20.4\% \pm 7.0$, and subspecific composition during 9 years was $27.1\% \pm 23.1$ lessers, $7.1\% \pm 3.5$ Canadians, and $65.7\% \pm 20.6$ greater with juveniles averaging $13.4\% \pm 8.8$ of the harvest. Mean values for hunt parameters in SWNM were: annual harvest 100.2 ± 45.9 , number of hunters 108.8 ± 45.7 , harvest per hunter 0.9 ± 0.3 , crippling loss $41.9\% \pm 14.9$, and mean subspecific composition for 9 years was $66.6\% \pm 18.2$ lessers, $13.0\% \pm 13.6$ Canadians, and $20.3\% \pm 10.6$ greater with juveniles representing a mean of $14.2\% \pm 7.1$ of the harvest. Our data indicated an increased vulnerability of juvenile lessers and greater to hunting as compared to adults. An analysis of variance revealed that 13 of 15 comparisons of subspecies-sex combinations (6) and measurements of morphological variables (5) were significantly different ($P < 0.001$). Only tail and wing chord measurements for male Canadians and female greater did not differ significantly. Hunt procedures allowed us to successfully monitor annual crane harvest and adjust hunting seasons as necessary to remain within acceptable harvest rates of Rocky Mountain Population (RMP) cranes as established in Pacific and Central Flyway guidelines. Responsible management and monitoring of sandhill crane hunts can be accomplished by combining education programs and mandatory check stations where harvested cranes are examined.

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Key words: *Grus canadensis canadensis*, *Grus canadensis rowani*, *Grus canadensis tabida*, harvest, crane hunting seasons, New Mexico, Rio Grande Valley, sandhill crane, southwestern New Mexico.

Populations of sandhill cranes (cranes) wintering in the MRGV and portions of southwestern New Mexico have increased significantly during recent decades (Drewien and Bizeau 1974, Drewien et al. 1995). Lessers and Canadians are from the Western Subpopulation of the Mid-continent Population (Tacha et al. 1984) and greater are from the RMP (Drewien and Bizeau 1974). Of the 3 migratory subspecies wintering in New Mexico, RMP greater are most limited in numbers, and recent estimates revealed about 16,200–21,500 (Benning et al. 1997). Beginning in 1982, the New Mexico Department of Game and Fish (NMGF) established hunting seasons for cranes in portions of southwestern New Mexico and in 1986 in the MRGV. These seasons were in response to increased interest in crane hunting, increases in overall winter crane populations, and depredations to corn, chili peppers, and alfalfa. Hunts provided the opportunity to collect information on distribution, numbers, food habits, and subspecific composition of wintering cranes. In this paper we report (1) parameters of sandhill crane hunting seasons that were established in the MRGV and SWNM, (2) estimates of harvest and crippling losses, (3) subspecific, sex, and age composition of specimens examined at hunter check stations, and (4) recommendations concerning future crane hunting in New Mexico.

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STUDY AREAS

The MRGV and portions of SWNM were regions where crane hunting seasons were established (Fig.1). In the MRGV, large numbers of cranes wintered along a 130-km strip from Los Lunas, Valencia County, south to the Bosque del Apache National Wildlife Refuge (NWR) in Socorro County. Smaller numbers of cranes wintered in the lower Rio Grande Valley floodplain (LRGV) between Caballo Reservoir

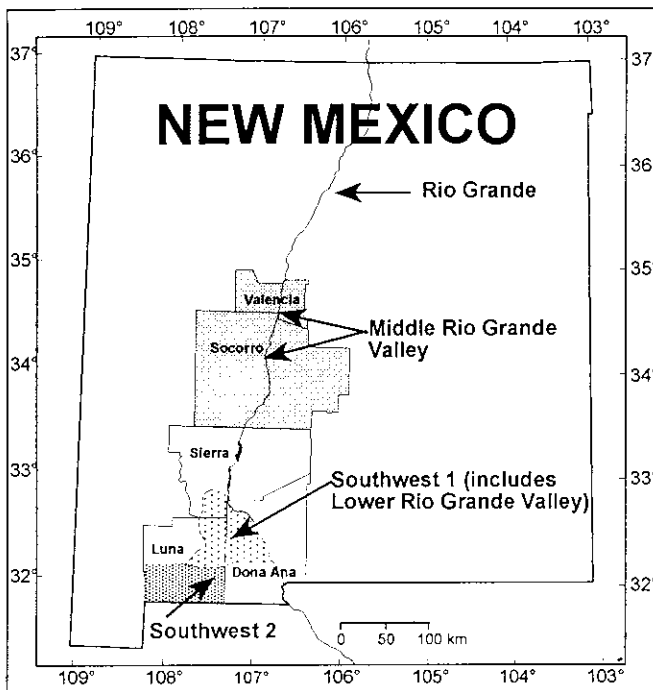


Fig. 1. Sandhill crane hunt boundaries during 1982-94 hunting seasons in the Middle Rio Grande Valley (Valencia and Socorro Counties), Southwest 1 (portions of Sierra, Doña, and Luna Counties including Lower Rio Grande Valley floodplain and the adjacent Uvas Valley), and Southwest 2 (Southern Luna County). Southwest New Mexico hunt boundaries include Southwest 1 and Southwest 2.

and the Hatch Valley in Sierra and Doña Ana Counties, the adjacent Uvas Valley in Sierra and Doña Ana Counties (Southwest Hunt Area 1), and agricultural areas near Deming and Columbus in Luna County (Southwest Hunt Area 2). In all areas, cranes concentrated in irrigated croplands. Drewien and Bizeau (1974), Walker and Schemnitz (1987), Taylor and Kirby (1990), and Drewien et al. (1995) described these wintering areas.

METHODS

Hunt Guidelines

All crane hunts in the MRGV and SWNM were cooperatively designed by personnel of the NMGF and USFWS. Operational plans were written and periodically revised and then agreed to by personnel of each agency and the Pacific and Central Flyway Councils to ensure adequate protection of whooping cranes (*G. americana*) and other protected species (Edens 1992, Lewis 1992). If necessary, hunts could be modified or canceled until such time that whooping cranes were not threatened. Operational plans also established a

process to educate hunters on species identification and aspects of the whooping crane reintroduction experiment (Edens 1992).

