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Conservation Commission, Jefferson City, Missouri, April 5, 1949.

THE SANDHILL CRANE IN THE BERNARD W. BAKER SANCTUARY, MICHIGAN

BY LAWRENCE H. WALKINSHAW

INTRODUCTION

IN September, 1921, I made my first visit to the area now constituting the Bernard W. Baker Sanctuary. Several visits were made to the area during August, 1930, and several during May, 1931. Thereafter, I have visited it nearly every month, often many times during some months. Some of these observations have been published by the author (1933, 1941, 1944, 1945, 1946, 1948). A great deal of information on the Greater Sandhill Crane, *Grus canadensis tabida* (Peters), has been secured on the area. Some of this material has been incorporated in my manuscript on the Sandhill Crane, but a great deal of it could not be used. I am assembling that data in this article.

THE AREA

The marsh in which the Bernard W. Baker Sanctuary area is located consists of approximately 1000 acres. The Sanctuary, purchased during 1941 by Bernard W. Baker of Marne, Michigan, and presented to the Michigan Audubon Society, consists of 571 acres. About 71 acres are on high land and land connecting the area to highways. The marsh lies in sections 10, 11, 14 and 15 in Convis Township, Calhoun County, Michigan.

The marsh consists of many irregular sedge and grass-grown "arms" reaching through forests of: tamarack, *Larix laricina;* maple, *Acer;* birch, *Betula;* ash, *Fraxinus;* basswood, *Tilia americana.* Some elm, *Ulmus*, and hickory, *Carya*, are found on the ridges or in swampland woods. One ridge of dry land is covered with second growth oak, mostly white oak, *Quercus alba*, with some black oak, *Quercus velutina* and red oak, *Quercus borealis maxima.* This ridge extends from the northeastern corner of the marsh over one-half mile toward the center. Another island occurs in the northwest corner and a third near the

western side of the north 160 acres. These, together with the tamarack peninsulas, almost completely surround the areas where the cranes nest. They produce the isolation necessary for cranes.

Several small streams enter the marsh from the southwest, one from the south, and one from the Ackley Lake region about one half mile from the northeast corner of the area. Several others flow in from the east during normal years but become dry during drought. The outlet leaves from the northwest corner of the Baker Sanctuary. Nearly all of the streams are two to four feet wide where they enter the marsh. The outlet is six to eight feet wide.

The 160 acres in section 15 are almost always covered with water varying from six to 36 inches in depth. Many other portions of the marsh are also covered with shallow water during years of normal rainfall. During drought years these become dry.

The predominant plants on the crane nesting area are: cat-tail, *Typha latifolia;* bur-reed, *Sparganium eurycarpum;* arrow-head, *Sagittaria latifolia; Zizania aquatica; Agrostis alba; Calamagrostis;* reed, *Phragmites communis;* some *Cyperus; Eleocharis; Scirpus validus; Scirpus cyperinus; Carex riparia; Carex Pseudo-Cyperus; Juncus; Iris versicolor;* water dock, *Rumex;* swamp milkweed, *Asclepias incarnata; Gnaphalium anaphalis; Galium,* and other less common associated plants.

These irregularly shaped, open blocks of marsh are surrounded by the forests mentioned above as well as by shrubs such as: dogwoods, *Cornus stolonifera; Cornus amomum; Cornus paniculata;* willow, *Salix;* poison sumac, *Rhus vernix;* and wild rose, *Rosa.* Isolation is also produced by a few small groups of quaking aspen, *Populus tremuloides,* thick stands of reed, *Phragmites communis,* and the predominant tree, tamarack. In these open marshes the cranes nest, roost at night, rest during the daytime, and often feed. Cranes also feed on the dry, pastured fields as well as on the corn, wheat, and oat fields within two miles of the heart of the marsh, after the grain has been cut, or in areas where grain still stands in the spring. Here they eat loose grain, capture many grasshoppers, crickets, and similar insects, and in places burrow for earthworms.

