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THE ECOLOGY OF THE PLATTE RIVER
AS RELATED TO SANDHILL CRANES AND OTHER
WATERFOWL IN SOUTH CENTRAL NEBRASKA

A Thesis

Presented to the Faculty of the Graduate School
of Kearney State College
Kearney, Nebraska

by

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In Partial Fulfillment of the Requirements
for the Degree of
Master of Science in Education

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ABSTRACT

THE ECOLOGY OF THE PLATTE RIVER

AS RELATED TO SANDHILL CRANES AND OTHER WATERFOWL IN SOUTH-CENTRAL NEBRASKA

The purposes of the study were fulfilling the requirements of a Master's Degree Thesis and at the same time obtaining much-needed data for the Bureau of Sport Fisheries and Wildlife's Ecological Service Branch for its final analysis of the Mid-State Division Project. The U.S. Department of Interior's Bureau of Sport Fisheries and Wildlife indicated in their 1957 report on the project that losses to waterfowl would occur. As a result, Congress authorized, as part of the project, a Federal refuge and a state area to mitigate the damage to waterfowl resulting from the project. This study should provide significant information useful in selecting an area for the proposed refuge.

Much of the information and result of this study have already been used by the Bureau of Sport Fisheries and Wildlife in preparing its study and report on the federally authorized Nebraska Mid-State Irrigation Project, its feasibility study of establishing a national wildlife refuge along the Platte River, generally between Grand Island and Wood River, and the National Audubon Society's initiation of acquisition of lands between Gibbon and Kearney for a bird sanctuary.

The Platte River from Grand Island to Overton, Nebraska, is believed to be the world's largest congregation area for Sandhill Cranes. Approximately 80 percent of the total continental population use the Platte River Valley as a spring staging area.

Factors affecting the location and relative size of the major Sandhill Crane roosts include the availability of wet meadow habitat, the hydrology

of the Platte River, the magnitude of degradation of certain reaches of the river, and the cumulative effects of all these factors that comprise the complex.

During early March of most years, Sandhill Cranes "probe" for food in the wet meadows adjacent to the Platte River. They also feed in crop fields near the river in the vicinity of their preferred roosting sites. As the spring season progresses, the waste grains, tender vegetation, and the animal matter related to the wet meadow complexes are used to their capacity or availability to fulfill the population's daily food requirements. They are then forced to move to feeding grounds that have not been extensively utilized.

Greater Sandhill Cranes have been reported at several locations along the Platte River prior to this study. This study revealed one Greater between Grand Island and Alda, Nebraska, on March 13, 1971, and three Greaters five miles east of Kearney, Nebraska, on March 24, 1973.

A classification system for the Platte River was developed during this study. This system, based on the degree of degradation that has occurred since 1938, shows that only three reaches within the study area can be classified as pristine. The pristine reaches of the Platte River and their associated wet meadow complexes are the sites of the largest Sandhill Crane roosts. These areas comprise 59.5 percent of the wet meadows and 45.3 percent of the Sandhill Cranes based on the 1971-1973 annual spring surveys. These areas offer the optimum for future sanctuaries.

FOREWORD

Background of the Investigator

Many of the data from this study have already been used by several state and federal agencies in the analysis of the controversial Mid-State Division, Bureau of Reclamation, Project. The Bureau of Sport Fisheries and Wildlife Position Statement of November 17, 1971, (unpublished data) is one example. Therefore, it is appropriate that the readers of this thesis understand my background and the relationship between this study and my regular professional duties at the time this study was conducted.

From October 1963 to June 1973, I was a fish and wildlife biologist with the U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Ecological Services (formally known as the Missouri River Basin Studies), stationed at Grand Island, Nebraska. My primary duties were to investigate the effects of federal water development projects on the fish and wildlife resources and the general environment; to write reports that recommended ways to mitigate damages and means of enhancing the environmental resources involved; and to coordinate among state, federal, and private organizations the day-to-day activities to accomplish the recommendations set forth by the results of those investigations.

In 1967, the year the Mid-State Division Project was authorized by the Congress of the United States, I became involved with the primary task of providing technical assistance to the Bureau of Reclamation for pre-construction planning purposes. As engineering and hydrological data became available, it was evident that the Platte River and associated habitat could be significantly affected by the reduction of the flows in the Platte River. Many important research data, however, were lacking on significant wildlife

species that were known to frequent the Platte River Valley within the confines of the Mid-State Division Project, especially on the Sandhill Cranes.

Therefore, I decided to work toward a Master's Degree (at Kearney State College, Kearney, Nebraska,) and hopefully provide some of the much needed data through research. The college is located near the Platte River in the heart of the Mid-State Division Project. Its proximity is ideal for studying the waterfowl resources, the bird life and other environmental parameters that make the Platte River paramount in importance and international in scope.

In the spring of 1970, I began to study the ecology of the Sandhill Crane (Grus canadensis) along the Platte River in south-central Nebraska. The Bureau of Sport Fisheries and Wildlife granted permission for me to go on leave without pay status for approximately nine months. Field investigations, class work, and travel were conducted on vacation time, weekends and for the most part off-duty hours. One June 20, 1972, I was awarded the Bureau's Special Achievement Award for my efforts and contribution of data (from this study) for the Mid-State Division Project study. I have also been appointed one of nine committee members for the Management of Sandhill Cranes in the United States.

The following information concerning the importance of the Platte River has been obtained from the Bureau of Sport Fisheries and Wildlife, the Nebraska Game and Parks Commission, other research studies, and my own general observations during the nine and one-half years I spent along the Platte River.

INTRODUCTION

Importance of the Platte River

Waterfowl

A brief synopsis taken from the original diaries of members of the Lewis and Clark Expedition, as written in the volumes of Elliott Coues, and published by the Omaha District, Corps of Engineers, U. S. Army, (1952) states:

"Platte River-Missouri Equator-July 21, 1804-At 7 P.M., after covering 14 miles in the rain the party reached the great river Platte. . . Captains Lewis and Clark ascended the Platte for about one mile, reported the current very rapid and divided into a number of channels, none of which was deeper than 5 or 6 feet. One of the Frenchmen, who had spent two winters on it, said its depth was generally not more than 5 or 6 feet, with many islands, cannot be navigated by boats or periogues, though the Indians pass it in small flat canoes made of hides. They estimated the Platte River to be 600 yards wide at its mouth and about that many miles from St. Louis (1891 mileage - 638.4). All those who had not passed the Platte before were required to be shaved unless they could compromise with a treat. Much merriment was indulged on the occasion."

Lewis and Clark's Expedition stayed near the mouth of the Platte for five days exploring to the confluences of the Platte and Elkhorn Rivers. On July 28, 1804, the same diaries stated:

"The Missouri was becoming more crooked since they passed the Platte and generally not so rapid."

Apparently the Platte River's flow contributed significantly to the Missouri's volume and physical characteristics.

The U. S. Department of Interior, Bureau of Reclamation, (1951) stated:

"Prior to the Louisiana Purchase in 1803, little was known about the area now included within Nebraska. A few French and Spanish explorers had followed the Missouri River and scouted the extreme eastern and northern parts of the area, but the interior was known only to the Indian tribes living there. In 1804, Lewis

and Clark were commissioned by the United States government to explore the territory, and in doing so, followed the Platte River about two miles westward from its mouth, then returned east and followed another route to the Niobrara River.

"Between 1806 and 1819, other expeditions were organized. Pike traveled the Republican Valley, the Astorian Expedition traveled to the west coast and only seven members of the expedition followed the Platte River back when it returned, and Long followed the Platte River to Denver and later published the famous report in which he described the Platte Valley as a "Great Desert".

"It was not until 1841, when the Oregon Trail was opened, that settlers began to arrive in the Lower Platte River Basin. The Oregon Trail enters Nebraska from Kansas near the Gage and Jefferson County line, then winds northwest to cross the divide near Grand Island where it follows the south side of the Platte River to Big Springs in Keith County. Here it crosses the South Platte River and goes north to reach the North Platte River. It then follows the south side of the North Platte River to the Wyoming border.

"The Mormon or California Trail was started by Brigham Young and his followers in 1847 and followed the north side of the Platte and North Platte Rivers from Omaha to Fort Laramie, Wyoming, where it merged with the Oregon Trail. Another trail of some importance was the Nebraska City Cutoff which started at Nebraska City, went through the present site of Ashland, crossed the Big Blue River near Seward, and joined the Oregon Trail at the site of Fort Kearney."

The Platte River, as we know it today, is not the torrent river (in July) as Lewis and Clark knew it. One hundred sixty-seven years later its importance can best be illustrated by the contents of the following letter from Mr. Willard Barbee, Director, Nebraska Game and Parks Commission, to Congressman Henry S. Reuss, Chairman of the Conservation and Natural Resources Subcommittee, House of Representatives, dated May 28, 1971:

"We will confine our remarks relating to the adverse impact that channelization of the Platte would have on our wildlife resources to the effect that it would have on migratory waterfowl and cranes, since this impact is international in scope. We shall also further restrict our remarks to the Central portion of the Platte since data for this area is most readily available from the reevaluation of the previously mentioned Mid-State project.

"Ducks and geese approaching 1,000,000 in number annually take advantage of this portion of the river and the adjacent cropland during their spring migration. State and Canadian provinces of the Central Flyway have been concerned with the status of white-fronted geese for many years as evidenced by highly restrictive harvest regulations throughout the flyway. In 1971, spring waterfowl census showed 143,000 white-fronts using the Platte Valley in Nebraska. This was 85.2 percent of the total mid-continent population of this species.

"There are about a quarter of a million lesser Sandhill Cranes (over 80 percent of the total continental population) that use this area and a short reach of the North Platte River as a spring staging area.

"It may logically be argued that the primary resource, the Platte River, that supports this high use by migratory birds will be lost as a result of the virtual dewatering of the Platte by implementation of the authorized Mid-State Project. Congress may determine, however, that the project is environmentally infeasible based on the yet to be developed Environmental Impact Statement.

"We obviously have omitted many items that should be included in an enumeration of the impact that dewatering of streams for irrigation purposes and channel improvement would have on an Environmental Corridor. Based on present knowledge, some of these factors are known and some are not. An example of an unknown that should be considered is, What is the importance of pre-breeding season conditioning to the reproductive capacity of the ducks, geese, and cranes which congregate annually in our fertile Platte Valley?

"In answer to your questions on the impact on neighboring watersheds and the extent that we participate in planning of agency projects, let me briefly state that too many projects merely result in transferring problems to another area at the expense of another resource as we have attempted to illustrate.

"As regards our participation in planning, I would only say it has not been adequate. It must be realized, however, that ...almost all of the meager compensation that we have received to date from the losses sustained by the wildlife resource due to federal projects stems from our operation and management of project lands."

The importance of the Platte River, on a continental basis, can also be shown by the following letter dated April 28, 1973, to Dr. J.P. Linduska, Associate Director, U.S. Bureau of Sport Fisheries and

Wildlife, from Dr. John S. Tener, Director General, Canadian Wildlife Service

"My letter of February 8, 1972, expressing concern about the Mid-State Diversion Project was not merely related to the destruction of sandhill staging habitat. The Platte River bottom lands are important to whooping cranes and their loss would undoubtedly affect the migration routes of waterfowl"

From the remarks of Barbee and Tener it has already been established that the Platte River is an important spring migration route for waterfowl. However, little has been said about the importance of hunting.

Waterfowl hunting is an important recreational resource along the Platte River. Figure 1 shows the waterfowl killed during a one-day hunt about the turn of the century.

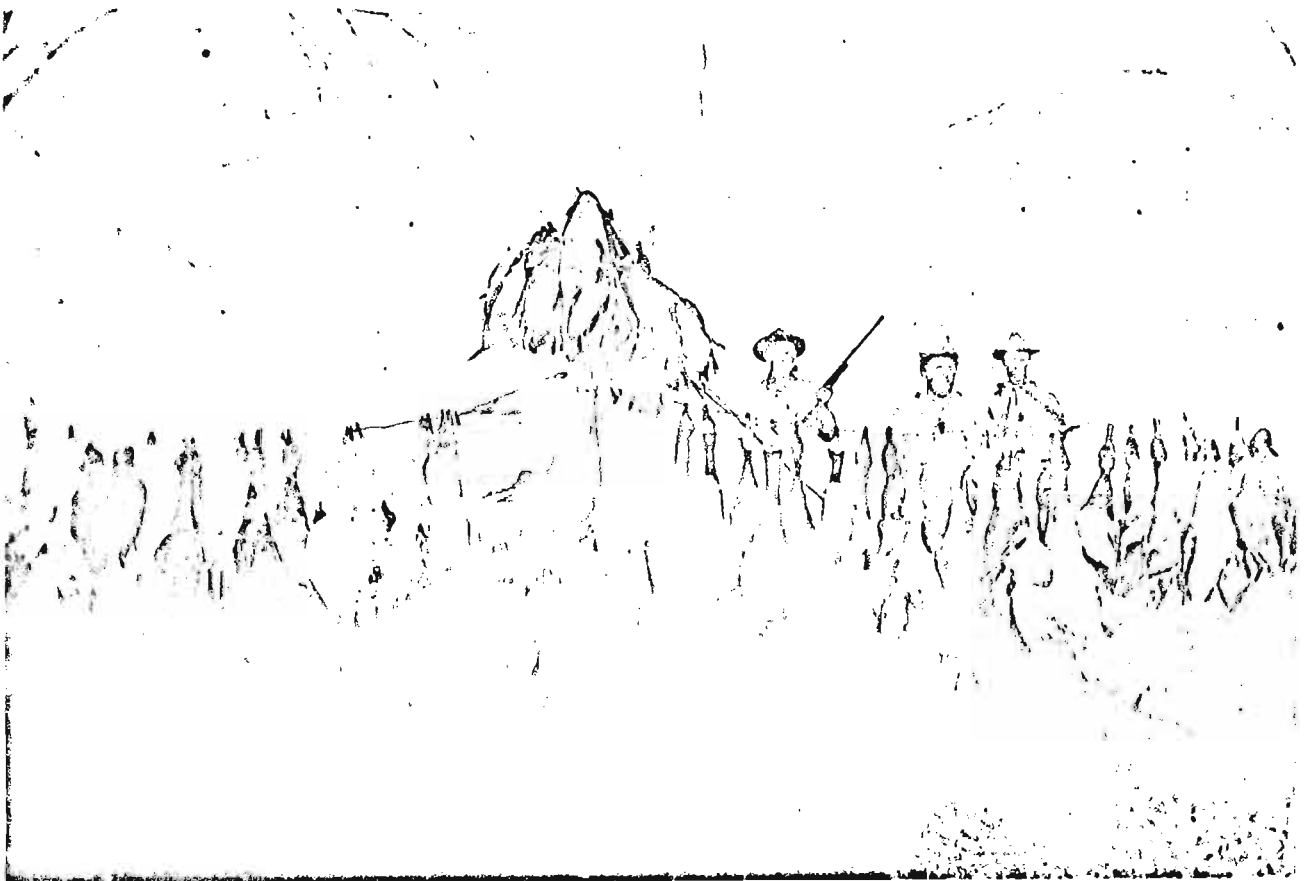


Fig. 1. One-Day's Kill. Photograph taken in April 1903, on the Platte River south of Aida, Nebraska. Courtesy of Mr. Gull Roushor and Bluh Museum, Grand Island, Nebraska.

The Nebraskaland Magazine featured an article entitled, "Mallards Meant Money". Norm Hellmers (1972), author, stated:

"Carl Wennerstem was alone, waiting for the first of the ducks to appear, and appear they did That day, when he took 153 mallards, Carl gave little thought to such notions. There were countless ducks. Besides, the delicious game birds meant money. Twenty-five ducks were tied together in a bunch, and each bunch was worth \$6.25."

Figure 2, taken about 1948, shows ducks and geese killed on the Platte River south of Wood River, Nebraska. The "camp log" of these hunters revealed kill data (1948-1971) as set forth in Table A of the Appendix (personal communication).

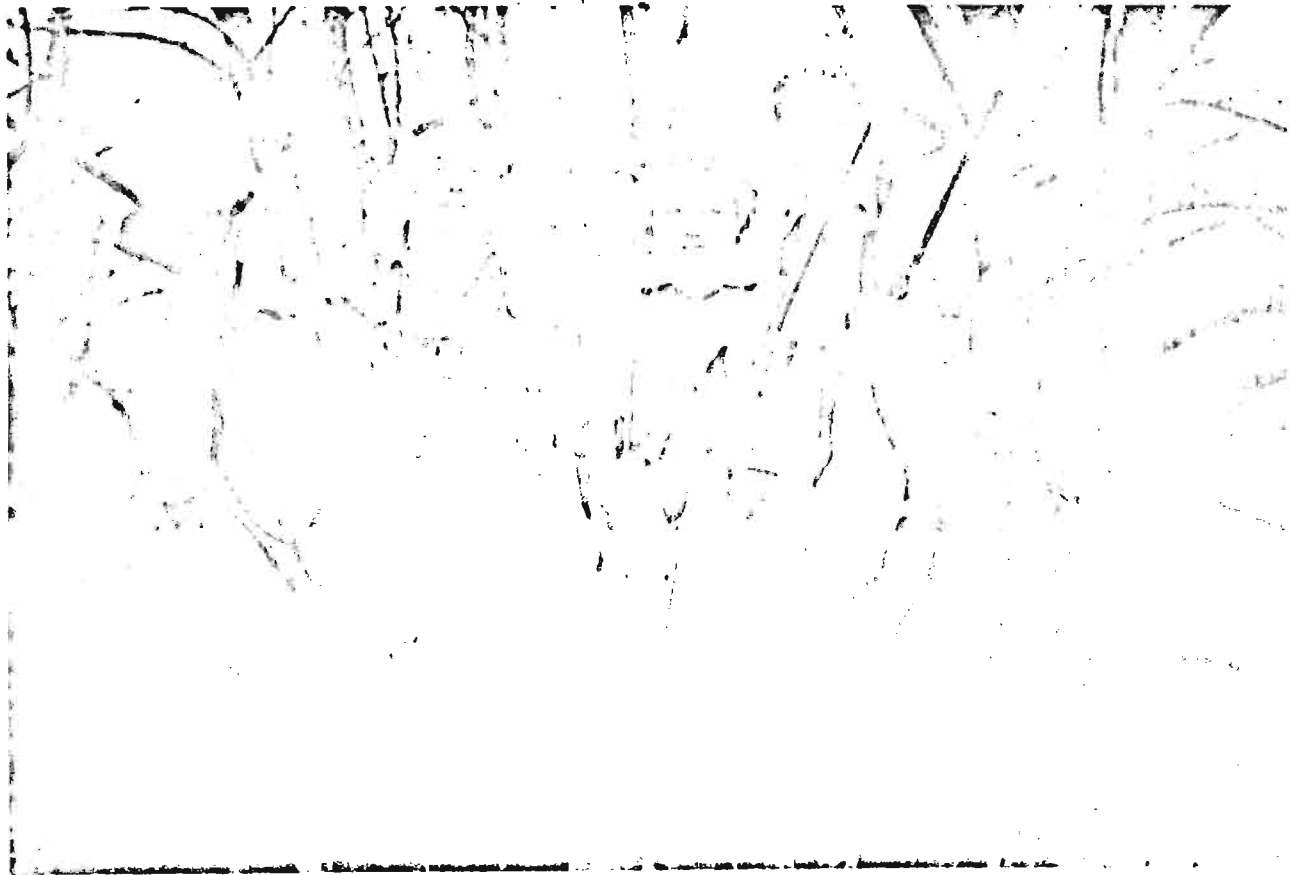


Fig. 2. Duck and Goose Kill. Photograph courtesy of Mrs. Detwiller, Grand Island, Nebraska.