The status of RMP greaterers was a priority in designing hunts. To responsibly administer hunting of the RMP, representatives of state wildlife agencies in the Pacific and Central Flyways formulated a management plan acceptable to the USFWS that allocated the harvest allotment among states commensurate with the population status and provided guidelines for hunting seasons (Smith 1991, Sharp 1995). This plan also provided annual guidelines for hunting seasons and responsibilities of the respective state wildlife agencies that selected hunting seasons for RMP cranes (Smith 1991).

Hunt Structures

To accomplish agreements in Pacific and Central Flyway operational hunt plans (Smith 1991), NMGF structured hunts on a limited permit system to prevent overharvest of RMP greaterers. Based on the annual harvest allotment of RMP greaterers (Smith 1991, Sharp 1995), numbers of hunting permits were determined annually. Other information used to determine hunt structures included estimates of hunter participation and their success in harvesting cranes. Daily bag and possession limits were adjusted to maximize hunting opportunity and to reduce crop depredations. Permits were issued by random drawings held in September for the MRGV hunts, during 1982-84 and 1991-95 southwest hunts, and in November for remaining SWNM seasons.

Requirements for Hunters

Permittees were sent information packages containing (1) instructions on required hunter education classes, (2) information on season dates, hunt area boundaries, and daily and season harvest limits, (3) questionnaires requesting information on number of cranes bagged, number shot but not retrieved (crippled), number, locations, and descriptions on observations of color-marked or banded cranes, use of decoys, calls, type of hunt area, and an estimate of expenses per day, and (4) information on identification of whooping cranes and other protected avian species that could be mistakenly identified as a sandhill crane. Beginning in 1993, a toll-free telephone information system was established where hunters could access current information on the status of hunt periods, particularly hunt closures when harvest quotas were reached or spot closures due to the presence of whooping cranes.

Bird identification classes included information on the status and identification of whooping cranes and sandhill cranes within hunt areas. A presentation of color slides

Table 1. Combination of measurements used to identify subspecies of adult sandhill cranes wintering in New Mexico.

Subspecies		Measurements
Males		
Lesser		Posterior culmen ^a < 85 mm and tarsus ^b < 215 mm
Canadian		Posterior culmen ≥ 85 mm but < 99 mm and tarsus ≥ 215 mm and wing chord < 526 mm
Greater		Posterior culmen ≥ 99 mm and tarsus ≥ 215 mm or wing chord ≥ 526 mm and tarsus ≥ 215 mm
Females		
Lesser		Posterior culmen < 81 mm and tarsus < 210 mm
Canadian		Posterior culmen ≥ 81 mm and posterior culmen < 90 mm and tarsus ≥ 210 mm and wing chord < 520mm
Greater		Posterior culmen ≥ 90 mm and tarsus ≥ 210 mm or wing chord ≥ 520 mm and tarsus ≥ 210 mm

^a Posterior culmen = culmen from posterior edge of nostril to tip of maxilla.

^b Tarsus = diagonal of tarso-metatarsus (Baldwin et al. 1931).

showing these species, sometimes in mixed species groupings, and an examination to test prospective hunters' ability to distinguish a safe shooting situation from one that was not (e.g., a situation that might result in a species other than a sandhill crane being shot) were administered. Persons passing the test were issued certificates valid for 3 years before testing was required again for re-certification. Persons failing the test were ineligible to hunt cranes that particular year but were eligible to take an exam the following year. Details of testing procedures were provided by Edens (1992).

During 1982–83, 1983–84, and 1984–85 SWNM crane hunting seasons and 1994–95 MRGV crane hunting seasons, hunters were required to check in and out daily at check stations and submit completed questionnaires and/or provide information concerning their hunt. In all other hunt seasons, hunters were requested to return by mail completed questionnaires summarizing their hunting activities.

Check Stations

Cranes that were brought to check stations located near popular hunting areas were examined by NMGF biologists to determine sex (by examination of gonads), age, and subspecific identification. In the MRGV, check stations were located at Los Lunas, Bosque del Apache NWR, Belen area, San Antonio area, and at the Bernardo Wildlife Management Area. During the first season in 1986, 3 check stations were operational (Bosque del Apache NWR, Interstate 25 at north Belen exit, and at the junction of New Mexico Highways 47 and 6); in subsequent years, 1–2 check stations were operated. During 1986–89 seasons, check stations were open during weekends, and in 1990–95, stations were operated daily. For SWNM hunts, 1982–94, check stations were located near Deming and Hatch, and in 1994–95 a check station was operated only at Hatch. These check stations were operated daily. Annual projections of hunter participation,

success, and crippling losses were made from data gathered at check stations and from questionnaires returned by hunters.

Age Determination

Specimens with red to reddish-orange colored papillose skin on their crowns and foreheads and having generally uniform gray plumage on the nape and secondary wing coverts were classified as adults. Cranes with fully feathered crowns/foreheads with brownish to various shades of gray feathers were classified as juveniles (Miller and Hatfield 1974, Lewis 1979). Drewien et al. (1995) noted juvenile greaters with adult-like head characteristics as early as October, and by late January as many as 54.4% juveniles had crowns that were partially red and up to 38.4% of juveniles had adult-like, red crown characteristics. Therefore, during our study, cranes with juvenal plumage on the nape (buff to brownish-tipped plumage) and secondary wing coverts (buff-colored plumage) were classified as juveniles even if they had adult-like heads.

Determination of Subspecies

Measurements (mm) of wing chord, posterior nares–culmen (posterior culmen), and tarsus (Baldwin et al. 1931) were recorded for each specimen. Beginning in 1987, additional measurements included anterior nares–culmen (anterior culmen), tail, and mass (g). Measurements (Table 1) on wing chord, tarsus, and culmen (culmen from posterior edge of nostril) from Walkinshaw (1965), Johnson and Stewart (1973), Aldrich (1979), Hubbard (1986), and Lockman et al. (1987) were used in comparisons with measurements of adult cranes of known sex that we examined. Adult cranes of known sex for which we had critical measurements (posterior culmen, wing chord, and tarsus) were compared with measurements listed in Table 1 and

Table 2. Characteristics of hunting seasons for sandhill cranes in the middle Rio Grande Valley and southwest New Mexico, 1982–83 to 1994–95.