The soil of the marsh areas consists of muck and peat overlying a marl base in places. The water is slightly basic, having a pH of about 7.6. The surrounding hills and valleys are covered with sand, sandy-loam, and in places clay; the stream valleys are muck and peat.

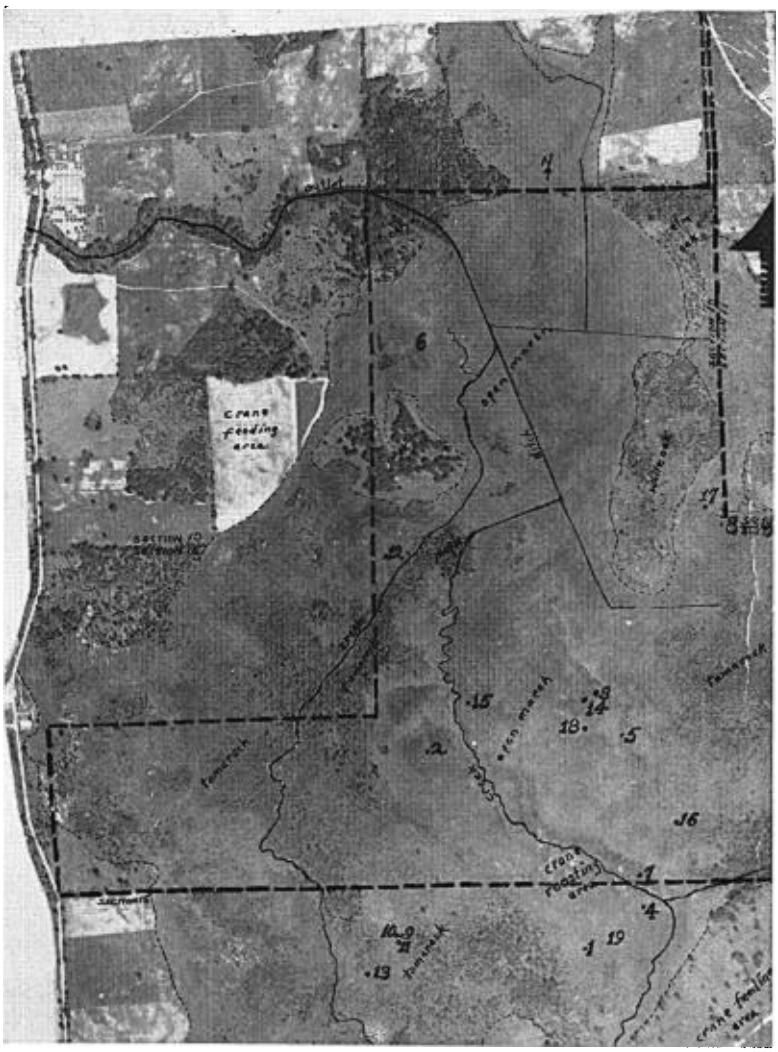
Farming in the neighborhood consists of the raising of wheat, oats, rye, corn and hay. In some sections dairy cattle are pastured.

Until the spring of 1943 the marsh was burned each spring or winter by some of the neighboring farmers. This has occurred since 1918, at least. Sometimes it was burned during the late winter, but usually in late March or early April, and again not until early May when considerable damage was produced. During 1931, 1932, 1933, 1935, 1938, 1940, and 1944, there was sufficient water to prevent severe damage at the time it was burned. In 1934 and 1936 the area was burned severely on the east side. During 1937, 1939, 1941, and 1942 (in early May), and to some extent during 1945, it was burned more severely. The fire in 1942 destroyed many duck nests and at least one crane's nest; it jumped the creek and ran through the forest areas.