Other "camp logs" and diaries give more precise dates of actual kills. Thus a more accurate picture is presented for peak periods of waterfowl concentrations along the Platte River in south-central Nebraska. Tables B through Q (Appendix) show the location, dates of kills, number of hunters, and in some instances the water conditions of the Platte River.

Whooping Crane

998 = 87% in!
TOTAL 1145

According to Swenk (1933), an actual count of the records or reports showed that outside of Nebraska, only 147 Whooping Cranes (Grus americana) were recorded as seen during the entire twenty-two year period, 1912 to 1933, inclusive. During the same period as covered in the literature, no fewer than 998 migrant Whooping Cranes were seen in the state of Nebraska, mostly in the "Big Bend" region of the Platte River.

Allen (1952) reported that Nebraska hunters killed 13 percent of all Whooping Cranes reported from 27 states, provinces, and districts. The reporting period from all states, provinces, and districts covered a period from 1722 to 1948. Nebraska's reporting period of record was 1884 to 1936.

Allen (1952) states:

"In general, it is seen that the main body of migrants reached Nebraska between April 1 and April 18 . . . I believe that one reason for the great number of migration reports from Nebraska, most of them from the Platte River area, is that the Whooping Crane make that territory a major stop, remaining in the region for some days . . .

"When the species was more numerous, according to Jack Kennedy, who was a resident of Dawson County, Nebraska, during the 1890's and early in the century, they sometimes remained in the vicinity of the Platte River for a week or longer. Mr. Kennedy's recollection contains some vivid pictures of the behavior of the Whooping Crane on this major migration highway 50 or more years ago. He told me that they were not so dependent on the river for food in those days, as there were still many buffalo wallows on the prairies. They roosted on the river bars at night and came to the wallows early in the morning. Here he watched them feeding on frog and toad egg masses, for the wallows were filled with and alive with all sorts of aquatic life. The Sandhill Cranes, established in vast roosts on the river bars, did not appear on the prairies until towards noon. The Whoopers avoided them, keeping off by themselves, 200 or 300 yards from the Sandhill flocks as a rule, although an occasional Whooper would join one of those flocks and travel with it. The Whoopers, Mr. Kennedy recalls, walked a good deal more than the Sandhills,

covering a large expanse of ground during a single day. They seemed to like the open stretches of short buffalo grass and he watched them turning over the cattle chips and feeding on the beetles that lived underneath.

"Some of the Whoopers, Mr. Kennedy told me, remained along the Platte until May 1, after all other migrants had gone with the exception of the white pelicans, that stayed as late as June."

Fall sightings and migration patterns are indicated by Allen in the same publication by the following statements:

"Single individuals are not unusual, both before and after the main body of migrants that appear in Nebraska in mid October.

"The fact that more Whoopers were killed in Nebraska than any other state, province, or district, doubtless results in part from the "funneling" that took place here, at the Big Bend of the Platte River. Also, there has always been considerable waterfowl shooting along the Platte and many Whooping Cranes have been killed from duck or goose blinds."

He also recommended a refuge in the following statement:

"A little more than a year ago, a recommendation in detail was made as to the most beneficial site for a Nebraska refuge. The Platte River has long been a major stopping place for the Whooper migrants, yet no safe resting place has been provided for them. Since the river bottom would also provide a haven for waterfowl, a practical waterfowl refuge could be set up by including a considerable stretch of river most suitably located with regard to migrating Whoopers. No conclusive action has as yet been taken on this important matter."

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Sandhill Cranes

The Platte River Valley, during the spring Sandhill Crane migration, with its shrinking multitude of wet meadow habitats with marshland similarity, is a vista of a "Marshland Elegy" described by Aldo Leopold in A Sand County Almanac (1949):

"High horns, low horns, silence, and finally a pandemonium of trumpets, rattles, croaks, and cries that almost shakes the bog with its nearness, but without yet disclosing whence it comes. At last a glint of sun reveals the approach of a great echelon of birds. On motionless wing they emerge from the lifting mists, sweep a final arc of sky, and settle in clangorous descending spirals to their feeding grounds. A new day has begun on the crane marsh . . .

"The cranes stand, as it were upon the sadden pages of their own history . . .

"To what end? Out on the bog a crane, gulping some luckless frog, springs his ungainly hulk into the air and flails the morning sun with mighty wings . . . He seems to know.

"Our inability to perceive quality in nature begins, as in art, with the pretty. It expands through successive stages of the beautiful to values as yet uncaptured by language. The quality of cranes lies, I think, in this higher gamut, as yet beyond the reach of words.

"This much, though, can be said: our appreciation of the crane grows with the slow unraveling of earthly history. His tribe, we now know, stems out of the remote Eocene. The other members of the fauna in which he originated are long since entombed within the hills. When we hear his call we hear no mere bird. He is the symbol of our untamable past, of that incredible sweep of millennia which underlies and conditions the daily affairs of birds and men.

"And so, they live and have their being--these cranes--not in the constricted present, but in the wider reaches of evolutionary time. Their annual return is the ticking of the geological clock. Upon the place of their return they confer a peculiar distinction. Amid the endless mediocrity of the commonplace, a crane marsh holds a paleontological patent of nobility, won in the march of aeons, and revocable

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only by shotgun. The sadness discernible in some marshes arises, perhaps, from their once having harbored cranes. Now they stand humbled, adrift in history . . .

"To the moss-meadows that replaced the ancient waterways they returned each spring to dance and bugle and rear their gangling sorrel-colored young. These albeit birds, are not properly called chicks, but colts. I cannot explain why. On some dewey June morning watch them gambol over their ancestral pastures at the heels of the roan mare, and you will see for yourself.

"For them, the song of the power shovel came near being an elegy. The high priests of progress knew nothing of cranes, and cared less. What is a species more or less among engineers? What good is an undrained marsh anyhow? . . .

"To build a road is much simpler than to think of what the country really needs. A roadless marsh is seemingly as worthless to the alphabetical conservationist as an undrained one was to the empire-builders. Solitude, the one natural resource still undowered of alphabets, is so far recognized as valuable only by ornithologists and cranes.

"Thus always does history, whether of marsh market place, end in paradox. The ultimate value in these marshes is wilderness, and the crane is wilderness incarnate. But all conservation of wilderness is self-defeating, for to cherish we must see and fondle, and when enough have seen and fondled, there is no wilderness left to cherish.

"Someday, perhaps in the very process of our benefactions, perhaps in the fullness of geologic time, the last crane will trumpet his farewell and spiral skyward from the great marsh. High out of the clouds will fall the sound of hunting horns, the baying of the phantom pack, the tinkle of little bells, and then a silence never to be broken, unless perchance in some far pasture of the Milky Way."

Peters (1934) recognized four subspecies of Sandhill Cranes and Walkinshaw (1965) described a new subspecies. They are:

1. Florida Sandhill Crane (Grus canadensis pratensis)
2. Cuban Sandhill Crane (Grus canadensis nesiotis)
3. Greater Sandhill Crane (Grus canadensis tabida)
4. Lesser or Little Brown Sandhill Crane (Grus canadensis canadensis)

5. Intermediate or Canadian Sandhill Crane (Grus canadensis rowani)

Since the Florida and Cuban Sandhill Cranes do not migrate through Nebraska, only the Greater, Intermediate or Canadian, and the Lesser or Little Brown Sandhill Cranes will be discussed in this thesis.

Greater Sandhill Crane

The Nebraska Game and Parks Commission (1972) indicates that the Greater Sandhill Crane undoubtedly travels through Nebraska in the spring migration in association with the Lesser Sandhill Crane; however, to what extent of their numbers are represented in the total flyway area is unknown.

Walkinshaw (1949) states:

"The Greater Sandhill Crane during Colonial days occurred east to the Atlantic seaboard of the United States. Peter Kalm reported that limited numbers of cranes passed through New Jersey in February (1748-1749) and that an old native said that in his youth (mid-seventeenth century), cranes came over in numbers. Alexander Wilson (about 1812) said that a few cranes made their appearance in December, particularly on Egg Island at the head of Delaware Bay (Stone, 1937, p. 329). J. J. Audubon (1835, p. 204), though as mentioned above, he confused Whooping and Sandhill Cranes, stated that cranes occurred in Illinois and Kentucky and were found near Natchez, Mississippi, in November, 1821.

"The Greater Sandhill Crane was formerly found throughout southern British Columbia, south and central Alberta, Saskatchewan, southern Manitoba, through Washington, Oregon, northeastern California, northern and western Nevada, Arizona, northern Utah, Idaho, Montana, Wyoming, northwestern Colorado, the Dakotas, central Nebraska, Minnesota, northern and eastern Iowa, Wisconsin, and southern Illinois; Michigan to central Indiana and central Ohio; and the area in Ontario along Lakes St. Clair and Erie. Lewis and Clark (Coues, 1893, p. 431), during their trip across the continent found the Sandhill Crane abundant near what is now Idaho County, Idaho, in 1806. John Krider (1879, p. 57) still found cranes breeding abundantly in Iowa in 1871, and Anderson (1907, p. 205) stated that a few still bred there in 1907, though shortly thereafter they disappeared from all of this area to the Rocky Mountains."

He attributes the disappearance (between 1870 and 1915) from many of these areas to the increase of human population which resulted in over-hunting and drainage of the crane's nesting areas. He also indicated that Greater Sandhill Cranes bred in Nebraska until about 1884 and that the estimated population of the Greater in the U. S. was between 1,300 and 1,850 and about that many in western Canada.

Littlefield and Ryder (1966) estimated 7,400 Greater Sandhill Cranes exist. There are 900 in eastern, 5,500 in middle, and 1,000 in western North America. They indicated wintering populations in New Mexico, Mexico, and California may even be greater.

According to recent information from the U. S. Department of Interior's Division of Refuges, U. S. Fish and Wildlife Service, Washington, D. C., the total population of the Greater Sandhill Crane is estimated at 18,000 (personal communication, 1972).

Intermediate or Canadian Sandhill Crane

Very limited research data are available on the Intermediate Sandhill Crane.

Miller, Hochbaum and Botkin (1972) state:

"The Canadian Sandhill Crane was described by Walkinshaw (1965) from ten specimens collected over a period of years from Alberta, central Saskatchewan, west-central Manitoba, and the southern Mackenzie district. Walkinshaw (1965) concluded that there was 'enough available material' to show that these specimens were, in fact, intermediate and could be used to describe a new subspecies, G. c. rowani. The summer range of the Canadian Sandhill Crane is described as covering the 'Coniferous Forest Biotic Community in southern Mackenzie, Alberta, Saskatchewan, and probably central western Manitoba. It may occur in northern Ontario where more cranes have been taken during the summer'. Walkinshaw (1965) does not explain how the wintering area of this subspecies were determined, but states that it winters in southern and eastern Texas and that one specimen has been reported from Cameron Parish in Louisiana."

Walkinshaw (1965) indicated that Sandhill Cranes breeding in Alberta, Saskatchewan, west-central Manitoba, and southern Mackenzie did not fit the criteria for either G. c. canadensis nor G. c. tabida and there was enough evidence to show that the cranes from these provinces and southern Mackenzie were intermediate in size. Based on this, he states:

"Consequently, I am describing these birds as a new subspecies."

Miller, Hochbaum and Botkin (1972) believe the total number of Intermediates to be exceedingly low. They state:

"If this is a valid subspecies it must be exceedingly rare and should also be designated as 'rare' or 'endangered'. We know that Sandhill Cranes once bred quite extensively across the southern parts of the prairie provinces, but most of these breeding populations disappeared when the land was developed for agriculture. Small flocks occur at a few localities in Saskatchewan and Manitoba during the summer, but these seem to be mostly non-breeding birds of unknown taxonomic status and young are seldom observed in these groups (Stephen 1967)."

According to James Lewis, Assistant Unit Leader, Fish and Wildlife Service, Oklahoma State University, Stillwater, Oklahoma, (personal communication) letter dated March 5, 1973, the racial composition of Sandhill Cranes collected along the Platte River and examined in museums by him was as presented in Table 1.

Table 1. Racial Composition of Sandhill Cranes

LOCATION	NUMBER EXAMINED	
	<u>G. c. canadensis</u>	<u>G. c. rowani</u>
Lewellen, Nebraska	5	3
North Platte to Hershey	15	3
Overton to Elm Creek	34	9
Kearney to Highway 10	6	12
Alda to Grand Island	1	5

Lewis (personal communication) stated that "Rowani seems more prevalent in the easternmost roosts and canadensis in the westernmost roosts."

	Les.	Can.
Lewellen	5	0
North Platte	10	1
Overton	14	7
Kearney	6	3
Alda	1	5

Lesser or Little Brown Crane

According to Miller, Hochbaum, and Botkin (1972), the Lesser Sandhill Crane is the most abundant of the five subspecies. They indicate that little is known of the Lesser's breeding areas or population ecology. However, they state:

"This subspecies apparently breeds in scattered groups from at least as far east as Bylot Island, across the high arctic of the Northwest Territories and Alaska and north into Siberia, and winters in the southwestern United States and Mexico. In spite of its numerical importance in the total species population, almost all of the observations of this subspecies have been on the wintering grounds or at concentration areas during migration, and there have been no studies of breeding populations."

Huey (1965) indicates that along the Pecos River in southeastern New Mexico, the crane population is one of the Lesser subspecies and no specimens of the Greater have been taken in that area, while along the Rio Grande, west-central New Mexico, the population is comprised mainly of Greater Sandhill Cranes.

From 1958-1960, 84 Lesser Sandhill Cranes were banded and color-marked at Bitter Lake National Wildlife Refuge near Roswell, New Mexico, and one recovery came after the bird was killed on May 25, 1961, near Krasneno Anadyr, Mogodon Region, U.S.S.R. ($64^{\circ} 37'$ N. lat., $174^{\circ} 22'$ E. long.) (Huey, 1965).

Purposes of the Study

The purposes of the study were fulfilling the requirements of a Master's Degree Thesis and at the same time obtaining much-needed data for the Bureau of Sport Fisheries and Wildlife's Ecological Services Branch for its final analysis of the Mid-State Division Project. The U.S. Department of Interior's, Bureau of Sport Fisheries and Wildlife indicated in their 1957 report on the project that losses to waterfowl would occur. As a result, Congress authorized, as part of the project, a Federal refuge and a state area to mitigate the damage to waterfowl resulting from the project. This study should provide significant information useful in selecting an area for the proposed refuge.

The refuge location should be based on the classification system I have developed. This system is based on the degree of degradation that has occurred to the Platte River channel as it relates to Sandhill Crane use. The classification terms and their definitions are:

1. Pristine - those areas that have not noticeably changed over the past 42 years.
2. Transitional - those areas that have been degraded to a noticeable degree over the past 42 years.
3. Degraded - those areas that have changed significantly over the past 42 years.

More specific objectives concerning the Sandhill Cranes included a map that shows where the main roosting areas are located on the Platte River between Grand Island and Overton.

I was also interested in researching the roosting areas to try to determine the major criteria or requirements that make a roosting site.

Associated with this objective was the interest in the relationships between major roosting sites and wet meadow complexes. The results of the investigation should help determine what factors influence behavior of Sandhill Cranes on the roosts and other areas. This I hoped would provide much needed information concerning the adaptability of cranes to man-made sites for roosting.

The Greater Sandhill Crane has been reported at several locations along the Platte River. Therefore, I was interested in documenting specific areas where I observed them.

During recent years environmental groups have emphasized the non-consumptive use of our Nation's wildlife resources such as bird watching, etc. Therefore, I was interested in the number of man-hours of bird watching by the general public as attributed to the Sandhill Crane within the study area. I was also curious about the importance of this activity from a local, state or national standpoint.

Although Sandhill Crane hunting is not permitted in the State of Nebraska it is allowed in several other states, provinces and districts. Since so much emphasis is attributed to the monetary significance of hunting, I was interested in a general comparison between the value placed on hunting as opposed to bird watching.

For several years before I began this study I believed censusing techniques could be improved considerably, based on Sandhill Crane behavioral aspects and the latest scientific techniques involving remote censusing. Therefore, I wanted to refine the present censusing techniques.

PROCEDURE

This investigation involved personal periodic censuses and observations of the Sandhill Crane in several selected stretches of the Platte River and elsewhere. It was augmented by personal contact with sportsmen, bird watchers, state, federal, and private environmental groups. Extensive travel was involved outside the State of Nebraska to observe Sandhill Crane behavior. Table 2 presents an approximate resume of the mode of travel, miles traveled, date, and location involved with the study.

This study was begun in March 1970 and ended in May 1973, with the majority of spring observations being made during the latter half of February, all of March, April, and early May of each of the four years. Winter observations were made in January 1972 on the Muleshoe and Bitter Lake National Wildlife Refuges near Muleshoe, Texas, and Roswell, New Mexico, respectively.

In 1970 and 1971, I attempted to observe Sandhill Crane roosting activities during nighttime hours using 7 x 35 binoculars. In most instances, my efforts were wasted. Therefore, in the spring of 1972, I obtained, on loan, a night vision (Starlight) scope from the Bureau of Sport Fisheries and Wildlife's Northern Prairie Wildlife Research Center, Jamestown, North Dakota.

Swanson and Sargeant (1972) used this "Starlight" Scope during 1969-71 to study the nighttime feeding behavior of ducks in the prairie pothole region of south-central North Dakota. The scope was developed by the Night Vision Laboratory of the United States Army's Electronics Command, Fort Belvoir, Virginia. Swanson and Sargeant describe its mechanical properties in the following statement:

"The 'Starlight Scope' intensified natural light 40,000 times. A 'fiber optic' traps the available natural light which then passes into the intensifier tube where it strikes

Table 2. Summary of Travel and Activity

Mode of Travel	Date	Miles (Approx) Traveled	Instate	Out of State	Location and Activity
Private 4x4 Pickup truck	January 8, 1971 through January 13, 1971	3,000		X	From Grand Island, NE to Muleshoe, NWR, thence to Bitter Lake NWR, thence to Lake McMillan, NM, and return
Private 4x4 Pickup truck	1972	900		X	From Grand Island, NE to Prewitt Reservoir, CO, and return
Private 4x4 Pickup truck	March 12, 1972 through March 14, 1972	1,200		X	Grand Island, NE to Jamestown Wildlife Research Center and Bismark, ND and return
Private 4x4 Pickup truck	Spring, 1970 Spring, 1971 Spring, 1972 Spring, 1973	2,500	X		Grand Island, NE, to study area and along Platte River
Bureau of Sport Fisheries and Wildlife aircraft	1970 1973	200	X		Grand Island to Lexington. Observe cranes and waterfowl in Platte River Valley and return
State of Nebr. aircraft	March, 1972	250	X		Platte River Valley crane and waterfowl concentration areas
Charter aircraft	March and April, 1971	200	X		Over Platte River to investigate roosting behavior
Canoe	March, 1970 June, 1971	60	X		Crane roost investigation and high water condition along Platte River
Walking	Spring, 1970 Spring, 1971 Spring, 1972 Spring, 1973	300	X		Wet meadow investigation roost areas, large islands

a photoemissive surface. The tube then discharges electrons into a vacuum where they are energized by 15,000 volts of electricity from a single 217^A gm., 6.5 volt BA-1100/u mercury battery which provides approximately 70 hours of continuous operation. The mercury battery is the only power supply required. Electrons finally strike a screen which provides the viewer with a television-type image containing a green cast. Specifications for this equipment are listed in the U.S. Army technical manual TM-11-5855-202-13."

During 1971 and 1973, I conducted "people counts" watching cranes. These surveys were taken on Sunday afternoons between 2:00 p.m. and 4:00 p.m. along the Platte River in the vicinity of Doniphan, Alda, Wood River, Shelton, Gibbon, and Kearney, Nebraska. These surveys were augmented by personal contact if large groups of people were observed watching cranes and crane watchers that had out-of-state license plates on their vehicles.