Hunt area and year	Dates	No. of days	No. of permits	Daily limit	Season limit	Hunt area and year	Dates	No. of days	No. of permits	Daily limit	Season limit
Southwest ^a						Southwest ^c (continued)					
1982–83	30 Oct– 1 Nov	3	40	3	3	1992	17 Jan– 19 Jan	3	350 ^f	3	3
	4 Dec– 5 Dec	3	40	3	3		24 Jan– 26 Jan	3		3	3
	15 Jan– 17 Jan	3	40	3	3	1993	22 Jan– 24 Jan	3	250 ^f	3	9
1983–84	28 Oct– 30 Oct	3	40	3	3		29 Jan– 31 Jan	3		3	9
	16 Dec– 18 Dec	3	40	3	3	1994	8 Jan– 9 Jan	2	100	3	6
	13 Jan– 15 Jan	3	40	3	3	1994–95	17 Dec– 18 Dec	2	75	2	4
1984–85	15 Jan– 17 Jan	3	40	3	3		14 Jan– 15 Jan	2	75	2	4
	27 Oct– 29 Oct	3	40	3	3	Middle Rio Grande ^d					
	15 Dec– 17 Dec	3	40	3	3	1986	16 Oct– 31 Oct	16	730	3	3
1984–85	12 Jan– 14 Jan	3	40	3	3	1987	17 Oct– 24 Oct	8	500	3	9
							25 Oct– 31 Oct	7	500	3	9
							15 Oct– 22 Oct	8	365	3	9
Southwest ^b						1988	23 Oct– 30 Oct	8	365	3	9
1982–83	30 Oct– 1 Nov	3	40	3	3		18 Oct– 24 Oct	7	365	3	9
	4 Dec– 5 Dec	3	40	3	3		25 Oct– 31 Oct	7	365	3	9
	15 Jan– 17 Jan	3	40	3	3	1989	26 Oct– 28 Oct	3	300	3	3
1983–84	28 Oct– 30 Oct	3	40	3	3		18 Oct– 21 Oct	4	750 ^f	3	3
	16 Dec– 18 Dec	3	40	3	3		25 Oct– 28 Oct	4		3	3
	13 Jan– 15 Jan	3	40	3	3	Middle Rio Grande ^e					
1984–85	27 Oct– 29 Oct	3	40	3	3	1992	16 Oct– 18 Oct	3	450 ^f	3	9
	15 Dec– 17 Dec	3	40	3	3		23 Oct– 25 Oct	3		3	9
	12 Jan– 14 Jan	3	40	3	3		30 Oct– 31 Oct	2	100 ^f	3	6
Southwest ^c						1993–94	15 Jan– 16 Jan	2		3	6
1989	6 Jan– 8 Jan	3	350 ^f	3	9		4 Dec– 5 Dec	2	100 ^f	3	6
	13 Jan– 15 Jan	3		3	9		12 Jan– 13 Jan	2		3	6
	20 Jan– 22 Jan	3		3	9	1994–95	18 Dec– 19 Dec	2	100 ^f	3	6
1990	27 Jan– 29 Jan	3		3	9		25 Jan– 26 Jan	2		3	6
	6 Jan– 8 Jan	3	350 ^f	3	9		29 Oct– 30 Oct	2	75	2	4
	12 Jan– 14 Jan	3		3	9	1994–95	10 Dec– 11 Dec	2	75	2	4
1991	19 Jan– 21 Jan	3		3	9		7 Jan– 8 Jan	2	75	2	4
	26 Jan– 28 Jan	3		3	9		21 Jan– 22 Jan	2	75	2	4
	12 Jan– 13 Jan	2	300 ^f	3	3						
	19 Jan– 20 Jan	2		3	3						

^a Parts of Sierra, Doña Ana, and Luna Counties bounded by a line running south along I-25 from its junction with State Road 90 to intersection with I-10, along I-10 to U.S. 180, north along U.S. 180 to State Road 26, north along State Road 26 and 27 to State Road 90, east on State Road 90 to I-25.

^b That portion of Luna County south of I-10.

^c The portions of Luna, Sierra, and Doña Ana Counties bounded on the south by the U.S./Mexico border; on the west by the western Luna County line north to I-10, I-10 east to U.S. 180 north to N.M. 26, N.M. 26 northwest to N.M. 27 at Nutt, N.M. 27 north to N.M. 152 at Hillsboro; on the north by N.M. 152 from Hillsboro to I-25; on the east by I-25 south to I-10, I-10 west to the Luna County line, and the eastern Luna County line south to the U.S./Mexico border.

^d That part of the middle Rio Grande Valley bounded on the north by the south boundary of Isleta Pueblo; on the west by I-25, but including all portions of Bosque del Apache and Sevilleta NWR's lying west of I-25; on the south by the south boundary of Bosque del Apache NWR; on the east by Bosque NWR boundary from I-25 southeast then north to the refuge's northeast corner, then by a dirt road running southeast approximately 0.8 km from that corner to the western boundary of the White Sands Missile Range Extension Co-Use area (WSMREC), then by the WSMREC boundary north then east to the southeast corner of Sevilleta NWR, then by the eastern boundary of Sevilleta NWR north to U.S. 60, by U.S. 60 west to N.M. 47 (N.M. 304), and by N.M. 47 (N.M. 304) north to Isleta Pueblo.

^e Socorro and Valencia Counties.

^f Hunts combined.

classified as lessers, Canadians, or greater. Adults for which the sex could not be determined or that did not have a critical measurement were not identified subspecifically. To estimate

subspecific harvest of juveniles and appraise their differential vulnerability to hunting, we classified juvenile specimens subspecifically based on comparisons with measurements in

Table 3. Projected harvest, number of hunters, mean harvest per hunter, number of non-retrievables, and percent crippling loss of sandhill cranes in the middle Rio Grande Valley, New Mexico, winters 1986 to 1994.

Year	Harvest	No. of hunters	Harvest/hunter (\bar{x})	No. of cripples	Crippling loss (%)
1986	569	431	1.3	111	19.5
1987	985	498	1.9	166	16.8
1988	355	406	0.8	71	20.0
1989	700	366	1.9	202	28.8
1990	145	162	0.8	47	32.4
1991	209	252	0.8	21	10.0
1992	194	292	0.6	34	17.5
1993-94	459	158	2.9	66	15.0
1994-95	514	223	2.3	125	24.3
\bar{x}	458.2	309.7	1.4	94.0	20.4
SD	272.0	121.8	0.8	61.8	7.0

Table 1. Comparable morphological data on juveniles from other studies were unavailable. We tested for differential vulnerability of juveniles to hunting by using a comparison based on the difference $\pi_1 - \pi_2$ methodology described by McPherson (1990). Age ratio data of RMP greaterers and Mid-continent Population lessers occurring in winter flocks were from Drewien (1994) and Drewien et al. (1995).