During March 1971, observations were made to determine food preferences in wet meadow areas. This was done by observation with 7 x 35 binoculars and 20 x spotting scope, followed by physical inspection of a wet meadow area after the cranes had left.

Tables 3, 4, 5, and 6 show the year, calendar dates, time, temperature, wind conditions, locations and type of major observations conducted along the Platte River. In some instances a Beaufort scale was used for estimating wind velocity.

Table 3. Observations During 1970

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
March 14	5:43 a.m. to 8:10 a.m.	13° - 17°	NW 10	Clear	Followed birds to feeding grounds 3 - 6 miles south of river.
March 24	10:30 a.m. to noon	47° - 51°	S 17	Overcast	Flew Platte River with Mr. Bonner Law, Game Management Agent, from Grand Island to Brady, Nebraska, and return - observe cranes.
March 26	3:15 p.m. to 8:00 p.m.	43° - 35°	Variable 5 - 10	Overcast	Assisted Jim Lewis, Assistant Unit Leader, Oklahoma State University, in collecting cranes on E $\frac{1}{2}$ Shoemaker Island
March 28	4:05 p.m. to 5:27 p.m.	41°	NW 15	5%	Observed cranes dancing and feeding in corn stubble NW $\frac{1}{4}$ Section 8, T.9 N., R.10 W.
April 4	4:35 p.m. to 7:20 p.m.	45°	W 15	20%	Observed two herds of cranes run toward each other and merge into one herd. 600 in one herd and 3,000 in the other - E $\frac{1}{2}$ Shoemaker Island. At 6:35 p.m. - 600 cranes At 6:55 p.m. - 3,000 cranes At 7:05 p.m. - 15,000 cranes

Table 3 (continued). Observations During 1970

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
April 9	6:00 p.m. to 7:31 p.m.	40°		10%	Counted rate of crane influx on roosting site S $\frac{1}{2}$ S $\frac{1}{2}$ Section 33, T.10 N., R.10 W.
	At 6:31 p.m.	- 21 cranes landed in roost area			7:04 p.m. - 160 landed
	6:34 p.m.	- 97 cranes landed and then all spooked			7:06 p.m. - 86 landed
	6:40 p.m.	-225 cranes on road			7:07 p.m. - 89 landed
	6:41 p.m.	- 35 landed			7:08 p.m. - 50 landed
	6:42 p.m.	- 90 landed			7:09 p.m. - 54 landed
	6:43 p.m.	- 92 landed			7:10 p.m. - 335 landed
	6:44 p.m.	- 6 landed			7:12 p.m. - 100 landed
	6:45 p.m.	- 27 landed			7:13 p.m. - 220 landed
	6:46 p.m.	- 61 landed			7:14 p.m. - 60 landed
	6:47 p.m.	- 33 landed			7:15 p.m. - 65 landed
	6:48 p.m.	- 98 landed, then all spooked			7:17 p.m. - 170 landed
	6:50 p.m.	- 14 landed			7:18 p.m. - 31 landed
	6:53 p.m.	- 21 landed			7:19 p.m. - 12 landed
	6:55 p.m.	-250 landed			7:20 p.m. - 72 landed
	6:56 p.m.	-272 landed			7:22 p.m. - 210 landed
	6:59 p.m.	-350 landed			7:24 p.m. - 73 landed
	7:02 p.m.	-150 landed			7:29 p.m. - 185 landed
	7:03 p.m.	-149 landed			7:31 p.m. - <u>106 landed</u>
					Total 4,069
		"There were many cranes slipping in beyond my view - some dancing on roost"			
April 10	5:00 p.m. to 8:05 p.m.	72°	W 3	90%	Recorded crane calls on roost of 6,000 cranes. They would take a drink of water after landing.

Table 4. Observations during 1971

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
March 6	8:30 a.m. to 12:00	27° - 30°	N 20-30	Overcast	Observed cranes in wet meadow and stubble and wheat field along south side of Platte River Valley from East of Doniphan to Wood River, NE
March 13	8:00 a.m. to 6:00 p.m.	45° - 67°	S 10-30	Clear	Observed cranes along Platte River Valley and Shoemaker Island between U.S. Highway 281 to Kearney, NE. Observed cranes feeding on <u>Veronica sp.</u> in Whiskey Slough. Conducted crane watchers survey between Highway 281 and Alda, NE. (11:00 a.m. to 11:50 a.m.) Saw 1 Greater Sandhill Crane
March 20	8:30 a.m. to 5:15 p.m.	26° - 58°	S 10	Clear	Observed approximately 1,000 cranes, half of which were standing on an ice shelf in the Platte River roost at 8:15 a.m. in S $\frac{1}{2}$ Section 33, T. 10 N., R. 10 W. Took many photographs of dancing in meadows. Assisted Jim Lewis in setting cannon nets in S $\frac{1}{2}$ S $\frac{1}{2}$ Section 17, T. 8 N., R. 14 W.
March 21	5:50 a.m. to 7:30 p.m.	34°	N 10	Overcast	Observed cranes leaving 2 roosts between Highway 281 and Alda. Followed them south for 6 miles in a semicircle and returned and landed in a wet meadow adjacent to the roosts they had left. By 8:45 a.m. 50% of cranes were utilizing crop fields. 3:00 p.m. conducted survey to count "crane watchers". Assisted Jim Lewis in one cannon and rocket net shot in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 17, T. 8 N., R 14 W.

Table 4 (continued). Observations During 1971

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
March 25	3:50 p.m. to 7:55 p.m.	28° - 29°	S 10	Cloudy	Assisted Jim Lewis in setting cannon and rocket nets. Observed approximately 30,000 cranes roost. Section 17, T. 8N., R. 14 W.
March 26	At 4:00 p.m.	35°	S 20	Fog	Worked area between Highway 281 and Alda along south side of River. Observed cranes as far south at 6½ miles. Largest concentrations were feeding 1-3½ miles south of river.
March 27	4:20 a.m. to 3:30 p.m.	39° - 73°	S 13 - NW 34	Clear	Observed cranes in stubble fields feeding as early as 4:35 a.m. Got vehicle stuck at 5:50 a.m. 200 yards from roost site. This spooked about 7,000 from roost. 2,000-3,000 returned and stayed on roost until 8:11 a.m. S½ SW¼ Sec. 34, T. 10 N., R. 10 W.
March 28	4:00 p.m. to 8:00 p.m.	50° - 34°	NW 23 - N 8	9%	Conducted survey of crane watchers between Doniphan and Alda, south side of river. Cranes did not come to roost until 7:00 p.m. S½ SE¼ Section 38, T. 10 N., R. 10 W.

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
January 9	2:20 p.m. to 5:30 p.m.	61°	13-2	20%	Observed cranes on the Muleshoe National Wildlife Refuge, Muleshoe, Texas - Daytime observation on grasslands
January 9 and January 10	11:00 p.m. to 5:20 a.m.	43°	13-3	30%	Observed cranes on the Muleshoe National Wildlife Refuge at nighttime using 7 x 35 binoculars
January 11	2:30 p.m. to 11:10 p.m.	47°	13-3	10%	Observed crane behavior on the Bitter Lake National Wildlife Refuge, Roswell, New Mexico - Daytime and nighttime observation of roosts
January 12	8:00 a.m. to 6:30 p.m.	40° - 70°	13-2	5%	Observed cranes on the Bitter Lake National Wildlife Refuge, Roswell, New Mexico, and Pecos River Valley - observed behavior and inspected river roost
January 13	9:00 a.m. to 5:15 p.m.	47° - 70°	13-2	0 - 5%	Made a reconnaissance of the Pecos River Valley, Roswell, New Mexico, to Lake McMillan, Artesia, New Mexico
January 14	11:20 a.m. to 12:10 p.m.	70°	13-2	0%	Observed cranes in a meadow area between Socorro and Albuquerque, New Mexico
March 19	7:00 a.m. to 9:05 a.m.	57°	S 10-12	10%	Flew over Platte River Valley and study area from Grand Island to Lexington, and returned, with Nathaniel P. Reed, Assistant Secretary of the Interior, and Bill Bailey, Assistant Director, Nebraska Game and Parks Commission, and observed cranes and waterfowl concentrations.

Table 5 (continued). Observations During 1972

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
March 24 and March 25	5:00 p.m. to 4:55 a.m.	8° - 40°	NW 10-20	50 - 100%	Observed nighttime behavior on the Platte River in the S $\frac{1}{2}$ Sec. 11, T. 9 N., R. 11 W., using the Starlight Night Vision Scope
March 30 and March 31	7:30 p.m. to 6:47 a.m.	20° - 43°	E 0-15	30 - 100% Rain, Sleet, Snow	Observed cranes in the S $\frac{1}{2}$ Sec. 11, T. 9 N., R. 11 W., using the Starlight Night Vision Scope. Official sunrise 6:18 a. m.
April 7	6:45 p.m. to 11:10 p.m.	41°	NW 30	70%	Observed cranes, using the Starlight Night Vision Scope in S $\frac{1}{2}$ Sec. 11, T. 9 N., R. 11 W.
April 7 and April 8	11:30 p.m. to 6:19 a.m.	23°	SE 40 gusting to 50	100%	Observed cranes, using the Starlight Night Vision Scope in S $\frac{1}{2}$ Sec. 11, T. 9 N., R. 11 W.
April 9	6:30 p.m. to 10:50 p.m.	45°	0-5	0%	Observed cranes in the S $\frac{1}{2}$ Sec. 34, T. 10 N., R. 10 W.
May 7	11:30 a.m. to 2:15 p.m.		13-3		Made a reconnaissance from south of Grand Island to Wood River, Nebraska, observed approximately 150 cranes between Alda and Wood River on South Channel

Table 6. Observations During 1973

Date	Time	Temperature (Fahrenheit)	Wind Conditions	% Cloud Cover	Location and Activity
March 18	2:00 p.m. to 3:00 p.m.	53°		20%	Made a reconnaissance from Highway 281 west to Wood River on south side of river, then north to east-west county road across west half of Shoemaker Island, then south to Martin Brothers Monument - observed crane watchers
March 21	2:00 p.m. to 4:00 p.m.				Section 20, T. 8 N. , R. 14 W. Observed several thousand cranes in Whiskey Slough. This was the latest date I observed cranes in this area during the study.
March 24	10:00 a.m. to 11:00 a.m.	50°	N 20	100% rain	Observed 3 Greater Sandhill Cranes 1½ miles south of Minden Interchange (I80) on Highway 10.
March 26	6:30 p.m. to 7:30 p.m.				Flew over Platte River to observe evening roosting activity with Agent Bonde and pilot Winnship, Grand Island to Lexington.
April 4	6:00 p.m. to 7:15 p.m.				Observed cranes coming to roost at the W½ Shoemaker Island.
April 7	2:30 p.m. to 7:15 p.m.	31°	NE 40	blizzard	Worked with Lowell Georgia, photographer, <u>National Geographic Magazine</u> . Used 2 stuffed crane decoys to decoy live cranes. Visibility less than 200 yards, poor luck, E½ Shoemaker Island.

Secondary Roosting Sites

Wheeler and Lewis (1972), indicated that cranes stand all night on the submerged sandbars and described them as being the "primary" roosts. Upon leaving their primary roosts at sunrise they alight on fields which Wheeler termed "secondary roosts" or staging areas. Secondary (pastures or hayfields) roosts, according to these writers are used first after daybreak and again prior to sunset for preening, dancing, resting and some feeding. They are located half a mile or less from the primary roosts. These writers stated:

"In the mornings the cranes use these secondary roosts for 15 minutes to 2 hours. The length of time seems to be governed by the brightness of the morning. Bright skies lead to brief stays, while foggy or overcast mornings cause prolonged use. Cranes fly to their feeding areas as individuals or pairs or in groups containing up to 1,000 birds. A few birds fly directly from the primary roost to the feeding fields."

I also observed cranes on the secondary roosts within the areas I studied. However, I believe the birds resorted to them more consistently during late afternoons and evenings than they did in the mornings. The cranes on many occasions left the primary roost and flew directly to feeding areas.

Major roosting areas were plotted on U.S. Geological Survey 7.5 minute Quadrangle Maps during field investigation. These data were later recorded on Figure 3.

RESULTS AND DISCUSSION

Description of Study Area

Wheeler and Lewis (1972) indicated the Platte River Valley between Grand Island and Lewellen contains the largest concentration of Sandhill Cranes in the world. Their study was conducted near Overton, Elm Creek, and areas west.

The study area is within the "Big Bend" region of the Platte River. It is composed of islands, thousands of acres of riverside woodlands and riparian wetlands that abut pasture and crop lands. These habitats give the region a wilderness character unique to south-central Nebraska. It has been described by Klutaske (1972) in the following statement:

"The material beauty of the Platte River is remarkable. It is like a wilderness, one to two miles wide, extending across the cultivated farmlands of Nebraska. Within this fragile thread of wild country, a scenic river makes its way toward the Missouri."

For several years prior to the initiation of this study, I felt that some of the largest concentrations of Sandhill Cranes were east of Overton, specifically from Grand Island to Wood River, and from Gibbon to Kearney. Therefore, my study zone consisted of the Platte River Valley from Grand Island to east of Overton, with special attention given to the two areas previously mentioned. Figure 3 (map) shows the location of the places studied.

Several areas are characterized by large islands comprised of vast acreages of wet meadows. Figure 4 shows one of the areas.

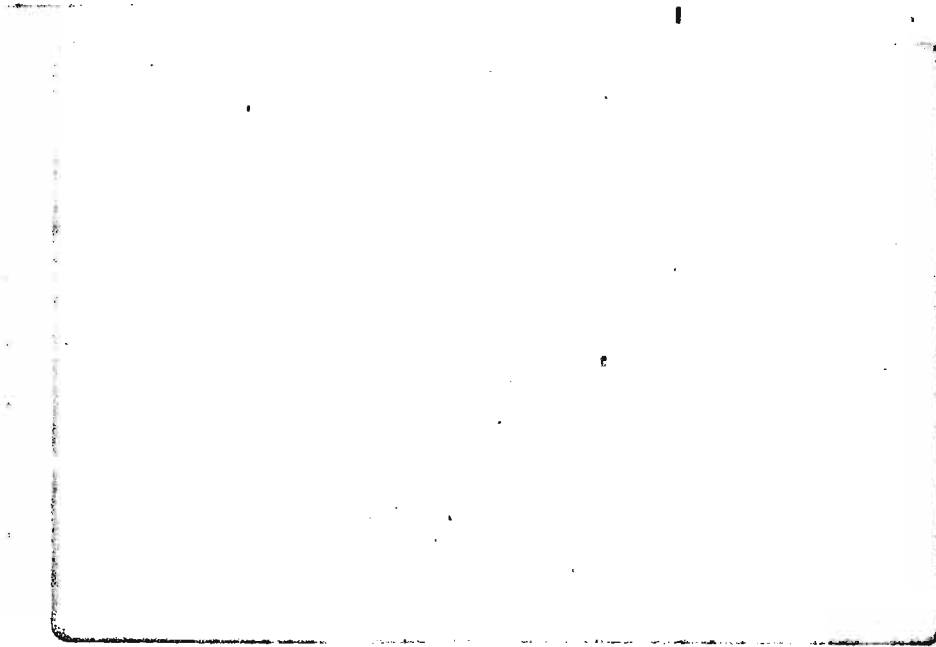


Fig. 4. A Typical Section in the Study Area. Photograph by Charles R. Frith, March 26, 1973 (7:01 p.m.)

Table 7 sets forth an inventory of these wet meadow complexes.

Table 7. Estimated Platte River and Wet Meadow Habitat

Area Between the Following Points of Reference	Miles of River	Acres <u>1/</u>	
		Platte River	Wet Meadows
East of Lexington to Overton	7.8	1,215.3	810
Overton to Elm Creek	8.8	1,262.7	690
Elm Creek to Odessa	7.2	1,103.8	405
Odessa to Kearney	9.6	1,085.4	525
Kearney to Gibbon	13.4	2,995.6	2,820
Gibbon to Shelton	6.6	1,578.8	1,755
Shelton to Wood River	9.2	1,257.3	2,421
Wood River to Alda	5.6	1,010.2	2,425
Alda to Grand Island	7.4	1,189.2	4,550
Grand Island to Chapman	18.4	4,104.0	4,231
Chapman to Central City	10.6	2,159.4	3,960
Central City to Clarks	12.6	2,318.0	2,250
Clarks to Silver Creek	14.5	3,023.7	1,275
Silver Creek to Columbus	17.8	3,928.2	1,200
Total	149.5	28,231.6	29,317

1/ Acreage figures were derived by visual inspection, 1938 and 1969 serial photographs (obtained from the National Archives Center, Washington, D.C.), 1962 U.S. Geological Survey 7.5 minute Quadrangle Maps, and Soil Classification Maps of Hall County (obtained from the Soil Conservation Service).

Range and Distribution of Sandhill Cranes

As with many other species of wildlife, the range and distribution of Sandhill Cranes has changed since first recorded by man. Walkinshaw (1949) stated:

"Crane remains (possibly *Grus* - Wetmore, 1940) have been found from the Eocene period (March, 1872, p. 256; Shufeldt, 1915, p. 41). There are fossil remains of *Grus canadensis* from the Pliocene of Nebraska and from the Pleistocene of California, Florida, Wyoming, and Nebraska (Wetmore, 1940, p. 50); also (*Grus c. canadensis*) from the Pleistocene of Coles County, Illinois (Galbreath, 1944, p. 35). In kitchen middens not more than 500 years old, crane remains have been identified as follows: *Grus*, Grenville County, Ontario (Toner, Edwards, and Curtis, 1942, p. 35); *Grus canadensis*, Turkey Tank and Wupatki Pueblo, Arizona (Hargrave, 1939 p. 208), and Buena Vista Kern County, California (DeMay, 1942, p. 229); *Grus c. canadensis*, Jackson County, Illinois (Frank C. Baker, 1937, p. 338); and Scioto County, Ohio, (Wetmore, 1943, p. 127). Subfossil eggs, probably *Grus canadensis*, estimated to be a thousand years old, were found at Lake Texcoco, Valle de Mexico; and conditions under which the eggs were found and the known change in the climate of the region make plausible the supposition that the Sandhill formerly nested there (Del Campo, 1944)."

Walkinshaw (1949) indicated that the former range of the Lesser Sandhill Crane occurred farther east than at present. The present breeding range includes northeastern Siberia, St. Lawrence Island, St. Matthew Island, Nunwak Island, Alaska, Yukon Territory, MacKenzie, and Keewatin, and many islands and peninsulas of Franklin in northwest Canada.

He again states:

"Judging from existing specimens, the majority of cranes found in New Mexico are Lesser Sandhills."

Walkinshaw (1949) indicates that McCall (1852) stated:

"This crane I found on the Rio Grande from Santa Fe to El Paso. in October (1850); but more particularly between Albuquerque and Sorocco where, for 50 miles, the land appeared to be covered with them."

I concur with McCall because in January 1972, I, too, saw thousands of Sandhill Cranes between Sorocco and Albuquerque.

Although little has been written about the present-day range, as it relates to the Platte River Valley and Nebraska, it nevertheless remains a fact that this area contains the largest number of all three subspecies of Sandhill Cranes at any given time. During several discussions with the late Robert Wheeler (U. S. Game Management Agent), North Platte, Nebraska, Mr. Loren Bonde, Supervisor for Nebraska (U. S. Game Management Agent), and Mr. James Lewis, Assistant Cooperative Research Unit Leader, Oklahoma State University, it was brought out that approximately 70 percent of the continental population "funnel" into the Platte River Valley between mid-February through late April and early May, between Grand Island and Lewellen, Nebraska. According to the U.S. Department of Interior's Fish and Wildlife Service's Annual Spring Sandhill Crane Inventories, a few cranes have been observed east of Grand Island; however, they consider this area to be insignificant to the overall Platte River range. Upon their departure they "fan-out" toward the breeding grounds described by Walkinshaw (1949).