Comparisons of Measurements of Subspecies

We did an analysis of variance of multiple comparisons (SAS Institute Inc. 1990) on 5 measurements (wing chord, posterior culmen, tarsus, tail, and mass) of males and females of the 3 subspecies to determine if these measurements differed between males and females of the same subspecies or among sexes of different subspecies. We also compared our measurements with those reported by Walkinshaw (1965), Johnson and Stewart (1973), Aldrich (1979), Hubbard (1986), and Lockman et al. (1987).

Other Information Collected from Crane Specimens

When possible, colors (Smithe 1975, 1981) of soft parts (tarsi, toes, bill, irides, and eye rings of juveniles) of specimens were recorded. Mass of each specimen was determined by Pesola balances with 50-g increments during 1982-90 and by electronic balances with accuracies of 1.0 g during 1991-95.

RESULTS

During 1982-83 to 1984-85, SWNM crane hunting

Table 4. Projected harvest, number of hunters, mean harvest per hunter, number of cripples, and percent crippling loss of sandhill cranes in southwest New Mexico, winters 1982 to 1994.

Year	Harvest	No. of hunters	Harvest/hunter (\bar{x})	No. of cripples	Crippling loss (%)
1982-83 ^a	78	61	1.2		
1982-83 ^b	35	98	0.3		
1983-84 ^a	69	81	0.8		
1983-84 ^b	33	91	0.3		
1984-85 ^a	65	71	0.9		
1984-85 ^b	36	41	0.8		
1989	212	140	1.5	57	26.8
1991	80	108	0.7	47	58.7
1992	73	80	0.9	32	43.8
1993	98	120	0.8	60	61.0
1994	64	44	1.4	20	31.2
1994-95	59	45	1.3	18	30.5
\bar{x}	100.2	108.8	0.9	39.0	41.9
SD	45.9	45.8	0.3	18.3	14.9

^a Parts of Sierra, Doña Ana, and Luna Counties bounded by a line running south along I-25 from its junction with State Road 90 to intersection with I-10, along I-10 to U.S. 180, north along U.S. 180 to State Road 26, north along State Road 26 and 27 to State Road 90, east on State Road 90 to I-25.

^b That portion of Luna County south of I-10.

seasons were conducted during October, November, December, and January and consisted of 3-day hunting seasons with 40 permits for each hunt. The daily bag and possession limits were 3 birds. SWNM crane hunting seasons were conducted during January in 1989-93 and in December in 1994-95. These seasons consisted of 2- to 3-day hunts with 100-350 permits available, a 2-3 daily bag limit, and a 3-9 possession limit. A summary of each SWNM season is provided in Table 2.

MRGV hunts during 1986-92 occurred during mid- to late October, and subsequent MRGV seasons occurred during October, December, and January. During 1986 and 1990, hunts consisted of a single season of 16 and 3 consecutive days, respectively. Subsequent hunting seasons consisted of 2-4 separate seasons consisting of 2-3 days. The number of permits during MRGV hunts varied from 75 to 750, daily bag limits varied from 2 to 3, and possession limits varied from 3 to 9 (Table 2).

In the MRGV the mean annual harvest during 9 seasons was 458.2 cranes and mean number of hunters was 309.7 (Table 3). Mean harvest per hunter was 1.4. Crippling losses averaged 93.6 cranes annually. The mean annual crippling loss was 20.4%. Similar data for SWNM hunts showed a mean annual harvest of 100.2 cranes and a mean of 108.8 hunters (Table 4). The mean harvest per hunter was 0.9. The

Table 5. Subspecific and sex composition of adult sandhill crane specimens examined at hunter check stations in the middle Rio Grande Valley, New Mexico, winters 1982 to 1994.

Year	Lessers				Canadians				Greateres			
	Males	Females	Total	% ^a	Males	Females	Total	% ^a	Males	Females	Total	% ^a
1983-84 ^b	4	3	7	13.2	1	2	3	5.7	26	17	43	81.1
1984-85 ^b	0	0	0	0.0	2	1	3	11.5	21	2	23	88.5
1986	33	30	63	26.0	3	11	14	5.8	78	87	165	68.2
1987	27	23	50	32.5	6	1	7	4.5	50	47	97	63.0
1988	9	13	22	35.5	2	2	4	6.4	22	14	36	58.1
1989	12	6	18	19.1	7	4	11	11.7	35	30	65	69.1
1990	13	9	22	36.7	4	1	5	9.0	19	14	33	55.0
1991	24	28	52	82.5	0	1	1	1.5	5	5	10	15.9
1992	20	28	48	40.7	3	1	4	3.4	32	34	66	55.9
1993-94	8	5	13	4.3	14	10	24	8.0	141	121	262	87.6
1994-95	18	9	27	7.6	23	18	41	11.6	143	142	285	80.7
\bar{x}	15.0	14.2	29.2	27.1	5.9	4.7	10.6	7.1	52.0	46.6	98.6	65.7
SD	9.6	11.6	20.7	23.1	6.9	5.6	12.0	3.5	48.3	48.3	96.4	20.6

^a Percent of annual total.^b In 1983-84 and 1984-85, specimens were collected for research studies and were not taken during hunting seasons.

mean annual crippling loss was 39.0 cranes and mean crippling loss per season was 41.9%.

In the MRGV greateres comprised most of the harvest (65.7%), followed by lessers (27.1%) and Canadians (7.1%) (Table 5). Lessers were more abundant (66.6%) in SWNM, followed by greateres (20.3%) and Canadians (13.0%) (Table 6).

Sex and age of crane specimens are summarized in Tables 7 and 8. The harvest of adult males by subspecies in

the MRGV (Table 9) was 55% for lessers (not different from 50%, $P = 0.94$), 54% for Canadians (not different from 50%, $P = 0.49$), and 57% for greateres (different from 50%, $P = 0.001$). In SWNM, males accounted for 56% of lessers (different from 50%, $P = 0.04$), 74% of Canadians (different from 50%, $P = 0.002$), and 51% of greateres (not different from 50%, $P = 0.836$). Mean harvest of juveniles (subspecies combined) was 13.4% in the MRGV and 14.2% in SWNM. In the MRGV, sex ratios (male:female) of lessers

Table 6. Subspecific and sex composition of adult sandhill crane specimens examined at hunter check stations in southwest New Mexico, winters 1982 to 1994.