Although Wheeler and Lewis (1972) did not mention the term "hourglass" it nevertheless best describes the present day range of the Sandhill Crane. I have used this term on many occasions but the term "hourglass" was originally used by Wheeler and Bonde (personal conversation). In any event it best describes the range in the following manner: The "hourglass" base represents the southern range (southwest United States and northern Mexico); the restricted part corresponds to the Platte River Valley described by Wheeler and Lewis (1972); and the top part, the breeding grounds described by Walkinshaw (1949).

Population

There is much confusion concerning the total present day population of Sandhill Cranes. This is largely due to the lack of accurate censusing techniques, funds, and equipment necessary to conduct adequate investigations, and the interest required from a continental standpoint necessary to conduct such a study.

In 1971 I spent considerable time trying to obtain clearance from higher authorities to conduct a joint effort involving the infrared scanner system capabilities of the U. S. Air Force and the Bureau of Sport Fisheries and Wildlife interest. All parties agreed such a study was needed; however, my efforts failed. Consequently, the best estimate of population in Nebraska is the U. S. Department of Interior, Fish and Wildlife Service's Annual Spring Sandhill Crane Inventories, conducted every year since 1957 along the Platte River Valley. These inventories are conducted to estimate the population of Sandhill Cranes at a specific time. Early inventories were based on the transect method. This method involved flying transects across the Platte River Valley and estimating the number of Sandhill Cranes seen for one-half mile on each side of the flight pattern. Beginning in 1971 all the inventories were conducted based on the number of cranes seen on the river roosts. The latter method is believed by the U. S. Department of Interior's Bureau of Sport Fisheries and Wildlife Service to be more reliable. Table 8 sets forth the results of these inventories, which are listed under Unpublished Data.

It should be emphasized that the results are dependent on the following conditions:

1. Weather conditions conducive to flying.
2. Human judgment on whether the cranes had reached their peak numbers on the day(s) of the census.

Table 8. Sandhill Crane Spring Surveys

*Reference points
all over the state*

Reference Points	3/28 1957	4/7 & 8 1958	3/21 & 22 1959	4/4 1960	3/21 1961	3/21 1962	3/21 1963	3/30 1964	3/30 1965	3/25 1966	3/23 1967
Grand Island to Alda	1,500	41,300	4,425	630							
Alda to Wood River	1,360	300			26,798	25,404	20,455	29,436	10,535	42,890	31,900
Wood River to Shelton	6,000	3,900	1,500	740							
Shelton to Gibbon	7,150	200		3,000	15,000	32,240	8,445	19,780	10,520	15,322	18,300
Gibbon to Kearney	1,100	25,000	18,200	19,000							
Kearney to Odessa		3,700	11,535		541	2,410	1,410	14,850	730	1,615	100
Odessa to Elm Creek		15,000	37,750		23,850	10,020	6,320	11,900	9,575	9,595	13,200
Elm Creek to Overton	12,000	46,100	6,020		24,210	15,100	26,800	20,050	13,135	10,680	21,000
Overton to Lexington		42,400	11,850		6,990	19,180	7,940	14,000	4,015	7,642	7,500

Table 8 (continued). Sandhill Crane Spring Surveys

Reference Points	3/22 1968	4/2 1969	3/26 1970	3/30&31 1971	3/27&28 1972	3/27,28 & 29 1973
Grand Island to Alda		17,195	22,300	28,000	18,600	31,300
Alda to Wood River	46,674	5,386	23,200	13,000	9,500	6,600
Wood River to Shelton		5,855	4,500	25,000	21,300	26,500
Shelton to Gibbon	24,913	7,700	17,200	6,000	36,800	4,900
Gibbon to Kearney		12,329	20,600	29,000	17,500	24,700
Kearney to Odessa	509	1,793	400	0	1,500	1,250
Odessa to Elm Creek	11,298	6,215	21,600	10,000	5,700	9,300
Elm Creek to Overton	16,962	10,610	10,000	8,000	12,700	23,800
Overton to Lexington	14,330	13,290	13,900	10,000	9,000	2,600

3. Censusing techniques. For example, the time the censuses have been taken have varied as much as 18 days. Also as will be shown later many of the birds have left the roosting sites before the survey is begun.

The inventories show that the concentration of Sandhill Cranes using the Platte River Valley are along three distinct areas. These areas include the Platte River from the town of Grand Island westward to Lexington, the area between North Platte and Sutherland, including several roosts on the North Platte River, and the area between the west end of Lake McConaughy and Lewellen, Nebraska, on the North Platte River (Wheeler and Lewis, 1972). The inventories also indicate Sandhill Cranes reach their peak population along the Platte River Valley between the dates of March 21 and April 8.

Therefore, about all that can be said at this time concerning total population of Sandhill Cranes is that some authorities estimate from 60 to 80 percent of the continental population congregate along the Platte River Valley and depending on the conditions at the time of the survey there should be about "x" number of cranes.

Hunting

According to Boeker, Aldrich, and Huey (1961), and Wheeler and Lewis (1972), Sandhill Cranes (Grus canadensis) were protected by a closed season in the United States and Canada between 1916 and 1961 because conservationists felt the surplus was not sufficient to harvest.

Wheeler and Lewis (1972) indicated that as information on abundance, timing of migration, and winter distribution of various subspecies of cranes became available, it was apparent that the hunting of Lesser Sandhill Cranes (Grus c. canadensis) in certain areas would not post a threat to the endangered Whooping Crane (Grus americana) or the rare Greater Sandhill Crane (Grus c. tabida). They state:

"Sandhill Cranes have been hunted in Mexico for years (Leopold, 1959). Since 1959, farmers in Saskatchewan have been permitted to shoot Cranes under general crop depredation orders (Blue Jay, 1960). In the United States, hunting was authorized in 1961 in eastern New Mexico, western Texas, and Alaska. Thereafter other states in the Central Flyway requested hunting seasons for Sandhill Cranes (Buller, 1967). Crane hunting was legalized in the Canadian provinces of Saskatchewan and Manitoba in 1964."

In a letter dated April 23, 1973, to Dr. J. P. Linduska, Associate Director, U. S. Bureau of Sport Fisheries and Wildlife, Dr. John S. Tener, Director General, Canadian Wildlife Service, indicated that Sandhill Crane hunting is limited to parts of two provinces (Manitoba and Saskatchewan) with an annual harvest average of approximately 500 birds in Manitoba and 3,500 in Saskatchewan. He states:

"This represents an estimated 13,800 man days of recreation by successful hunters. Unfortunately our survey is not

designed to pick up unsuccessful hunters. If they were included, man days of recreation would probably be close to 20,000 Personally I would suspect that crane hunting would be on a cost basis similar to goose hunting. It has been estimated that the average goose rendered to bag is worth \$25 if one includes cost of licenses, shells, travel, etc. If that is acceptable then an annual expenditure of \$100,000 would be reasonable."

According to the Federal Hunting Regulations, No. 90, Section 10.106 (1972-73) the taking of Little Brown Cranes (Federal Regulations still use term Little Brown Crane) with a daily bag limit of three and possession limit of six could be shot in the following areas for the dates indicated:

"(a) In the Central Flyway portion of Colorado excluding the San Luis Valley, season dates are October 1 - November 5, 1972.

"(b) In the New Mexico counties of Chaves, Curry, De Baca, Eddy, Lea, Quay, and Roosevelt, and in that portion of the state of Texas lying west of a line running south from the Oklahoma border along U. S. Highway 287 to the U. S. Highway 87 at Dumas, along U. S. Highway 87 to U. S. Highway 277 at San Angelo, and along U. S. Highway 277 to the International toll bridge in Del Rio; season dates are October 28, 1972 - January 28, 1973.

"(c) In that portion of Oklahoma lying west of U. S. Highway 81, and in that portion of Texas lying east of a line running south from the Oklahoma border along U. S. Highway 287 to U. S. Highway 87 at Dumas, then along U. S. Highway 87 to San Angelo, and lying west of a line running north from San Angelo along U. S. Highway 277 to Abilene, along State Highway 351 to Albany, along U. S. Highway 283 to Vernon, and then along U. S. Highway 183 east to the Oklahoma border; season dates are December 2, 1972 - January 28, 1973.

"(d) In the North Dakota counties of Kidder, Stutsman, Benson, Emmons, Pierce, McLean, Sheridan, and Burleigh; and in part of South Dakota described as follows: from the North Dakota border, south on U. S. Highway 83 to U. S. Highway 212, west on U. S. Highway 212 to the Promise Road, north on the Promise Road to State Highway 20, north on State Highway 20 to U. S. Highway 12, northwest on U. S. Highway 12 to State Highway 63,

north on State Highway 63, to the North Dakota border; the season dates are November 11 - December 10, 1972.

"(e) In Phillips County, Mont., the season dates are October 1 - November 6, 1972.

"(f) In Platte and Goshen Counties, Wyo., the season dates are October 7 - November 5, 1972."

According to Miller, Hochbaum and Botkin (1972) the estimates of the annual hunting harvests (1961-1970) in New Mexico, Texas, Saskatchewan and Manitoba are 6,552 cranes, or two percent of the migratory population. However, when a crippling loss factor is applied, the hunting mortality of 12,771 birds, or 4.3 percent of the migratory population, reflects a more accurate estimate of the annual hunting harvest. These writers believed the total population to be approximately 300,000.

Sherwood (1971), using an estimated population of 200,000, estimated the annual harvest to be 12,000. This also represents a 30 percent crippling loss for a nine percent harvest of the total population.

Miller, Hochbaum and Botkin (1972) state:

"Sherwood (1971) points out that open seasons on Sandhill Cranes and whistling swans were initiated mainly by government agencies, with very little demand from hunters. We have also noted that the emphasis on the management of Sandhill Cranes has apparently shifted from control of crop depredations to hunting for recreation, and that the original reason for authorizing an open season is no longer justifiable and seems to have been abandoned. The state and provincial agencies have responded by requesting more liberal seasons and regulations and expansion of the areas open to hunting. Unless the federal agencies can clearly demonstrate that additional hunting of Sandhill Cranes would be detrimental to the welfare of the species, these requests will be difficult to refuse. This raises a question that exists in the management of most game species, of whether decisions

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about hunting will be made on political grounds, or whether they will be based on biological data and the welfare of the species.

"Experience with the effects of human pressure on natural environments and the increasing number of rare and endangered species indicates that it should become a cardinal principle of wildlife management that a species not be exploited as a resource until it can be clearly shown, with adequate data, that its protection is insured. Our model suggests that Sandhill Cranes do not now have this insurance, and that further research should be initiated to provide the necessary data for sound, responsible management of this species."

Crane Watching

I have observed Sandhill Cranes for several years, prior to initiation of this study, along the Platte River in the vicinity of Doniphan, Alda, Wood River, Shelton, Gibbon, and Kearney, Nebraska. During these observations much enjoyment came from watching people watch cranes. Unfortunately I never conducted "people counts" watching cranes until March, 1971, and again in March, 1973. Table 9 sets forth the results of the surveys.

Table 9. Sandhill Crane Watchers

Date	Location	Number of Counties Represented	Number of Sandhill Crane Watchers	
March 13, 1971	Doniphan to Alda (six miles)	5	25	<i># of birds</i> <i>(1 person/observer)</i> 7
March 21, 1971	Doniphan to Gibbon (28 miles)	8 Nebraska Counties and 1 Oklahoma County	115	29
March 28, 1971	Doniphan to East of Alda (4 mile area)	6	30	8 <i>2-11-71</i>
March 18, 1973	Doniphan to Wood River to south of Alda via W ¹ / ₂ Shoemaker Island to Martin Brothers Monument (21 miles)	13	227	<i>17 March</i> 57 <i>188</i> <i>2-18-73</i> 187

Crane watching seems to signify the end of winter and the beginning of spring for many local and non-local residents in the state as well as people from out of state. All surveys were taken on Sunday afternoons between 2:00 p.m. and 4:00 p.m. The increase in crane watching between 1971 and 1973 is attributed to the National Audubon Society's campaign to bring about recognition and protection of the environmental integrity of the Platte River.

In a letter dated April 28, 1973, to Dr. J. P. Linduska, Associate Director, U. S. Bureau of Sport Fisheries and Wildlife, Dr. John S. Tener, Director General, Canadian Wildlife Service, projects the importance of crane watching in Canada by the following statements:

"We have absolutely no information on bird watching days at Last Mountain Lake. The area is widely utilized by family groups and naturalists but no charge is levied and no statistics are kept. Eventually we propose to build an interpretation centre at Last Mountain Lake similar to ones already existing at Perce, Cap Tourmente, and Wye Marsh. These centres cost approximately \$250,000 to construct and \$100,000 per annum to maintain and operate. A major theme of the Last Mountain Lake Centre will be Sandhill Cranes.

"....We recognize that our data base in the area of non-consumptive recreation is woefully inadequate. I believe however that more people enjoy watching birds and probably spend more money in so doing, than are involved with hunting."

Nithtime Observations

During the observations with the Starlight Scope, I observed Sandhill Cranes leaving their river roost as early as two hours before sunrise, particularly when the wind velocity was greater than about 20 miles per hour. On April 8, 1972, I observed approximately 25 percent of the cranes leaving the roost starting about two and one-half hours before sunrise. The rate at which the cranes left the roost increased with the approach of sunrise. I believe this behavior has a definite effect on the results of the annual Sandhill Crane inventories conducted annually. The inventories are usually begun at approximately 30 minutes before sunrise.

Some cranes were observed standing on one leg with their head lying on their back or tucked under their wing. I assume from the observed behavior that they were sleeping.

Cranes were active up until midnight on the nights observed. When the wind velocity was greater than 20 miles per hour the cranes were restless and some movement consisting of short flights over the herd was common. They were least active during the hours 12:00 midnight and about 2:00 a.m. if the wind velocity was less than 20 miles per hour. Therefore, this would be the best time to conduct inventory investigations using the infrared scanner system capabilities of the U. S. Air Force as previously discussed.

Figures 5 and 6 show the same roost. Figure 5 was taken at 6:30 p.m. under natural light conditions, while Figure 6 was taken approximately three and one-half hours later under nighttime conditions through the "Starlight Scope". Both photographs were taken from the same location, but Figure 6 reveals the 7x magnification properties of the "Starlight Scope". On the evening of April 9, 1972, when both photographs were taken, the wind velocity was under five miles per hour.

Most of the cranes shown in Figure 6 (left half of the photograph) are sleeping. They were also the first arrivals on the roost.

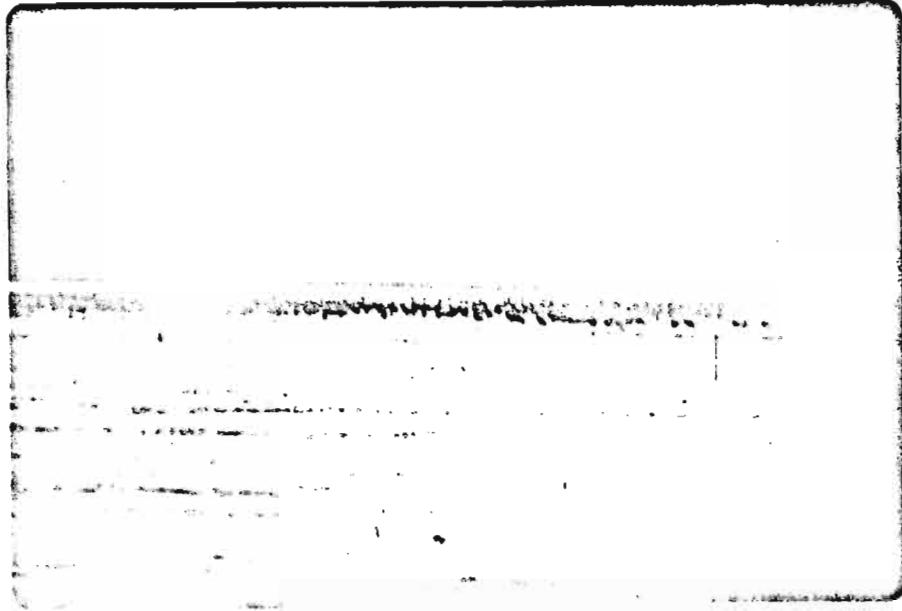


Fig. 5. A Small Roost. S $\frac{1}{2}$ Section 34, T. 10 N., R. 10 W.
Photograph by Charles R. Frith, April 9, 1972 (6:30 p.m.)

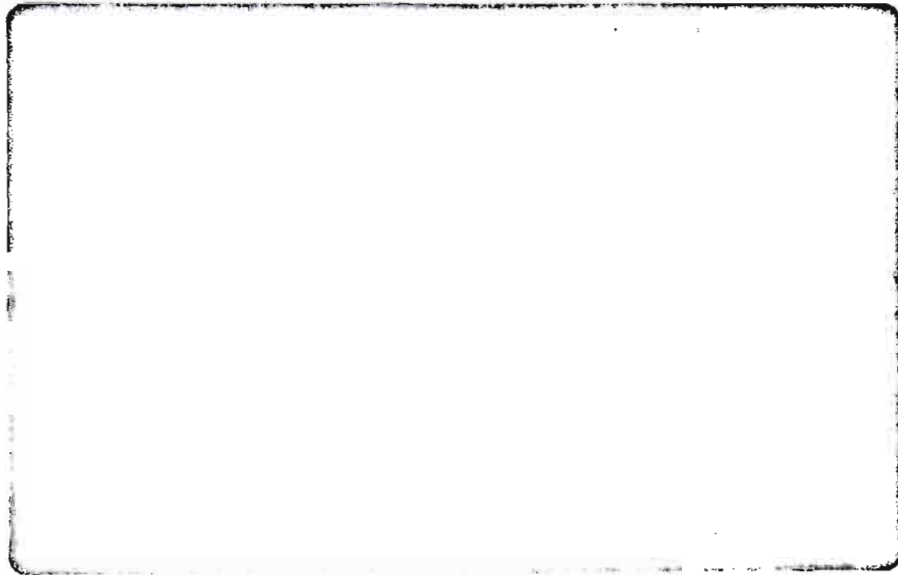


Fig. 6. Sleeping Cranes. S $\frac{1}{2}$ Section 34, T. 10 N., R. 10 W.
Photograph by Charles R. Frith, April 9, 1972 (10:50 p.m.)

Pictorial Sequence

The results of this study can best be described, in part, by a pictorial sequence. Therefore, the following photographs are presented to depict and substantiate many of the conclusions made.

Figure 7 shows a wet meadow complex. Areas such as this are becoming rare because of agricultural practices resulting from land use changes, drainage, sand and gravel mining operation acceleration, upstream water diversions including irrigation withdrawals from the Platte River and highway development and associated businesses.

Although there have been no investigations in my study area, Keech (1964) conducted a study of fluctuations of the water table in the Chapman, Nebraska area, approximately 10 miles east. He stated:

"The fluctuations of the water table generally correlate with variations in the climatic factors of precipitation, temperature, and evaporations and with changes in the stage of the water in the Platte River and the North Channel of the Platte River . . .

"The water table tends to fluctuate in response to the rise or fall of the stage of the river because the aquifer beneath . . . has excellent hydraulic connection with the river. When the stage of the Platte River rises above the ground-water level at its banks, water percolates out of the river and into the ground until the adjacent water table is raised to a level corresponding approximately to the level of the stream. Conversely, when the stage of the river is lower than the adjacent water table, water percolates back to the river and the water table declines."