Year	Lessers				Canadians				Greateres			
	Males	Females	Total	% ^a	Males	Females	Total	% ^a	Males	Females	Total	% ^a
1982-83	18	3	21	45.7	17	3	20	43.5	4	1	5	10.8
1983-84 ^b	40	20	60	72.3	1	2	3	3.6	11	9	20	24.1
1984-85 ^b	40	23	63	85.1	2	0	2	2.7	5	4	9	12.1
1989	19	20	39	60.9	3	5	8	12.5	12	15	27	26.6
1991	20	18	38	100.0	0	0	0	0.0	0	0	0	0.0
1992	13	9	22	64.7	3	1	4	11.7	2	6	8	23.5
1993	18	19	37	60.7	4	2	6	9.8	8	10	18	29.5
1994	7	14	21	41.2	9	4	13	25.5	12	5	17	33.3
1994-95	4	5	9	69.2	1	0	1	7.7	1	2	3	23.0
\bar{x}	19.8	14.5	34.4	66.6	4.4	1.8	6.3	13.0	6.1	5.7	9.8	20.3
SD	12.7	7.2	18.3	18.2	5.4	1.8	6.5	13.6	4.8	4.8	6.9	10.6

^a Percent of annual total.^b In 1983-84 and 1984-85, specimens were collected for research studies and were not taken during hunting seasons.

Table 7. Sex and age of sandhill crane specimens examined at hunter check stations in the middle Rio Grande Valley, winters 1986–94.

Year	Adult			Juvenile			Sex undetermined			Combined total cranes			
	Male	Female	Total	Male	Female	Total	Adult	Juvenile	Total	Adult	Juvenile (%) ^a	Male	Female
1983–84 ^b	32	22	54	1	2	3	1	3	4	55	6 (9.9)	33	24
1984–85 ^b	25	13	38	0	1	1	6	0	6	44	1 (2.2)	25	14
1986	123	145	268	16	12	28	24	17	41	292	45 (13.3)	139	157
1987	87	81	168	12	3	15	7	16	23	175	31 (15.0)	99	84
1988	37	33	70	5	2	7	3	3	6	73	10 (12.0)	42	35
1989	55	51	106	4	3	9	10	3	13	116	12 (9.3)	59	54
1990	36	27	63	14	7	21	1	7	8	64	28 (30.4)	50	34
1991	30	36	66	12	10	22	2	5	7	68	27 (28.4)	42	46
1992	57	66	123	13	6	19	0	1	1	123	20 (13.9)	70	72
1993–94	170	153	323	6	13	19	10	3	13	333	22 (6.2)	176	166
1994–95	194	198	392	15	14	29	2	0	2	394	29 (6.8)	209	212
\bar{x}	76.9	75.0	153.5	8.9	6.6	15.7	6.0	5.2	11.2	149.2	20.2 (13.4)	85.9	81.6
SD	59.8	62.5	123.5	5.8	4.9	9.6	7.0	5.9	11.6	117.4	12.9 (8.8)	62.4	66.5

^a Percent of annual total.^b Specimens collected in 1983–84 and 1984–85 were for research studies and were not taken during hunting seasons.

averaged 55:45, Canadians 54:46, and greater 57:43 and, in SWNM, lessers 56:44, Canadians 74:26, and greater 51:49 (Table 9). Sex ratios for juveniles (subspecies combined) were 57% males in the MRGV and 76% males in SWNM.

In the MRGV the subspecific composition consisted of 21.3% lessers, 7.5% Canadians, and 71.2% greater. In the LRGV portion of Southwest Hunt Area 1 (Rio Grande floodplain), the subspecific composition was 48.1% lessers, 15.3% Canadians, and 36.6% greater. The subspecific composition from the floodplain of the Rio Grande Valley (MRGV and LRGV combined) consisted of 24.6% lessers,

8.5% Canadians, and 66.9% greater. In other SWNM hunting areas outside the LRGV, the subspecific composition was 87.6% lessers, 1.4% Canadians, and 10.9% greater (Table 10).

We estimated that approximately 52.9% of the juveniles killed by hunters in the MRGV were lessers, 12.3% Canadians, and 34.7% greater. Respective estimates for SWNM were 88.0% lessers, 1.5% Canadians, and 10.4% greater. The mean harvest of 5.7% juvenile greater we recorded in the MRGV varied from 2.7% in 1988 to 16.7% in 1991 (Table 11). In the MRGV the percent RMP harvest of

Table 8. Sex and age of sandhill crane specimens examined at hunter check stations in southwest New Mexico, winters 1982–94.

Year	Adult			Juvenile			Sex undetermined			Combined total cranes			
	Male	Female	Total	Male	Female	Total	Adult	Juvenile	Total	Adult	Juvenile (%) ^a	Male	Female
1982–83	92	15	107	17	3	20	0	0	0	107	20 (15.7)	19	18
1983–84	53	32	85	9	3	12	1	6	7	86	18 (17.3)	62	35
1984–85	51	31	82	6	1	7	6	6	12	88	13 (12.9)	57	32
1989	38	44	82	5	2	7	9	6	15	91	13 (12.5)	43	46
1991	21	19	40	9	5	14	0	0	0	40	14 (25.9)	30	24
1992	21	17	38	6	1	7	1	1	2	39	8 (17.1)	27	18
1993	31	32	63	3	1	4	0	0	0	63	4 (6.0)	34	33
1994	29	23	52	1	0	1	1	0	1	53	1 (1.9)	30	23
1994–95	6	7	13	1	2	3	0	0	0	13	3 (18.7)	7	9
\bar{x}	38.0	24.4	62.4	6.3	2.0	8.3	2.0	2.1	4.1	64.4	10.4 (14.2)	44.3	26.4
SD	25.1	11.3	29.4	5.0	1.5	6.0	3.2	2.9	5.8	30.7	6.7 (7.1)	29.3	11.1

^a Percent of annual total.

Table 9. Sex ratios of sandhill crane specimens examined at hunter check stations in the middle Rio Grande Valley, winters 1986–94, and southwest New Mexico, winters 1982–94.