"I concur with Keech's statements because for many years I, too, have observed that the wet meadow complexes in the area he reported on and the area shown in Figure 7 were dry in the late summer and early fall when the Platte River level was low. Conversely, when the river was high, the meadows were wet.

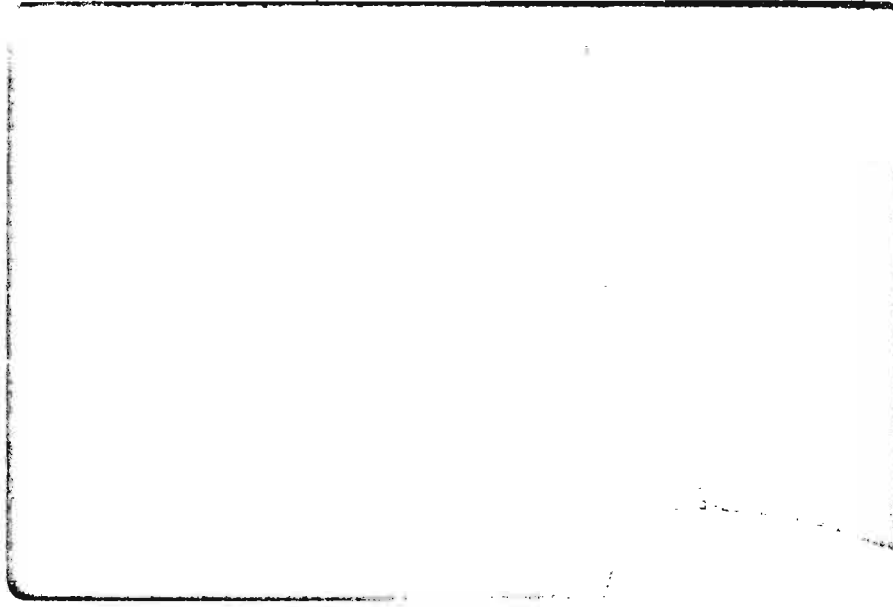


Fig. 7. Shoemaker and Mormon Islands Sections 26, 27, 34, 35, T.10 N., R.10 W. Photographed by Charles R. Frith, April 5, 1971.

Figure 8 shows one wet "ribbon" of a wet meadow complex. Sandhill Cranes congregate in and along these ribbons to feed on emergent vegetation.

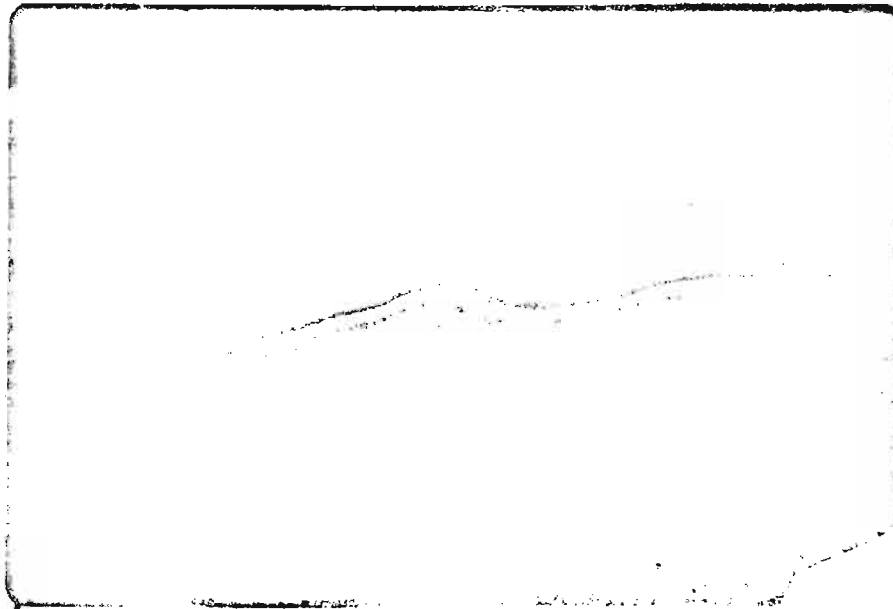


Fig. 8. Sandhill Cranes in a wet "ribbon". Section 4, T. 9 N., R. 10 W. Photograph by Charles R. Frith, April 5, 1971.

Figure 9 shows a wet "ribbon" as seen from the ground. Areas such as this receive intensive use in the morning and evening. Wheeler and Lewis (1972) refer to areas such as these shown in Figures 7 and 9 as "secondary" roosting sites. During my study, I have never observed cranes roosting in these areas. However, they do remain at times in such areas until after sundown before going to the river to roost.

Conversely, I have observed cranes leaving the river roosts before daylight and congregating on these areas before sunrise.

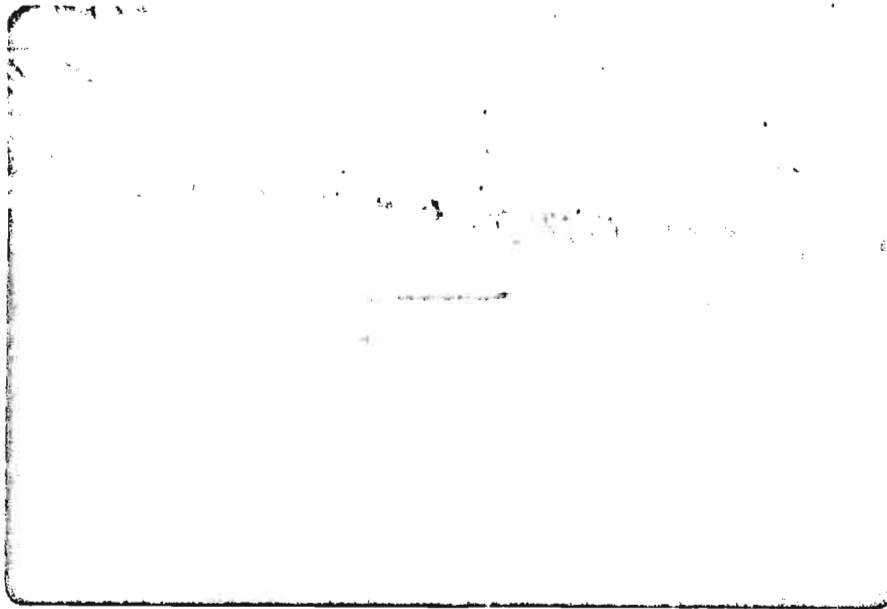


Fig. 9. Wet "ribbon". NW $\frac{1}{4}$ Section 3, T.9 N., R.10 W.
Photograph by Charles R. Frith, March 28, 1971

Figure 10 shows what is probably the single largest wet meadow complex in the study area. This particular wet meadow complex is only one-fourth of a mile from the largest roost (Figure 22) within the study area. I have seen and heard cranes in this meadow complex as early as two hours before sunrise.

Sandhill Cranes spend much time throughout the day feeding in this area. early in the season when there seems to be a shift to the stubble fields.

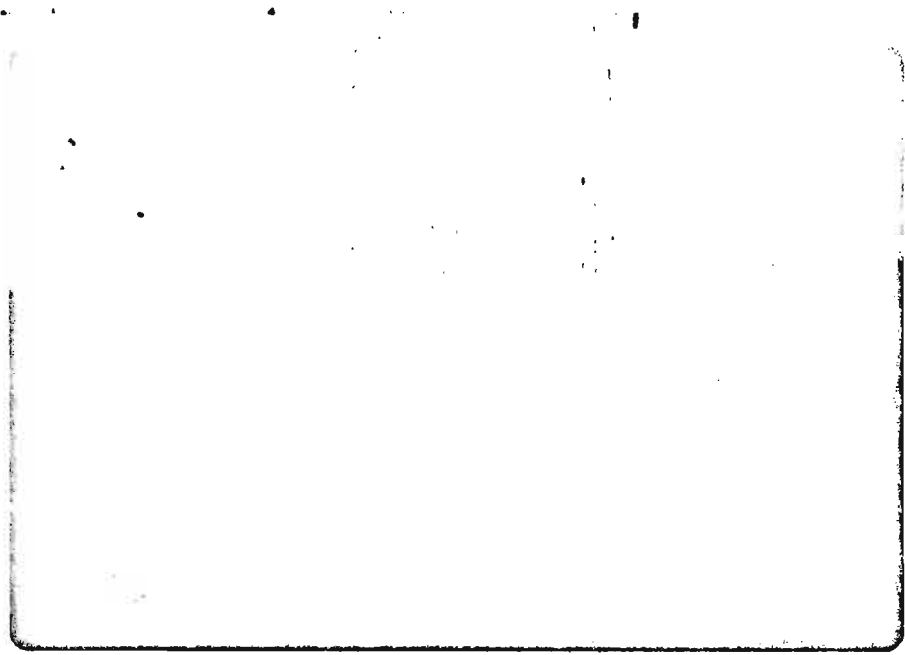


Fig. 10. Cranes feeding in wet meadow complex on west one-half Shoemaker Island. N $\frac{1}{2}$ Section 11, T. 10 N., R.11 W. Photograph by Charles R. Frith, March 13, 1971 (2:00 p.m.)

Another large wet meadow complex known as "Whiskey Slough" parallels the middle channel of the Platte River. The area shown in Figures 3 and 11 is utilized heavily by cranes until about the middle of March. Cranes were observed feeding on young tender shoots of Veronica sp. On the afternoon this photograph was taken, there were about 4,000 - 5,000 cranes using the slough. I never saw large numbers of cranes using this area after March 15 in 1971 and succeeding years, except on March 21, 1973, at 3:00 p.m.

This wet meadow complex is located approximately one mile west of the Alda bridge on Shoemaker Island. The roost is adjacent to the wet meadow complex near one of the largest river roosts.

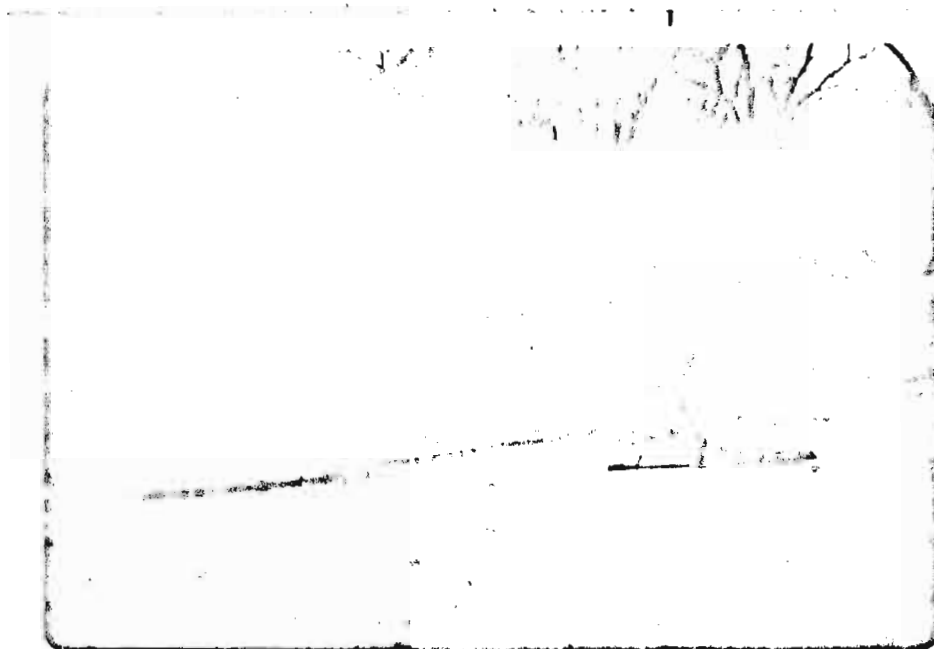


Fig. 11. Sandhill Cranes feeding in "Whiskey Slough".
N $\frac{1}{2}$ NE $\frac{1}{4}$ Section 20, T.8 N., R.14 W.
Photograph by Charles R. Frith, March 13, 1971.

Areas such as shown in Figure 12 do not provide suitable conditions for Sandhill Crane roosting sites because of the vegetation encroachment that has occurred during the 31 years of record. Vegetative encroachment refers to the increase of islands, with permanent vegetation, that evolves within the river channel. This phenomenon is the result of reducing the annual flows in the river due to upstream water withdrawal developments. Since Sandhill Cranes prefer the more open areas for roosting, this phenomenon is detrimental and eventually could eliminate areas presently used by cranes.

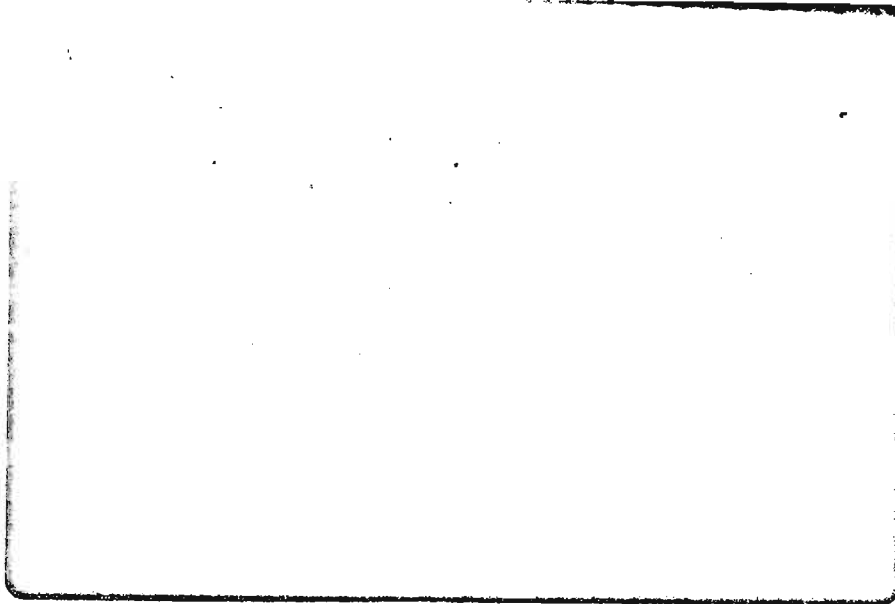


Fig. 12. Platte River vegetative encroachment area.
Located near Kearney, Nebraska.
Photograph by Charlon R. Frith, April 1971.

Figure 13 shows limited crane roosting activity near an "encroachment" area. This is the only indication I found that suggests that Sandhill Cranes will use areas such as this in substantial numbers. This particular reach of river is more of a transitional zone between "open" river and intensive "encroachment" sections. This reach of river is still wide, islands low, and water depth conducive to roosting requirements. Compare this figure with Figure 14.



Fig. 13. Platte River transitional zone showing limited roosting activity. Located near Kearney, Nebraska. Photograph by Charles R. Frith, April 1971.

Aerial photographs obtained from the National Archives Center, Washington, D. C., covering this reach of the Platte River indicate that areas such as shown in Figure 14 were more open and devoid of islands and vegetation in 1938.

Contrast Figure 14 with the previous figure and note the difference in the degree of encroachment. Examination of 1938 and 1969 aerial photographs revealed that this area has not significantly changed over the 31 years of record. Consequently, the area provides the essential ingredients for roosting, such as water depth (1-6 inches), broad river channel (approximately 2,000 feet) and the absence of permanently vegetated island.

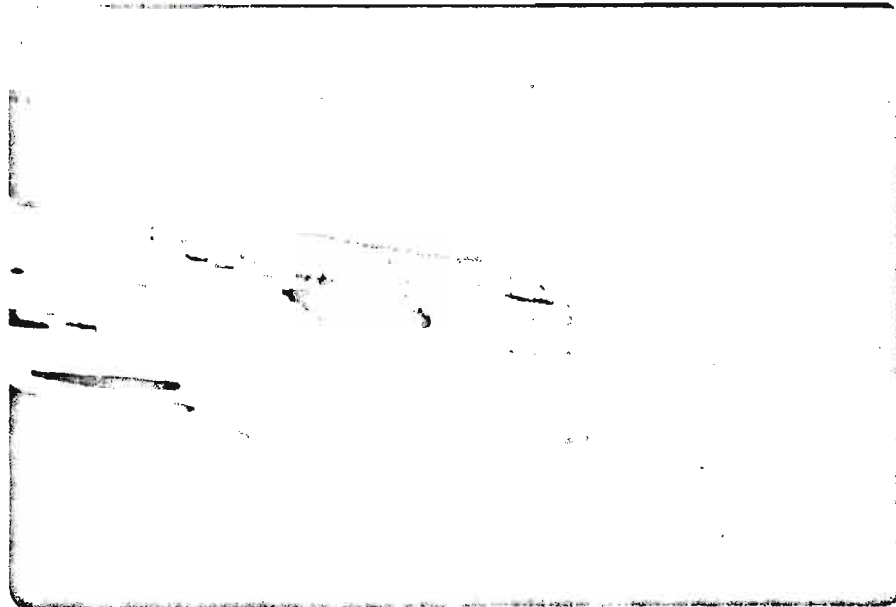


Fig. 14. A major Sandhill Crane roost. $6\frac{1}{2}$ Section 34, T.10 N., R.10 W. Photograph by Charles R. Frith, April 9, 1971 (6:00 a.m.)

Figure 15 shows the same roost area as Figure 14, only taken at a lower altitude.

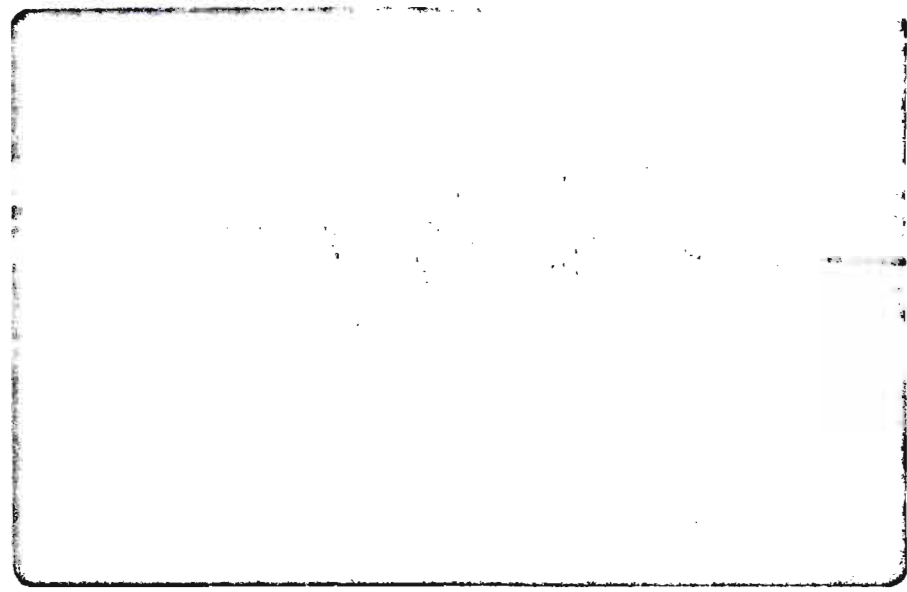


Fig. 15. A major Sandhill Crane roost. S $\frac{1}{2}$ Section 34, T.10 N., R.10 W. Photograph by Charles R. Frith, April 9, 1971 (6:10 a.m.)

Figure 16 shows the same locality as the two previous photographs only at a lower altitude. Notice the spacing between the birds, their preference for shallow water, and the water depth between the two groups of cranes.