Hunt area and year	Lessers		Canadians		Greater	
	<i>n</i>	♂♂:♀♀	<i>n</i>	♂♂:♀♀	<i>n</i>	♂♂:♀♀
Middle Rio Grande Valley						
1983–84 ^a	7	57:43	3	33:67	43	61:39
1984–85 ^a	0		3	67:33	23	91:9
1986	63	52:48	14	21:79	165	47:53
1987	50	54:46	7	86:14	97	52:48
1988	22	41:59	4	50:50	36	61:39
1989	18	68:32	11	64:36	65	54:46
1990	22	59:41	5	80:20	33	58:42
1991	52	46:54	1	0:100	10	50:50
1992	48	41:59	4	75:25	66	49:51
1993–94	13	61:39	24	58:42	262	54:46
1994–95	27	68:32	41	56:44	285	50:50
Southwest New Mexico						
1982–83	21	86:14	20	85:15	5	80:20
1983–84	60	67:33	3	33:67	20	55:45
1984–85	63	64:36	2	100:0	9	56:44
1989	39	49:51	8	60:40	27	44:56
1991	38	53:47	0		0	
1992	22	60:40	4	75:25	8	25:75
1993	37	49:51	6	68:32	18	44:56
1994	21	34:66	13	70:30	17	71:29
1994–95	9	44:56	1	100:0	3	33:67

^a Specimens collected in 1983–84 and 1984–85 were for research studies and were not taken during hunting seasons.

juveniles was significantly higher in 1986 (14.9%, $P < 0.001$) and 1993–94 (12.4%, $P < 0.001$) than the 5.1% (SD = 1.1) of juvenile greater comprising RMP cranes reported from the MRGV and SWNM winter recruitment surveys conducted during 1986–94 (Drewien 1994, Drewien et al. 1995). The mean harvest of 36.9% juvenile lessers recorded from the MRGV ranged from 14.2% in 1989 to 48.8% in 1990 (Table 11). The percentage of juvenile lessers harvested in the MRGV during our study was significantly higher in 1986 (20.2%, $P = 0.026$), 1987 (25.3%, $P = 0.004$), 1990 (48.8%, $P < 0.001$), 1991 (36.6%, $P < 0.001$), 1992 (23.8%, $P = 0.010$), 1993–94 (33.3%, $P = 0.023$), and 1994–95 (25.0%, $P = 0.029$) than 11.2% (SE = 0.3) of juvenile lessers reported from western New Mexico during 1987–92 by Drewien et al. (1995). The mean percentage of juvenile lessers harvested in SWNM was 20.5% and ranged from 4.5% in 1994 to 26.7% in 1992 (Table 11). The percentage of juvenile lessers harvested in SWNM during our study was significantly higher in 1983–84 (18.9%, $P = 0.05$) and 1992 (26.7%, $P = 0.028$) than the 11.2% reported

by Drewien et al. (1995). For other years, percentages were either not significantly different or sample sizes were too small for analysis.

Soft part colors of adult cranes showed irides of varying shades of orange. Of 1,145 adults examined for a color match of the irides, 45.2% were spectrum orange, 29.4% were chrome orange, 21.2% were orange yellow, and 4.2% were flame scarlet. Juveniles had irides that were various shades of light brown to dark brown and most had conspicuous buff to buff-yellowish eye rings. Juveniles examined for color matches of irides revealed that approximately 75% were buff and 25% were burnt umber. Adults had dusky brown to blackish maxillas and mandibles with varying amounts of olive-brown and smoke gray-colored areas on the sides of the bill. Adults and juveniles typically had blackish-colored tarsi and toes. Juveniles typically had bills that were various shades of brown, including dusky brown, olive-brown, and raw umber.

An analysis of variance of multiple comparisons of the 15 subspecies-sex (6 combinations) and measurement (5 variables) combinations revealed that 13 of these combinations were significantly different ($P < 0.001$). Tail and wing chord measurements of male Canadians and female greater were the only sex-subspecies and measurement combinations that did not differ significantly (Table 12).

Morphological data we collected are similar to those reported by Walkinshaw (1965), Johnson and Stewart (1973), Aldrich (1979), Hubbard (1986), and Lockman et al. (1987) (Table 13). Our mean values of wing chord measurements on female Canadians were significantly larger ($P < 0.05$) than similar measurements reported by Johnson and Stewart (1973) and Aldrich (1979). Our mean values of wing chord measurements on female greater were significantly smaller ($P < 0.05$) than measurements reported by Lockman et al. (1987) and significantly larger ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and Hubbard (1986). Our mean values of wing chord measurements on male Canadians were significantly larger ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and Aldrich (1979). Our mean wing chord measurements on male greater were significantly smaller ($P < 0.05$) than measurements reported by Lockman et al. (1987) and significantly larger ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and Hubbard (1986). Posterior culmen measurements on female lessers during our study were significantly smaller ($P < 0.05$) than measurements reported by Johnson and Stewart (1973); they were on female greater significantly larger ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and significantly smaller ($P < 0.05$) than measurements reported by Aldrich (1979). Our mean measurements of posterior culmen on male lessers were

Table 10. Subspecific composition of sandhill cranes harvested in the Rio Grande Valley and southwest New Mexico, winters 1982–94.

Hunt area and county	Lessers		Canadians		Greater	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Middle Rio Grande Valley						
Socorro	296	22.2	97	7.3	942	70.6
Valencia	31	15.3	19	9.4	152	75.2
Total and \bar{x}	327	21.3	116	7.5	1,094	71.2
Lower Rio Grande Valley ^a						
Sierra	82	45.6	30	16.7	68	37.8
Doña Ana	22	61.1	3	8.3	11	30.6
Total and \bar{x}	104	48.1	33	15.3	79	36.6
MRGV/LRGV combined	431	24.6	149	8.5	1,173	66.9
Southwest New Mexico ^b						
Sierra	5	50.0	0	0.0	5	50.0
Luna	179	89.5	3	1.5	18	9.0
Total and \bar{x}	184	87.6	3	1.4	23	10.9

^a Areas within southwest hunting boundaries that were within the Rio Grande Valley floodplain.^b Areas within southwest hunting boundaries that were outside of the Rio Grande Valley floodplain.

significantly smaller ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and on male Canadians were significantly larger ($P < 0.05$) than measurements reported by Johnson and Stewart (1973) and Aldrich (1979). Our mean

tarsus measurements were significantly larger ($P < 0.05$) for female Canadians than those reported by Aldrich (1979) and for female greater than measurements reported by Hubbard (1986). Our mean tarsus measurements on male greater were significantly larger ($P < 0.05$) than measurements reported by Hubbard (1986). Our mean mass measurements on lessers were significantly smaller ($P < 0.05$) than data reported by Johnson and Stewart (1973) and significantly larger ($P < 0.05$) for Canadians and greater than data reported by Johnson and Stewart (1973).

Table 11. Estimated juvenile crane harvest by subspecies in the middle Rio Grande Valley, New Mexico, winters 1986 to 1994 and in southwest New Mexico, winters 1983 to 1994.

Hunt area and year	Percent of annual total		
	Lessers	Canadians	Greater
Middle Rio Grande Valley			
1986	20.2	5.0	14.9
1987	25.3	36.3	8.5
1988	18.5	50.0	2.7
1989	14.2	21.4	5.7
1990	48.8	50.0	5.7
1991	36.6	50.0	16.7
1992	23.8	0	7.0
1993–94	33.3	4.0	12.4
1994–95	25.0	16.3	4.0
Southwest New Mexico			
1983–84	18.9	0	16.6
1984–85	16.0	0	10.0
1989	15.2	11.1	6.9
1991	20.8	0	0
1992	26.7	0	0
1993	9.6	0	0
1994	4.5	0	0
1994–95	27.2	0	0

DISCUSSION

A major concern in designing our hunting seasons was not to exceed annual harvest quotas of RMP greater allocated to New Mexico. In all years except 1989, we achieved this goal. Achieving the yearly allotment during 1989 MRGV hunts required cancellation of January 1990 SWNM crane hunts. In 1993–94 MRGV hunts, the final 2 hunt segments were also canceled for similar reasons. In both instances, hunters were notified of these closures by letter and, during 1993–94 MRGV hunts, by mail and information made available on a toll-free telephone message. Hunter training and certification along with hunt designs appeared adequate to protect whooping cranes and none were known to be shot during the sandhill crane hunting seasons.

Subspecies distribution varied in different hunt areas. Greater comprised a larger proportion of the harvest at northern winter sites in the MRGV, whereas lessers predominated in SWNM hunts. Drewien and Bizeau (1974) noted a

Table 12. Morphometry (mm) and mass (g) of sandhill crane specimens examined at hunter check stations in the Middle and Lower Rio Grande Valley and southwest New Mexico during winters 1982-94.

Subspecies	Female						Male					
	Wing chord	Posterior culmen	Tarsus	Anterior culmen	Tail	Mass	Wing chord	Posterior culmen	Tarsus	Anterior culmen	Tail	Mass
Lessers												
<i>n</i>	284	284	284	204	191	201	331	331	331	214	240	218
\bar{x}	448.4	68.8	176.2	57.9	162.7	2,954.5	472.8	73.2	186.0	61.4	171.2	3,434.1
SD	19.0	4.0	11.5	3.7	3.7	271.1	20.1	4.3	12.0	3.8	9.1	273.3
SE	1.1	0.2	0.7	0.7	0.3	19.1	1.1	0.2	0.7	0.3	0.6	18.5
min.	401	58.0	115	49.1	141	2,272	426	56.6	147	53.2	141	2,600
max.	545	80.0	206	70.4	209	3,827	535	84.1	214	76.1	211	4,250
Canadians												
<i>n</i>	65	65	65	50	44	50	89	89	89	80	72	79
\bar{x}	495.6	86.9	221.3	74.8	188.3	4,700.7	509.6	94.8	232.9	79.7	195.5	5,153.7
SD	19.5	2.0	7.9	2.5	10.3	366.4	12.6	2.8	9.0	3.1	10.5	385.8
SE	2.4	0.3	1.0	0.4	1.6	51.8	1.3	0.3	1.0	0.4	1.2	43.4
min.	382	81.1	210	69.3	162	3,800	434	87.6	216	70.9	165	4,155
max.	519	89.8	248	79.8	209	5,412	525	98.8	259	87.3	213	5,900
Greater												
<i>n</i>	573	573	573	443	397	445	624	621	621	484	446	481
\bar{x}	513.9	97.7	227.5	82.0	193.5	4,928.3	537.6	103.6	239.3	86.8	203.8	5,554.3
SD	18.3	5.4	9.8	4.8	9.8	413.2	18.7	5.7	10.5	4.9	9.6	487.8
SE	0.7	0.2	0.4	0.2	0.5	19.6	0.8	0.2	0.4	0.2	0.5	22.2
min.	463	82.7	210	62.0	160	2,604	424	84.0	215	72.5	172	3,268
max.	597	121.0	271	103.9	228	6,350	590	132.5	280	105.2	250	6,850

similar distribution; greater dominated on northern winter sites in the MRGV and lessers predominated on southern winter sites.

Crane hunts in the MRGV and SWNM can be administered to provide limited permit hunting commensurate with the status of RMP cranes. Generally, participating hunters have demonstrated a willingness to follow guidelines that protected whooping cranes and other non-hunted avian species. They have also become familiar with and supported a harvest allocation that was based on the status of RMP cranes. Permit requirements and mandatory check stations were accepted by most hunters. A recently adopted system of mandatory check in/out check stations has allowed for an accurate measure of harvest, hunter participation, and eliminated the need of projecting harvest estimates based on incomplete samples of questionnaires. This system has proven to be accurate, acceptable by most hunters, and more efficient for NMGF personnel.

Males consistently outnumbered females in hunter-harvested cranes; however, we have no data that supported findings by Tacha and Vohs (1984) that Mid-continent male cranes were 1.3 times more vulnerable than females to harvest. The sex ratio of 74% male Canadians in SWNM

may have resulted from a relatively small sample size. We have no data that suggested Canadian males were more vulnerable to hunting than males of other subspecies. Our findings of 51-57% male greater in the harvest are similar to 55% males in harvested greater in Wyoming (Lockman et al. 1987).

Our data indicate that lesser and greater juveniles were more vulnerable to harvest than adults during most years. Greater vulnerability of juvenile sandhill cranes to hunting is not unexpected; however, the impacts of this differential vulnerability on the population are unknown and warrant further investigation.

Morphometric and mass data we collected on 3 migratory subspecies showed a number of significant differences when compared with similar data reported from other studies. We attribute most of these differences to our much larger sample sizes and associated larger variations resulting from large samples. We assume that in other studies morphometric data were collected with similar techniques, although most of these studies did not report specific methodology. Use of different techniques could contribute to some of the differences noted. For example, the diagonal measurement of the tarsus (Baldwin et al. 1931) in this study is different from the

Table 13. Comparison^a of measurements of wing chord, posterior culmen, tarsus, and mass of sandhill cranes from various studies.