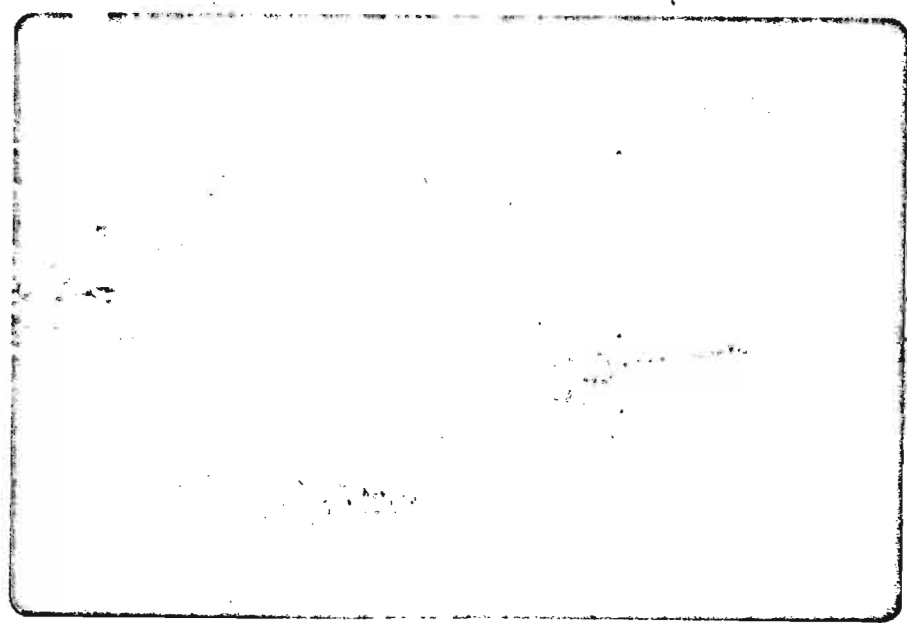


Fig. 16. Sandhill Cranes roosting. Section 34, T.10 N., R. 10 W. Photograph by Charles R. Frith, April 9, 1971.

Figure 17 was taken at even a lower altitude than the previous photographs. Notice the spacing, water depth, and the general configuration of the herd in relation to the submerged sandbar. The spacing is uniform between cranes and generally observed to be more than one body's width between individual birds.

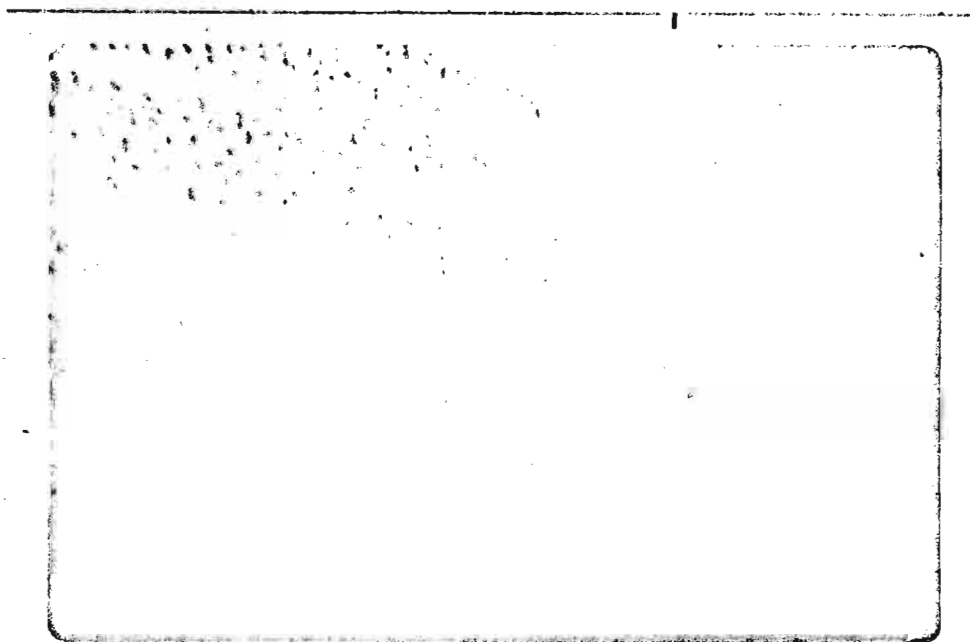


Fig. 17. Sandhill Cranes on submerged sandbar. Section 34, T.10 N., R.10 W. Photograph by Charles R. Frith, April 9, 1971 (6:10 a.m.)

Figure 18 is probably one of the best photographs depicting the cranes' preference for depth of water, herd configuration in relation to physical characteristics of the river bottom, and individual spacing requirements.

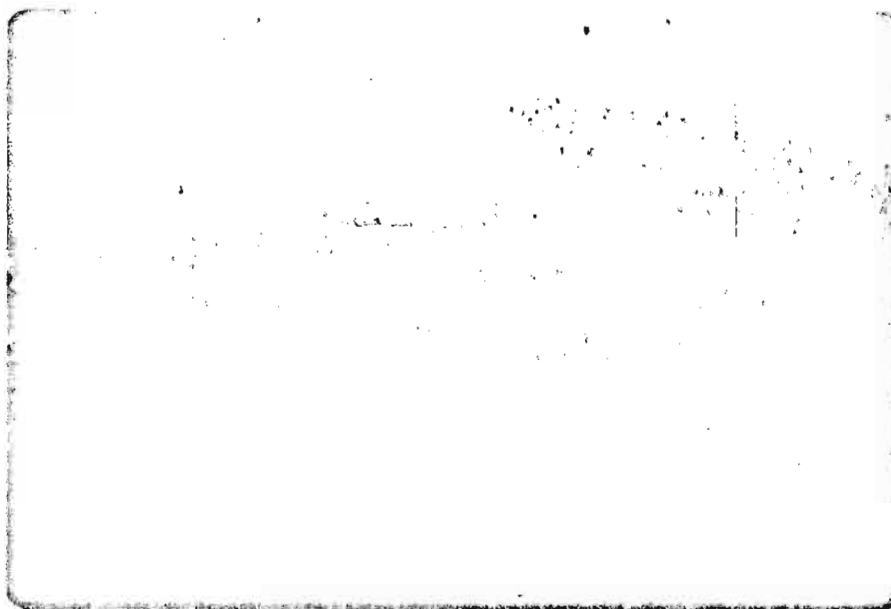


Fig. 18. Roost characteristics. Section 34, T.10 N., R.10 W. Photograph by Charles R. Frith, April 9, 1971 (6:08 a.m.).

Figure 19 shows a small herd of cranes on the river roost. These birds were observed still standing in the water as late as 9:10 a.m. Most of the cranes in this photo were facing upstream. Although the herd is facing upstream I have observed other herds facing downstream and individual birds facing all directions in relation to the stream's current.

I believe that wind is more of a determining factor concerning this behavior. In general, I believe cranes face into the wind if the wind velocity is approximately 20 miles per hour or greater. On numerous occasions I have observed cranes not facing into the wind even though the velocity was approximately 60 miles per hour. However, those cranes were protected by a high bank or a shelter belt of trees along the river.

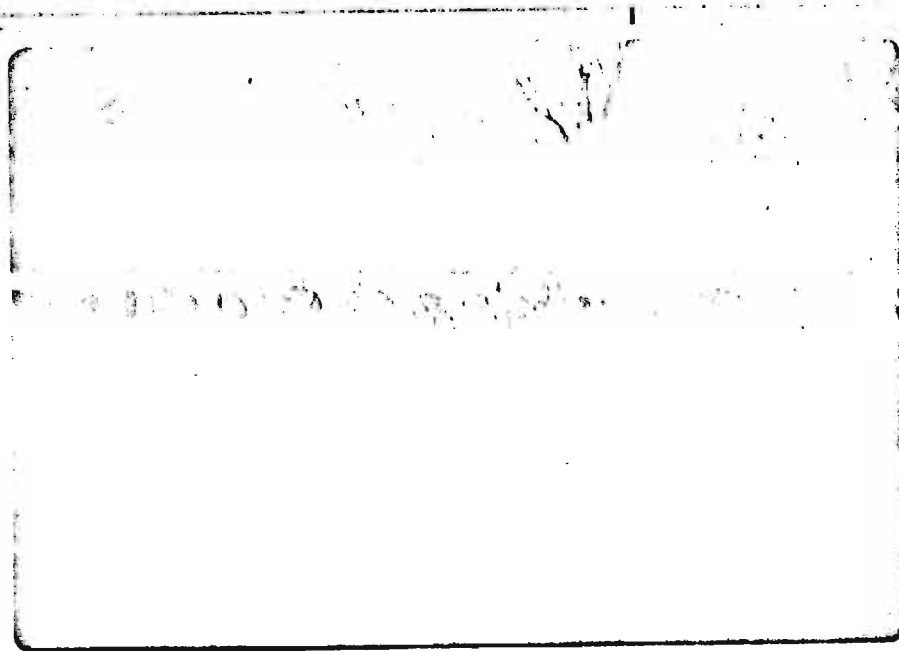


Fig. 19. Late afternoon. S $\frac{1}{2}$ S $\frac{1}{2}$ Section 33, T. 10 N., R. 10 W. Photograph by Charles R. Frith, March 29, 1971.

Along about sundown (Figure 20) late arrivals fly across the Platte River to join the herds comprising thousands of individuals. They congregate on the large islands comprising the largest wet meadow complexes, such as Shoemaker, Mormon, Killgore, and Fort Farm Islands.



Fig. 20. Late arrivals at sundown. SA Section 4, T. 9 N., R. 10 W. Photograph by Charlen R. Frith, March 20, 1971.

After the cranes spend about an hour on the congregation areas (secondary roosts) they travel a short distance to the river to roost for the night (Figure 21). Most of the cranes arrive on the roost approximately one hour before sundown to one hour after sunset. The cranes in this photograph were arriving about 30 minutes after sunset. On this particular evening the cranes filled the river to within about 30 feet from the near bank and the roost was over a mile long. By 8:00 p.m., there were approximately 30,000 cranes present.



Fig. 21. Cranes going to roost. NW $\frac{1}{4}$ Section 12, T.9 N., R.11 W. Photograph by Charles R. Frith, March 30, 1971.

The next year I worked the same roost throughout several nights. Figure 22 shows the same roosting area taken one year later (April 1972) about 20 minutes before sunrise.

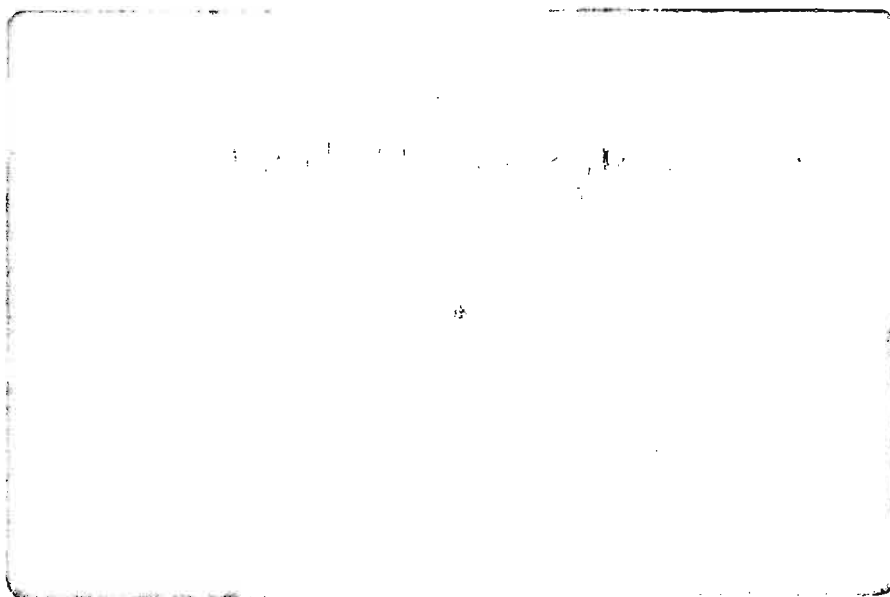


Fig. 22. Same roost (shown in Fig. 21) one year later. Photograph by Charles R. Frith, April 1972.

On March 31, 1971, Mr. Jerome Johnson (Fish and Wildlife Service biologist) and I counted 19,800 cranes. My field notes stated:

"March 31, 1971: Worked the same river roost as on March 30, 1971. The temperature is 71°F and the wind is out of the north at 60 miles per hour.

"At 5:45 p.m., there were 50 cranes in the middle of the river. All birds were facing into the wind. Cranes coming into the roost are having a very difficult time flying into the wind.

"At 6:00 p.m., the river is white capped, wind 60 miles per hour, and 70 percent overcast skies.

"At 6:10 p.m., the cranes moved from the middle of the river to the shallow water on the north side of the river (protected by trees).

"At 6:45 p.m., I estimated 1,200 cranes roosting along the north side of the river and I started to count the cranes as they went to the river roost. Jerome Johnson was with me. We positioned ourselves where the cranes were coming over us and heading into the wind. It is an ideal location for counting cranes. They came in over us at a steady stream. He counted the right turns, I counted the left. At 7:55 p.m., we have counted 19,800 cranes. It is too dark and overcast to continue counting. We can still hear cranes coming over us at 8:10 p.m. calling as they come. The spring census taken on the 30th of March only showed 13,000 cranes on this 6 miles of river. Maybe they left before the plane got this far east."

I was interested in Sandhill Crane roosting behavior in other geographical areas other than the Platte River. Therefore, I also observed crane behavior in west Texas and eastern New Mexico. Their requirements concerning water depth, spacing and general behavior were the same as that observed along the Platte River. Figure 23 shows Sandhill Cranes leaving the natural lake roosts located on Muleshoe National Wildlife Refuge, Muleshoe, Texas, before sunrise.

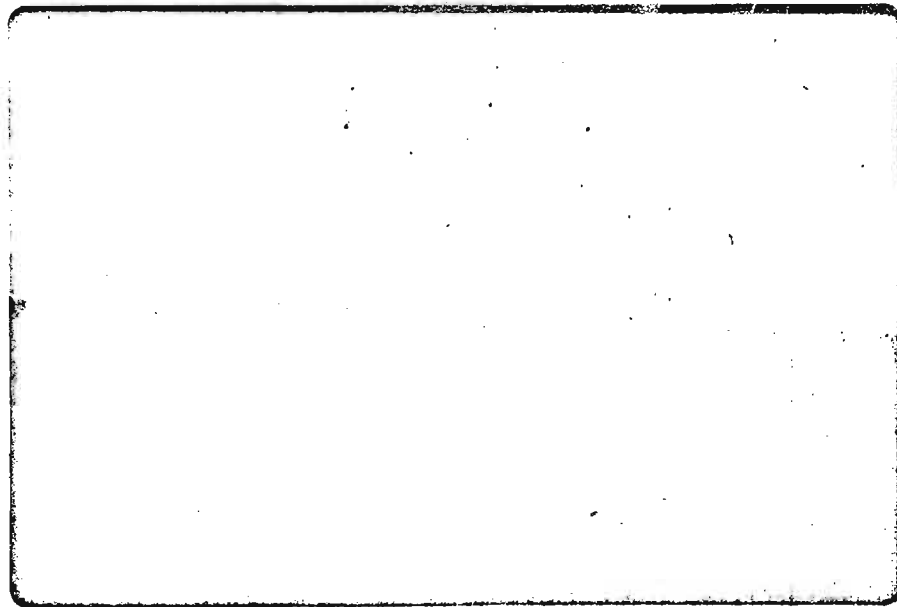


Fig. 23. Sandhill Cranes leaving roost at Muleshoe National Wildlife Refuge. Photograph by Charles R. Frith, January 1972.

During the daytime Sandhill Cranes feed on the grasslands on and adjacent to Muleshoe Refuge. Figure 24 shows a herd of cranes feeding. According to Refuge personnel, the cranes consume large numbers of grasshoppers on these areas.

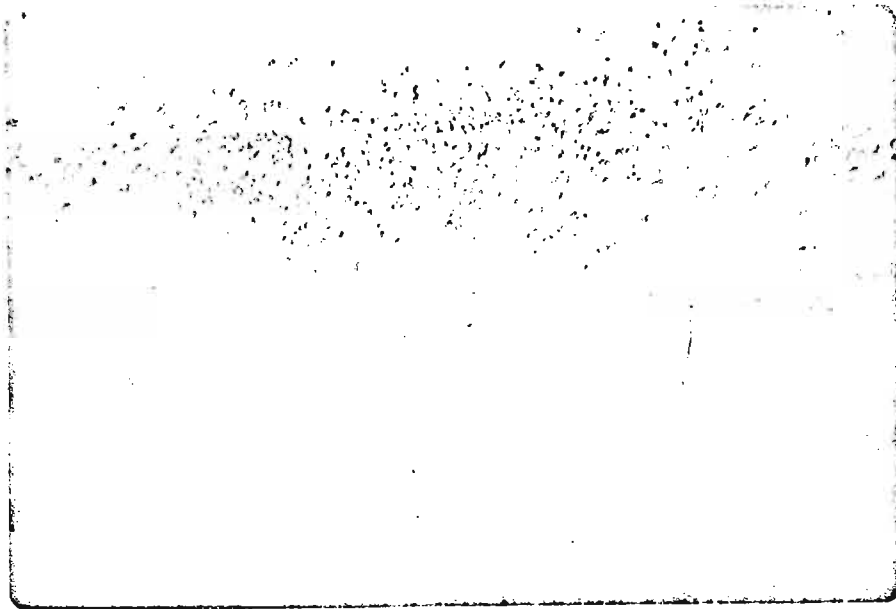


Fig. 24. Sandhill Cranes feeding on the grassland at Muleshoe Refuge. Photograph by Charles R. Frith, January 1972.

Another high density area of wintering Lesser Sandhill Cranes is Bitter Lake National Wildlife Refuge in the Pecos River Valley near Roswell, New Mexico. Figure 25 shows several thousand Cranes approaching one of the natural lakes to roost during the night.

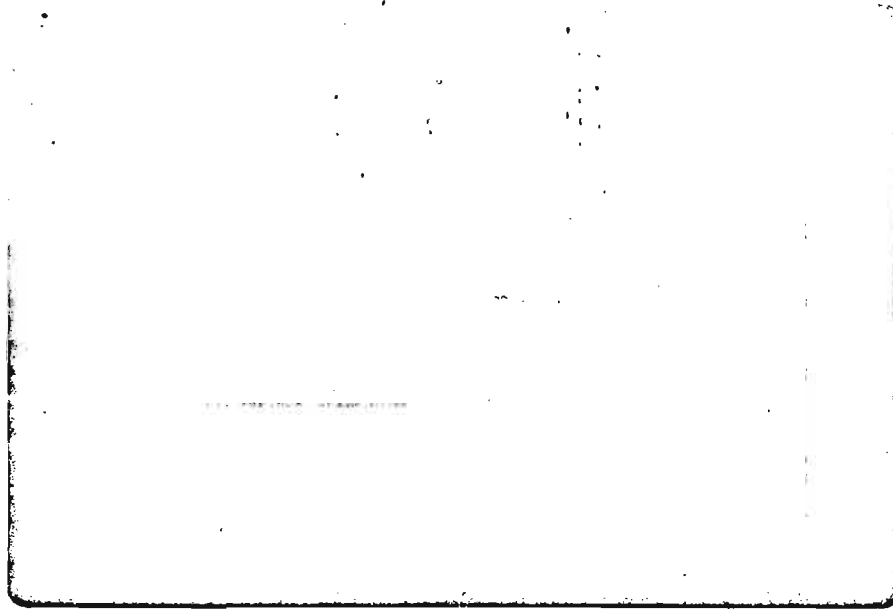


Fig. 25. Cranes approaching Bitter Lake to roost for the night. Photograph by Charles R. Frith, January 11, 1972.

Sandhill Cranes can be observed throughout the daytime (Figure 26) during certain days on the natural lakes at Bitter Lake Wildlife Refuge. These birds are standing in about six inches of water. The soils associated with the lakes are high in salt content. This particular area takes on the appearance of snow.