Measurement and subspecies	Female						Male						Reference ^b
	<i>n</i>	\bar{x}	SD	SE	min.	max.	<i>n</i>	\bar{x}	SD	SE	min.	max.	
Wing Chord (mm)													
Lessers	17	451.2			420	490	33	475.6			439	503	1
	17	445.7	12.0		421	464	31	467.0	15.5		419	502	2
	23	447.2	18.1	3.8	420	490	44	468.5	19.9	3.0			3
	35	450.2	17.1		414	487	57	469.8	17.6		420	510	4
	284	448.4	19.0	1.1	401	545	331	472.8	20.1	1.1	426	535	6
Canadians	3	472.6			456	495	7	507.3			480	524	1
	33	475.5*	14.3		434	505	51	503.0*	12.9		469	530	2
	4	474.3*	14.7	7.4	456	492	20	497.3*	12.8	4.0	482	525	3
	1	500.0					2	507.0			500	514	4
	65	495.6	19.5	2.4	382	519	89	509.6	12.6	1.3	434	525	6
Greaterers	9	546.0			510	575	8	561.5			526	598	1
	10	487.3*	13.8		472	524	11	518.9*	9.4		504	531	2
	13	523.4	29.4	8.2	490	575	17	547	26.2		502	598	3
	19	500.9*	16.8		472	523	30	528.0*	13.6		497	556	4
	90	524.0*	20.1		485	575	105	545.0*	20.9		495	600	5
573	513.9	18.3	0.7	463	597	624	537.6	18.7	0.8	424	590	6	
Posterior culmen (mm)													
Lessers	17	67.4			63	74	33	71.4			65	76	1
	17	72.4*	4.0		63.7	78	31	76.5*	3.1		70.3	84.0	2
	14	69.9	4.7	1.3	62	76	20	71.5	4.6	1.0			3
	35	69.4	5.8		57	82	56	74.6	4.8		60	83	4
	284	68.8	4.0	0.2	58.0	80.0	331	73.2	4.3	0.2	56.6	84.1	6
Canadians	3	80.0			73	87	7	85			82	88	1
	33	86.7	3.3		82.8	94	51	92.1*	4.8		74	102	2
	3	82.7	8.4	4.8	73	88	6	89.5*	4.7	1.9	85	91	3
	1	87.0					2	92.5			87	98	4
	65	86.9	2.0	0.3	81.1	89.8	89	94.8	2.8	0.3	87.6	98.0	6
Greaterers	1	97					8	107.2			101	116	1
	10	93.5*	2.5		90	98	10	100.7	4.5		95	107	2
	8	100.1*	2.1	0.7	97	103	9	107.1	6.9	2.3	100	120	3
	18	100.1	6.7		91	114	30	106.9*	4.7		100	117	4
	89	99	4.8		86	110	109	105	6.9		88	120	5
573	97.7	5.4	0.2	82.7	121.0	621	103.6	5.7	0.2	84	132.5	6	
Tarsus (mm)													
Lessers	17	182.0			162	198	33	186.6			156	210	1
	17	179.2	10.8		165	197	31	187.5	14.4		151	203	2
	23	180.7	12.0	2.5	156	200	44	187.8	12.1	1.8			3
	35	170.0	13.1		139	196	56	185.3	12.0		166	207	4
	284	176.2	11.5	0.7	115	206	331	186.0	12.0	0.7	147	214	6
Canadians	3	210.6			205	216	7	222			216	239	1
	33	217.0	7.6		203	232	51	230.6	9.5		211	249	2
	4	212.3*	2.2	1.1	210	215	11	226.8	10.8	3.3	203	240	3
	1	220.0					2	219.5			212	227	4
	65	221.3	7.9	1.0	210	248	89	232.9	9.0	1.0	216	259	6
Greaterers	9	230.5			222	239	8	244.5			226	264	1
	10	228.3	6.3		219	235	11	236.5	8.3		227	253	2
	14	227.2	6.7	1.8	217	238	17	243.5	12.2	3.0	226	264	3
	19	220.4*	6.2		210	230	30	229.9*	7.6		217	242	4
	90	231	15.1		200	272	109	239	13.0		210	280	5
573	227.5	9.8	0.4	210	271	621	239.3	10.5	0.4	215	280	6	
Mass (g)													
Lessers	17	3,459.9*	250.1		2,866	3,829	31	3,945.6*	299.6		3,235	4,671	2
	201	2,954.5	271.1	19.1	2,272	3,827	218	3,434.1	273.3	18.5	2,600	4,250	6
Canadians	31	4,110.2*	251.9		3,676	4,895	49	4,794.8*	385.3		3,890	5,613	2
	50	4,700.7	366.4	51.8	3,800	5,412	79	5,153.7	385.8	43.4	4,155	5,900	6
Greaterers	9	4,453.7*	427.1		3,645	5,052	11	4,885.6*	370.8		3,870	5,432	2
	88	4,845	338		3,975	5,675	101	5,430	432		4,425	6,600	5
	445	4,928.3	413.2	19.6	2,604	6,350	481	5,554.3	487.8	22.2	3,268	6,850	6

^a **P* < 0.05, significantly different from comparable measurements in this study.^b 1=Walkinshaw (1965), 2=Johnson and Stewart (1973), 3=Aldrich (1979), 4=Hubbard (1986), 5=Lockman et al. (1987), 6=THIS STUDY.

lateral measurement parallel to the tarsal axis (Johnsgard 1983:240).

From our past experience and information derived from crane hunts in the MRGV and SWNM, we recommend the following:

1. NMGF should continue to monitor the MRGV and SWNM hunts by establishing mandatory check in/out check stations where harvested cranes can be examined. Objectives of check stations should include an intensive effort to gather additional data on sex, age, and subspecific composition of harvested cranes. Investigations should include initiatives to determine effects of timing, duration, and hunting methods on the sex, age, and subspecific harvest of cranes in relation to their use of wintering areas in the MRGV and SWNM.
2. All crane hunting seasons within the New Mexico range of the RMP should be carefully reviewed and conducted in a manner consistent with guidelines outlined in the Pacific and Central Flyways Management Plan (Smith 1991). Changes in proportions of subspecies composition by hunt areas should be closely followed to ensure that excessive harvest of greater does not occur.
3. NMGF should consider monitoring crane hunts in eastern New Mexico, including the Pecos Valley, primarily Chaves County, and major concentration areas in Curry and Roosevelt Counties.
4. NMGF should actively support and participate in Pacific and Central Flyway efforts to better understand the taxonomy, genetic composition, and distribution of all 3 migratory subspecies of cranes with particular emphasis on the Canadian subspecies, of which so little is known.

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