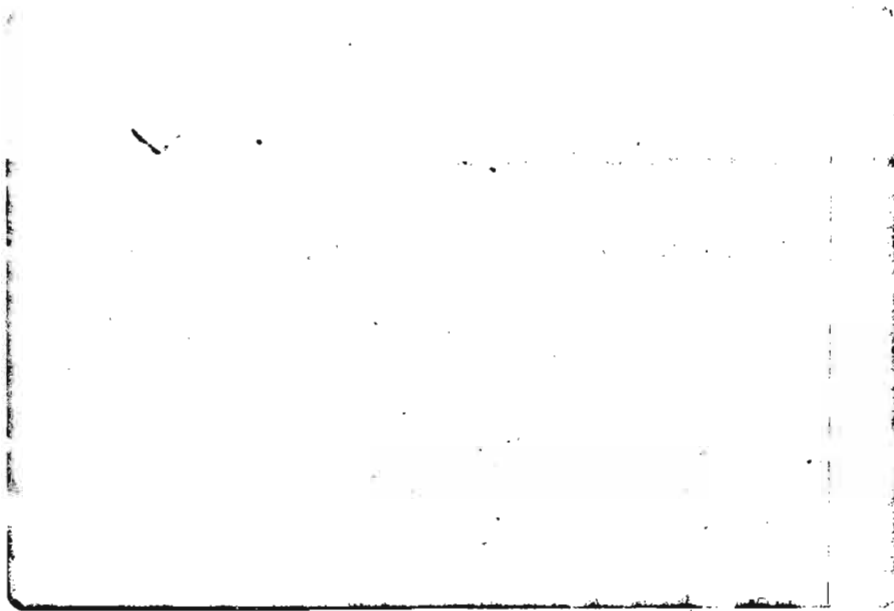


Fig. 26. Sandhill Cranes in Bitter Lake. Photograph by Charles R. Frith, January 11, 1972.

Another preferred roosting site for Sandhill Cranes is the unchannelized sections of the Pecos River. Figure 27 shows such an area within the Refuge boundary. Unfortunately, there are only a few stretches of the Pecos River that have not been channelized. According to Refuge personnel, the channelized portions are not utilized by Sandhill Cranes for roosting sites.



Fig. 27. An unchannelized segment of the Pecos River.
Photograph by Charles R. Frith, January 12, 1972.

About 60 miles south of Bitter Lake National Wildlife Refuge is Lake McMillan, a man-made impoundment for storage of irrigation waters of the Pecos River. Although Sandhill Cranes are known to frequent the general region, I could find no evidence that Sandhill Cranes roosted in this reservoir. Figure 28 shows the upper end of the reservoir, and from all appearances, it looks conducive for roosting activities. Several of the local residents indicated they had never observed cranes roosting in the lake. Several herons were observed using the shallow upper end.

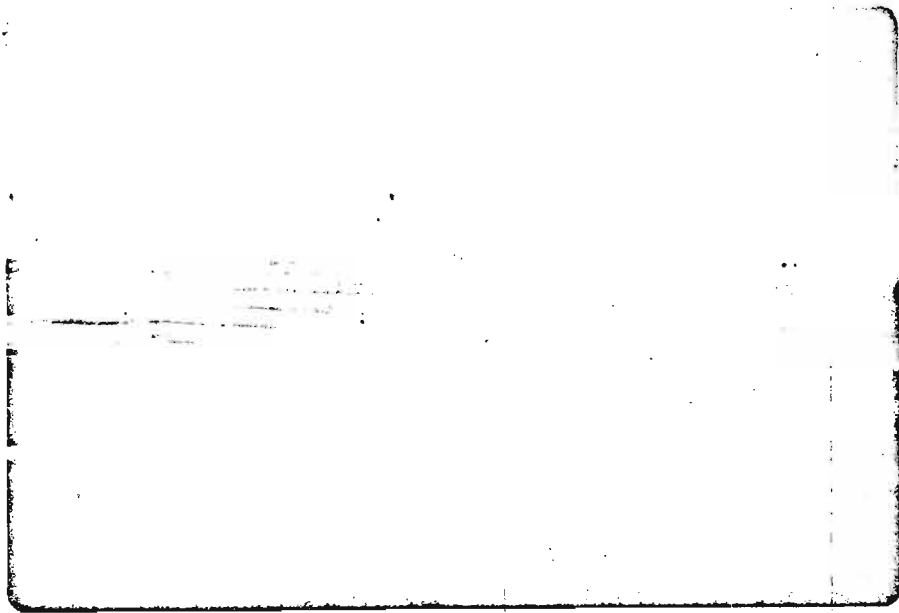


Fig. 28. Upper end of Lake McMillan, south of Artesia, New Mexico. Photograph by Charles R. Frith, January 12, 1972.

During March of most years, Sandhill Cranes will "probe" for food along the wet meadows adjacent to the Platte River. Figure 29 shows a wet meadow area that has been "raked" over by Cranes. They very carefully "rake back" the snow and dead plant material to get at the tender shoots emerging at this time. Wheeler and Lewis (1972) indicate they "grub" for worms and other animal matter.

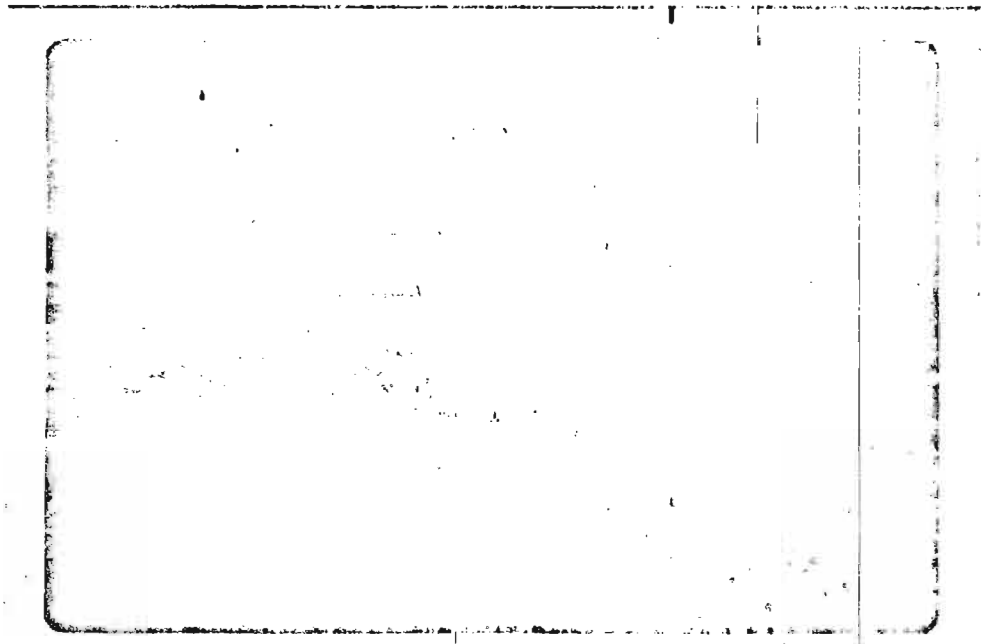


Fig. 29. A "grubbed over" wet meadow. Section 4, T.9 N., R.10 W. Photograph by Charles R. Frith, March 27, 1971.

Wheeler and Lewis (1972) emphasized that in the Overton area cranes fed extensively in harvested cornfields within three miles of the river, but as the spring plowing operations progressed, cranes extended their feeding range seven to eight miles from the river.

I concur to some degree with their findings; however, I believe the wet meadow conditions during late spring is the determining factor responsible for their extended range concerning feeding. Spring plowing within three miles of the river in the areas I studied are not plowed any sooner than those fields seven or eight miles from the river.

It seems Sandhill Cranes prefer the wet meadow complexes early in the spring, generally until mid-March, depending on seasonal conditions. During this same period (early spring) they are feeding in both the wet meadow areas and the crop fields near the river in the vicinity of their preferred roosting sites. As the season progresses the waste grains, tender vegetation, and animal matter related to the wet meadow complexes are used to their capacity or availability to fulfill the populations daily food requirements. They are then forced to move to feeding grounds that have not been extensively utilized and contain a higher percentage of waste corn.

Apparently Sandhill Cranes "grub" in other areas besides wet meadows. Figure 30, although similar in appearance to the previous photograph, is quite different. In this instance, Sandhill Cranes have "grubbed" around Iodine Bush (Suaeda suffrutescens) in soils high in salt concentrations. According to Refuge personnel at Bitter Lake, where this picture was taken, the cranes "probe" around the root system of this plant, possibly for animal matter. This behavior pattern was also observed in the wet meadow areas along the Platte River. Therefore, the "grubbing" and "probing" activities of Sandhill Cranes are not unique only to the Southwestern United States.

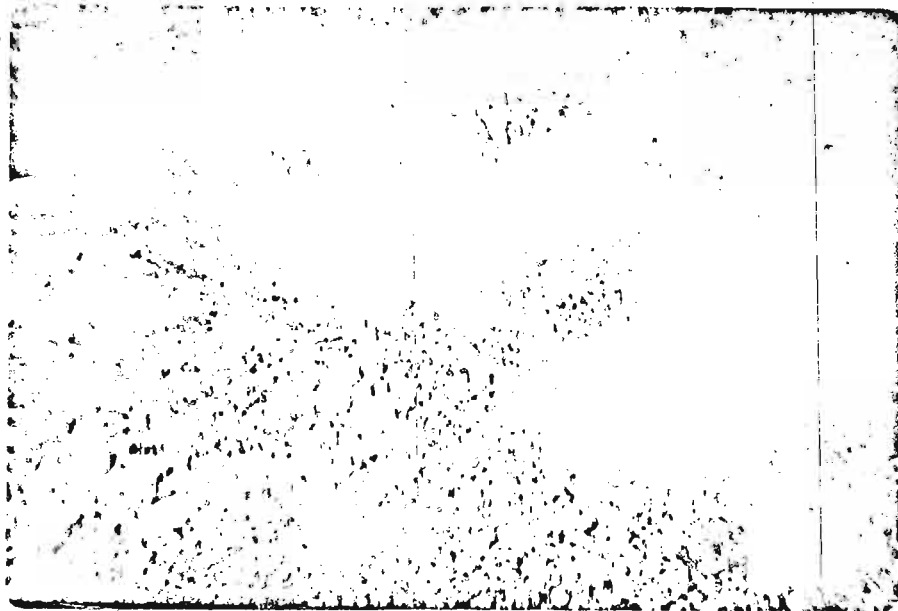


Fig. 30. Probing around Iodine Bush. Bitter Lake National Wildlife Refuge, Roswell, New Mexico. Photograph by Charles R. Frith, January 11, 1972.

South of the Platte River Valley, in the vicinity of Doniphan and Kenesaw, Sandhill Cranes utilize the upland pastures, particularly in the afternoon. Within the study area, I have observed them in this type of habitat (Figure 31) as far as 7 miles south of the Platte River. I observed similar feeding behavior on the grasslands at Muleshoe Refuge in west Texas.

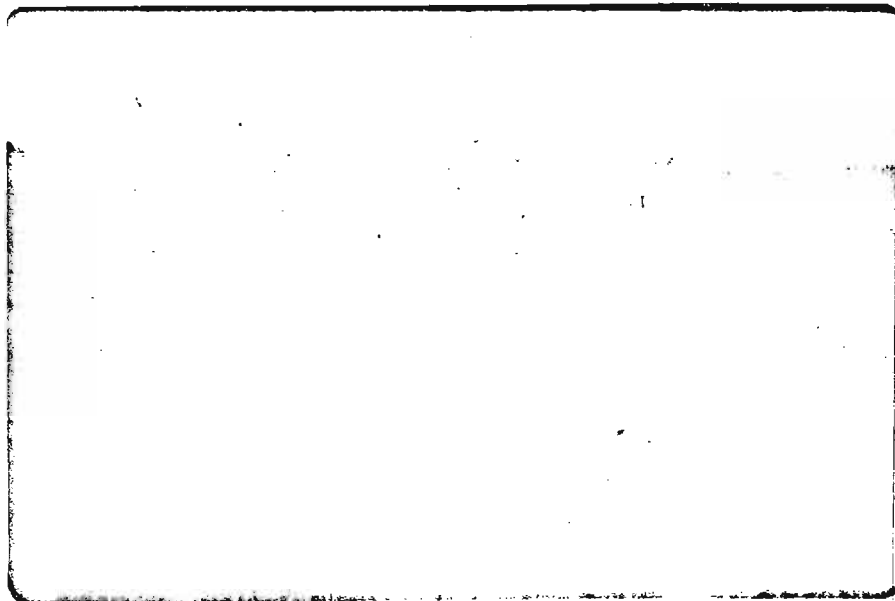


Fig. 31. Sandhill cranes in upland grasslands.
Photograph by Charles R. Frith, March 27, 1971.

Along many stretches of the Platte River Valley, cropland adjoins wet meadow habitat. Figure 32 shows Sandhill Cranes using both types of habitat.



Fig. 32. Multiple habitat. NE $\frac{1}{4}$ Section 9, T. 8 N., R. 13 W.
Photograph by Charles R. Frith, March 13, 1971 (2:15 p.m.)

During the four-year study, I have only observed cranes sitting on three occasions. Once, on March 27, 1970, during a blizzard, I observed 44 Sandhill Cranes sitting flat on the ground facing into the 38 mile per hour wind. On another occasion when the wind velocity was only 25 miles per hour I saw one crane in a herd of 20 sitting (Figure 33). I deliberately "spooked" this herd to determine if the sitting crane was injured. It flew away with the others.

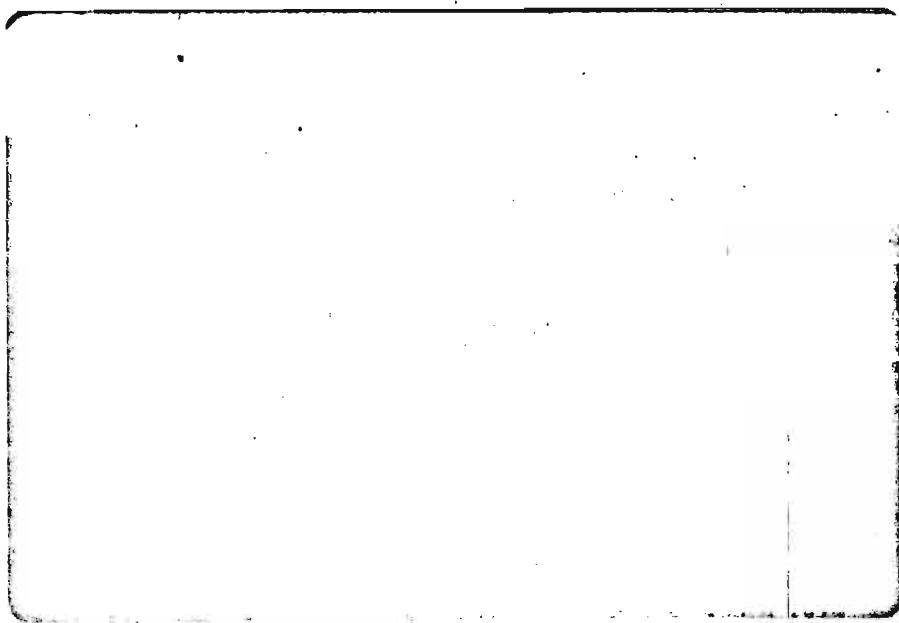


Fig. 33. A sitting crane. SE¹ Section 12, T. 8 N., R. 14 W. Photograph by Charles R. Frith, March 13, 1971.

Although I have observed Greater Sandhill Cranes at several locations along the Platte River from Grand Island to east of Kearney, Nebraska, I was only able to get this one photograph (Figure 34). I observed one Greater between Grand Island and Alda in March, 1972, and three Greaters 5 miles east of Kearney on March 24, 1973.

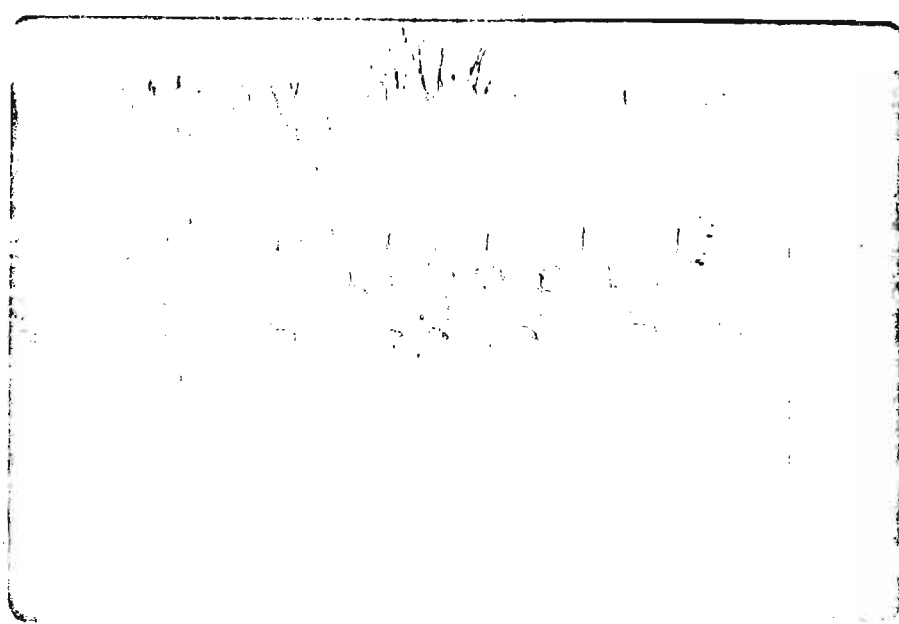



Fig. 34. Greater Sandhill Crane. NE¹ Section 9, T. 8 N., R. 14 W.

Recommendations for Habitat Preservation

The importance of the Platte River has already been emphasized to varying degrees concerning the waterfowl and Whooping Cranes resources. Therefore, it is imperative that the reader of this thesis understand the changing characteristics of the Platte River before conclusions can be made concerning the present and future of the Sandhill Crane resource.

The future of this resource is dependent on the basic preservation of existing habitat. Although the survival of a species is largely dependent on the preservation of its habitat in all sections of its range, the Sandhill Crane is probably one of the most vulnerable species because of its restricted range at a given geographical area. Its wintering area covers several thousand square miles in the Southwest United States and Northern Mexico, likewise, its breeding grounds cover an even larger area in the U.S., Canada and U.S.S.R. Sixty to eighty percent of the total Sandhill Crane population funnel into the Platte River Valley and stage for a duration during their northward migration each spring. This small unique area, the Platte River Valley, is the weak link" in the international ecosystem requirements of this species. It is the restricted part of the "hourglass" and is the most easily destroyed area because of its physical characteristics. Water withdrawal activities have affected it in the past and will affect it in the future.

Within the authorized Mid-State Division Project boundary, the Platte River can be classified in three categories concerning Sandhill Crane use. I have developed this classification based on the degree of degradation that has occurred to the Platte River channel as it relates to Sandhill Crane use.



The following classification terms and their definitions are:

1. Pristine - those areas that have not noticeably changed over the past 42 years.
2. Transitional - those areas that have been degraded to a noticeable degree over the past 42 years.
3. Degraded - those areas that have changed significantly over the past 42 years.

The degradation of the Platte River by activities already described on page 53 have resulted in the establishment of vegetative encroachment within the river channels.

It has already been emphasized that there appears to be a definite relationship between the ground water and the surface water within the Platte River Valley and particularly in areas adjacent to the river. For several years I have discussed this condition with hydrologists and there does not seem to be agreement as to why certain areas of the river have or have not changed. Therefore, I believe that the pristine areas have not changed because of the possibility that the underground aquifers are shallower and thus recharge faster in the pristine reaches. I believe this is the reason the wet meadows are more abundant in those areas of the Platte River that I have classified as pristine reaches. This seems to be reasonable when examination of past flow records of the U.S. Department of Interior's Geological Survey (1960-1972) reveal that Platte River flows at Overton are greater than at Grand Island (approximately 70 miles downstream) during the fall months. In other words the Platte River is a losing stream during the fall season between Overton and Grand Island. Apparently, much of the surface river flows are going underground to replenish the underground aquifers after the irrigation season when the water table is at its lowest ebb.

Regardless of theoretical explorations, the important thing is that the pristine reaches of the Platte River and their associated wet meadow complexes are the sites for the largest Sandhill Crane roosts. These areas comprise 59.5 percent of the wet meadows and 45.3 percent of the Sandhill Cranes, based on the U.S. Department of Interior, Fish and Wildlife Service's 1971-1973 annual spring surveys.

The unfortunate aspect is that there are only three pristine stretches left between Grand Island and Lexington, Nebraska. These areas are located along the Platte River between Grand Island and Alda, Alda and Wood River and Gibbon and State Highway No. 10 (Figure 3). Every effort should be made to preserve these areas for Sandhill Cranes and future generations. At this writing, the National Audubon Society is in the acquisition phase of acquiring some acreage within the Gibbon to State Highway No. 10 area. The Bureau of Sport Fisheries and Wildlife is studying the feasibility of establishing a National Wildlife Refuge along the Platte River, generally between Grand Island and Wood River. This is proposed as a separate development and not as a part of the Nebraska Mid-State Division, although a wildlife refuge and state hunting area was authorized as a part of the Division.

The transitional areas are those areas where wet meadow habitat is not as abundant as compared to the pristine areas, and generally the broad river channel is becoming "choked" with island, permanent vegetation, and has essentially lost its "openness" and primitive characteristics. These areas vary in degree from near pristine to almost degraded in physical characteristics and importance. The river and associated complex between Wood River and Shelton is a higher order or degree of the transitional classification. This complex area contains approximately 14.7 percent of the wet meadows while holding 18.5 percent of the Sandhill Cranes. On the lower scale of

the transitional classification is the Overton area. This area contains only approximately 4.2 percent of wet meadows but 11.3 percent of the Sandhill Cranes. Only 1971-1973 aerial spring survey data are used in this classification system for comparison between the previous and forthcoming classification area because these surveys are believed to be more accurate than earlier ones.

The degraded areas, or those that have changed significantly over the past 42 years and are, for the most part, void of Sandhill Crane use. These areas are located from Kearney to Odessa and just west of Overton to Lexington, Nebraska, with a "sprinkling" of degraded areas adjacent to bridge crossings from Lexington to Grand Island. These areas apparently have resulted from narrowing the river channel at these points for the purpose of reducing the span length of the bridges themselves. This "squeezing" of the channel apparently increases the velocity thus causing the water to drop or deposit its silt load as it "fans out" and the velocity is reduced. This phenomenon results in vegetative encroachment and eventually changes the physical characteristics of the river channel habitat. The degraded areas comprise about 3.2 percent of wet meadows between Lexington and Grand Island and only 0.7 percent of the crane population use these areas.

It should be noted that in comparing Tables 10, 11, 12, and 13, there appear to be some discrepancies in the classification systems when comparing Sandhill Crane use. Therefore, a few examples are given to illustrate: The Wood River to Shelton location has the second highest crane use, the fourth highest wet meadow acreage, but is classified in the high order of the transitional system.

Table 10. Summary of the 1971-73 Sandhill Crane Inventories ^{1/}

Location	Years			Average Per Location
	1971	1972	1973	
Platte River				
Grand Island to Alda	28,000	18,600	31,300	25,963
Alda to Wood River	13,000	9,500	6,600	9,700
Wood River to Shelton	25,000	21,300	26,500	24,230
Shelton to Gibbon	6,000	36,800	4,900	15,900
Gibbon to Kearney	29,000	17,500	24,700	23,733
Kearney to Odessa	0	1,500	1,250	917
Odessa to Elm Creek	10,000	5,700	9,300	8,333
Elm Creek to Overton	8,000	12,700	23,800	14,833
Overton to Lexington	10,000	9,000	2,600	7,200
Lexington to Cozad	0	0	0	0
Cozad to Gothenburg	0	0	0	0
Gothenburg to North Platte	0	0	0	0
Total	129,000	132,600	130,950	130,809
North Platte River				
North Platte to Hershey	61,500	27,700	39,800	43,000
Hershey to Sutherland	13,500	13,300	18,600	15,133
Head end of Lake McConaughy	3,500	10,000	6,000	6,500
Total	78,500	51,000	64,400	64,633
Grand Total	207,500	183,600	195,350	195,483

^{1/} Data compiled from the U. S. Department of Interior, Fish and Wildlife Service's 1971-73 Annual Spring Sandhill Crane Inventories of the State of Nebraska.

Table 11. Relationship of Platte River to Wet Meadows and Sandhill Cranes ^{1/}

Location	Miles of River	Wet Meadow Habitat (Acres)	Average Number of Sandhill Cranes (1971-1973 Census)
Grand Island to Alda	7.4	4,550	25,963
Alda to Wood River	5.6	2,425	9,700 ^{2/}
Wood River to Shelton	9.2	2,421	24,230
Shelton to Gibbon	6.6	1,755	15,900
Gibbon to Kearney	13.4	2,820	23,733
Kearney to Odessa	9.6	525	917
Odessa to Elm Creek	7.2	405	8,333
Elm Creek to Overton	8.8	690	14,833
Overton to Lexington	8.8	810	7,200
Total	76.6	16,401	130,809

^{1/} Data compiled from 1969 aerial photographs, U. S. Geological Survey 7.5 minute quadrangle maps and aerial photographs obtained from the U. S. Soil Conservation Service.

^{2/} My own personal observations during 1971 and 1972 indicate the roosting use on this stretch of river is much higher than the Spring Surveys indicate. *[2-3 x as high - checked with telephon - 9/12/75]*

Table 12. Percentage of Platte River, Wet Meadows and Sandhill Cranes ^{1/}

Location	Percent of River	Percent of Wet Meadow Habitat	Percent of Sandhill Cranes
Grand Island to Alda	9.66	27.74	19.85
Alda to Wood River	7.31	14.78	7.42 ^{2/}
Wood River to Shelton	12.01	14.77	18.52
Shelton to Gibbon	8.62	10.70	12.16
Gibbon to Kearney	17.49	17.19	18.14
Kearney to Odessa	12.53	3.20	0.70
Odessa to Elm Creek	9.40	2.47	6.37
Elm Creek to Overton	11.49	4.21	11.34
Overton to Lexington	11.49	4.94	5.50
Total	100.00	100.00	100.00

^{1/} Data compiled from Table 11.

^{2/} My own personal observations during 1971 and 1972 indicate the roosting use on this stretch of river is much higher (2-3 times) than the Spring Surveys indicate.

Table 13. Summary of the Classification of the Platte River Complex ^{1/}

Location	Miles of River Complex	Classification
Grand Island to Alda	7.4	Pristine ^{2/}
Alda to Wood River	5.6	Pristine ^{2/}
Wood River to Shelton	9.2	High Order of Transitional
Shelton to Gibbon	6.6	Transitional
Gibbon to Highway No. 10	6.4	Pristine
Highway No. 10 to Kearney	7.0	Low Order of Transitional
Kearney to Odessa	9.6	Degraded
Odessa to Elm Creek	7.2	Low Order of Transitional
Elm Creek to Overton	8.8	Low Order of Transitional
Overton to Lexington	8.8	Low Order of Transitional (4 miles) to Degraded (4.8 miles)

1/ Classification System:

1. Pristine - Those areas that have not noticeably changed over the past 42 years.
2. Transitional - Those areas that have been degraded to a noticeable degree over the past 42 years.
3. Degraded - Those areas that have changed significantly over the past 42 years.

2/ My own personal observations during 1971 and 1972 indicate the roosting use on this stretch of river is much higher than the Spring Surveys indicate; therefore, I have classified it as Pristine.



The Gibbon to Highway No. 10 area has only the third highest crane use, but the second highest wet meadow acreage, and is classified in the pristine system.

The one aspect that the tables fail to project to the reader is the visual aspect of the area. The Wood River to Shelton location has undergone a noticeable deterioration (vegetative encroachment) in several reaches of its 9.2 river miles during the past 42 years.

Another area that deserves special attention concerning its accelerated degradation is the Overton area (Figure 3).

Prior to this study, it was the general consensus that the Overton area was probably the largest single roosting area on the Platte River. It may have been; however, there seems to have been a decrease (since about 1965) in crane use of the area, probably due to the rate of degradation resulting from vegetative encroachment to the area.

The Platte River will undergo these classification changes (if the flows are diverted for the uses already described) at a rapid rate unless the fish and wildlife resources are recognized as a beneficial use of the water under Nebraska State Water Laws.

The major criteria or requirements for roosting sites are water depth (1-6 inches), width of river ("openness"), adjacent to wet meadows or similar congregation areas. It is difficult to put a priority on a single major criterion that will designate an ideal roosting site. Therefore, all the above requirements together comprising a complex are essential with the ultimate being a replica of the pristine areas already described.

The pristine areas have withstood the test for the past 42 years; therefore, it seems only appropriate that these areas offer the greatest potential for preservation of the Platte River habitat and associated flora

and fauna ecological systems. How much longer the pristine areas can withstand the test of accelerated development I cannot speculate except to caution that eventually these areas will go from pristine to transitional and finally to the degraded phase.

Likewise, the Sandhill Crane resources of this continent will be effected by the changing ecological conditions of a very complex habitat and will experience a yet unknown fate determined by them.

CONCLUSIONS

Inventories along 149.5 miles of the Platte River show there are approximately 29,317 acres of wet meadows.

The "hourglass" configuration best describes the present day range of the Sandhill Crane. Its base represents the southern range (southwest United States and northern Mexico); the restricted part corresponds to the Platte River Valley; and the top, the breeding grounds of several northern states including Alaska, some Canadian Provinces and parts of Siberia, U.S.S.R.

A starlight scope is useful in studying the nighttime behavior of Sandhill Cranes. Through the use of this instrument Sandhill Cranes were observed leaving their river roost as early as two hours before sunrise, particularly when the wind velocity was greater than about 20 miles per hour. The rate of departure from the roost increases with the approach of sunrise. The cranes appeared to be less active during the hours between 12:00 midnight and about 2:00 a.m. provided the wind velocity was less than 20 miles per hour. This behavior has a definite effect on the results of the annual Sandhill Crane inventories conducted annually. Therefore, between 12:00 midnight and 2:00 a.m. would be the best time to conduct inventory investigations using the infrared scanner system capabilities of the U. S. Air Force.

Vegetative encroachment refers to the increase of islands, with permanent vegetation, that evolves within the river channel. This phenomenon is the result of reducing the annual flows in the river due to upstream water withdrawal developments. Since Sandhill Cranes prefer the more open areas for roosting, this phenomenon is detrimental and eventually could eliminate areas presently used by cranes.

The essential requirements for a roosting area include water depth ranging from 1 to 6 inches; broad river channels (approximately 2,000 feet) and the absence of permanently vegetated islands or sandbars.

After cranes spend about an hour on the congregation areas (secondary roosts) they travel a short distance to the river to roost for the night. Most cranes arrive on the roost approximately one hour before sundown to one hour after sunset.

Observations made in Texas and New Mexico showed that requirements concerning water depth, spacing and general behavior were the same as that observed along the Platte River. Unfortunately, there are only a few stretches of the Pecos River, New Mexico, that still possess the necessary requirements that are essential to roosting activities. Most stretches of the Pecos River have been channelized; therefore, they are not utilized by Sandhill Cranes for roosting sites.

During March of most years, Sandhill Cranes "probe" for food in the wet meadows adjacent to the Platte River. They very carefully "rake back" the snow and dead plant material to get at the tender shoots emerging at this time. Other authors indicate they "grub" for worms and other animal matter. This behavior is not unique to the Platte River Valley because I observed cranes in New Mexico "grubbing" around the root system of Iodine Bush, possibly for animal matter.

Wheeler and Lewis (1972) indicated that cranes fed extensively in harvested cornfields within three miles of the Platte River, but as the spring plowing operations progressed, cranes extended their feeding range seven to eight miles from the river.

I concur to some degree with their findings; however, I believe the wet

meadow conditions during late spring is the determining factor responsible for their extended range concerning feeding. Fields within three miles of the river in the areas I studied were not plowed any earlier than those fields seven or eight miles from the river.

I conclude that Sandhill Cranes prefer the wet meadow complexes early in the spring, generally until mid-March, depending on seasonal conditions. During this same period (early spring) they are feeding in both the wet meadow areas and the crop fields near the river in the vicinity of their preferred roosting sites. As the season progresses the waste grains, tender vegetation, and animal matter related to the wet meadow complexes are used to their capacity or availability to fulfill the population's daily food requirements. They are then forced to move to feeding grounds that have not been extensively utilized and contain a higher percentage of waste corn.

South of the Platte River Valley, in the vicinity of Doniphan and Kenesaw, Nebraska, Sandhill Cranes utilize upland pastures, particularly in the afternoon. Similar feeding behavior was observed on the grasslands at Muleshoe National Wildlife Refuge in west Texas.

Greater Sandhill Cranes have been reported at several locations along the Platte River prior to this study. During the four years of observations associated with this study, I observed one Greater between Grand Island and Alda, Nebraska, on March 13, 1971, and three Greaters five miles east of Kearney, Nebraska, on March 24, 1973.

A classification system for the Platte River was developed during this study. This system, based on the degree of degradation that has occurred since 1938 shows that only three reaches within the study area could be classified as pristine. These pristine reaches of the Platte River and

their associated wet meadow complexes are the sites of the largest Sandhill Crane roosts. These areas comprise 59.5 percent of the wet meadows and 45.3 percent of the Sandhill Cranes based on the 1971-1973 annual spring surveys. It is difficult to put a priority on a single major criteria that will designate an ideal roosting site. Therefore, all the above requirements together comprising a complex are essential with the ultimate being a replica of the pristine areas. These areas offer the optimum for future sanctuaries and every effort should be made to preserve this unique and essential habitat.

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Nebraska. Loose leaf report.

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APPENDIX

Tables A through M are included in this thesis to substantiate the importance of the Platte River and to provide data for comparison purposes concerning the ultimate fate of the Platte River habitat and associated waterfowl resources.

The tables also provide an insight concerning the recreational potential that may be lost if appropriate steps are not taken to preserve the integrity of the area.

Table A. Kill Data ^{1/}

Duck Blind on Platte River, south of Wood River, Nebraska

Year	Ducks	Geese
1948	90	2
1949	77	1
1950	102	10
1951	190	1
1952	137	0
1953	201	1
1954	79	1
1955	80	1
1956	60	2
1957	305	4
1958	160	6
1959	120	7
1960	67	0
1961	78	3
1962	61	11
1963	77	3
1964	20	6
1965	79	4
1966	53	0
1967	52	0
1968	45	0
1969	No record for this year	
1970	94	2
1971	<u>48</u>	<u>4</u>
23 year total	2,352	69
Average/Year	102	3

^{1/} - Data courtesy of Mrs. M. G. Detweiler, Grand Island, Nebraska.

Table B. 1933 Kill Data ^{1/}

Duck and Goose Blind near Chapman, Nebraska

Date	Ducks	Geese	No. Hunters	Remarks
October 1	4	0	3	
October 2	15	0	4	Used live decoys, ducks and geese as callers and "sink box" blind.
October 3	1	0	1	
October 4	3	4	3	
October 6	0	0	2	
October 7	1	0		
October 8	0	0	4	
October 9	3	0	3	
October 11	5	0	3	
October 12	4	2	2	
October 13	0	11	5	All geese killed on this page were white-fronted geese except for four Canada geese.
October 14	4	2	3	
October 15	3	6	5	
October 16	0	0	3	
October 17	0	0	3	
October 18	0	0	2	
October 19	1	0	3	
October 20	0	0	4	
October 21	4	0	4	
October 22	8	6	3	
October 23	6	0	3	
October 24	1	0	3	
October 25	5	0	3	
October 26	2	1	3	
October 27	1	3	3	
October 28	3	0	4	
October 29	14	0	4	
October 30	5	0	3	
October 31	1	0	2	
November 1	0	0	2	
November 2	12	0	3	
November 3	34	0	4	
November 4	12	1	4	
November 5	24	0	5	23 Mallard - 1 Bluebill
November 6	4	0	3	
November 7	0	0	3	
November 8	7	0	2	
November 9	11	0	2	All Mallards
November 10	10	0	2	7 Mallards
November 11	2	0	3	
November 12	34	7	5	
November 13	2	0	3	
November 14	0	0	3	

Table B. (continued)

Date	Ducks	Geese	No. Hunters	Remarks
November 15	0	0	3	
November 16	0	0	3	
November 17	0	0	6	
November 18	0	0	3	
November 19	4	0	4	
November 21	1	0	4	
November 22	0	3	3	
November 23	0	0	4	
November 25	0	0	3	
November 26	1	0	4	
November 27	0	0	3	
November 28	0	0	3	
Total	252	46	174	

1/ Data courtesy of Mr. Clarence Zlomke, Grand Island, Nebraska.

Table C. 1934 Kill Data ^{1/}

Duck and Goose Blind - Near Chapman, Nebraska, on Platte River

Date	Ducks	Geese	No. Hunters	Remarks
October 16	0	0	4	October 16 - opening of duck and goose season. "Just naturally pretty discouraging with no water in the river. She simply lacks the "Old Pepper". A pack of rugs and a camel would be more appropriate on the Platte now than a water dog and a shot gun."
October 17	0	0	4	
October 18	0	0	4	
October 19	1	5	4	
October 20	1	9	5	
October 22	0	6	3	
October 23	0	2	4	
October 24	0	0	3	
October 25	0	4	4	
	(Saw flock of cranes)			
October 26	0	0	4	
October 27	0	1	3	
October 28	1	2	4	
October 29	0	0	3	
October 30	0	3	3	
October 31	0	2	4	
November 1	0	0	3	
November 2	0	1	3	
November 3	0	0	4	
November 4	2	0	3	
November 6	0	0	3	
November 7	0	0	3	
November 8	0	0	3	
November 9	1	0	3	
November 10	0	0	2	
November 11	0	0	5	
November 12	0	0	3	
November 13	0	0	2	
November 14	0	0	3	End of season
Total	6	35	96	

^{1/} Data courtesy of Mr. Clarence Zlomke, Grand Island, Nebraska.

Table D. 1935 Kill Data ^{1/}

Duck and Goose Blind Near Chapman, Nebraska, on Platte River.

Date	Ducks	Geese	No. Hunters	Remarks
October 21	0	0	2	Before season opened, the diary read Saturday, October 12, 1935, "White geese playing up and down river but seemed to circle over sink box many times Noise galore - just makes one sick to know he dare not go after them. Anyway, it's music to the ears - let them howl."
October 22	0	0	2	
October 23	0	0	2	
October 24	0	0	3	
October 25	0	0	4	
October 26	0	0	2	
October 27	0	0	2	
October 28	3	0	2	
October 29	0	0	2	
October 30	8	0	2	
October 31	8	0	4	River bed was dry prior to opening day - opening day a trickle.
November 1	8	0	3	"Extra water helps."
November 2	8	0	3	
November 3	3	0	3	
November 4	0	2	5	
November 5	0	0	3	
November 6	4	0	2	
November 7	0	4	3	
November 8	3	0	3	
November 9	0	0	3	
November 10	0	0	2	
November 11	0	0	2	
November 12	0	0	2	
November 13	0	0	2	
Total	48	6	63	

^{1/} Data courtesy of Mr. Clarence Zlomke, Grand Island, Nebraska.