ANIMALS OF THE AREA

During the 1945 fire the oak ridge was burned severely, and Dr. Miles D. Pirnie located charred eggs in the remains of a nest of the Ruffed Grouse, *Bonasa umbellus*. Probably, fires have been the chief cause of the fluctuation of such species as the Prairie Chicken, *Tympanuchus c. americanus*, and the Short-eared Owl, *Asio f. flammeus*. Not only did it destroy their nesting cover, but it also made them more vulnerable to attacks by the red fox, mink, opossum and raccoon which live there. The red fox, *Vulpes fulva*, has increased on the area during the past few years. Probably only one den was located in the marsh during 1931; in 1946, at least three were in use. However, only one dead crane has been found. That was found on top of a muskrat house where the water was two feet deep, and foxes were not the culprits. They prefer to walk around water rather than crossing it. Downy cranes, when they feed on dry land, are very vulnerable to foxes. Raccoons, *Procyon l. lotor*, forage over the water areas and the evidence is rather strong that they destroyed one nest. During the daytime the cranes probably are able to care for themselves. It is during the night that mammals can produce damage to eggs and young.

Birds on the area which might cause harm to young or eggs are: Red-tailed Hawk, *Buteo borealis;* Cooper's Hawk, *Accipiter cooperii;* Marsh Hawk, *Circus cyaneus;* Great Horned Owl, *Bubo virginianus;* and Crow, *Corvus brachyrhynchos*. Probably none of these cause any damage to nesting cranes unless eggs are left uncovered or young deserted temporarily by parent cranes. I have no proof that any bird has taken a young or egg in the Baker Sanctuary. Eggs have been left in nests for several days after desertion without being disturbed by Crows. However, Crows will eat them if they find them uncovered. A crane's nest in Bellevue Township, Eaton County, only five miles from the Baker Sanctuary was found April 19, 1947, without eggs. On April



AERIAL VIEW OF AREA OF STUDY. THE BOUNDARY OF THE BAKER SANCTUARY IS MARKED BY DASHES. NUMBERS WITH DOTS INDICATE NESTS OF SANDHILL CRANES. ARMY AIR FORCES PHOTOGRAPH (SCALE, 4 INCHES = 1 MILE).

23 it still contained no eggs. Because of the proximity of trees, I was able to examine this nest without being observed by the cranes. On April 27 the remains of a crane's egg were found in the nest. Evidently, the isolating trees, in this case much too close, had produced a stopping place for Crows. They had apparently broken the eggs while the parents were away. After both eggs are laid cranes very seldom leave their nests. Nearly always one is at the nest.

In southern Michigan I often stop to discuss the rarity of the cranes with owners of property. In nearly all cases they soon help to protect them. During my studies of the species there has been an increase of cranes throughout Michigan. Probably the protection offered by the owners and the creation of refuges are responsible. In southern Michigan the Baker Sanctuary, the Rose Lake Experiment Station (Clinton County), and the Waterloo Refuge (Jackson County) are all used by cranes. In the upper peninsula, the Seney Wildfowl Refuge is used. Although we have little warden service at the Baker Sanctuary and there are a number of habitual poachers, cranes have increased there. Probably, much less shooting of cranes now occurs in Michigan than 15 to 20 years ago.

Birds nesting in close proximity to the crane nesting areas are: Least Bittern, *Ixobrychus e. exilis;* Mallard, *Anas p. platyrhynchos;* Black Duck, *Anas rubripes;* Blue-winged Teal, *Anas discors;* Virginia Rail, *Rallus l. limicola;* Sora, *Porzana carolina;* Florida Gallinule, *Gallinula chloropus cachinnans;* Wilson's Snipe, *Capella delicata;* Short-eared Owl, *Asio f. flammeus;* Prairie Marsh Wren, *Cistothorus p. iliacus;* Short-billed Marsh Wren, *Cistothorus stellaris;* Northern Yellow-throat, *Geothlypis t. brachidactyla;* Red-wing, *Agelaius p. phoeniceus;* Swamp Sparrow, *Melospiza g. georgiana;* and Song Sparrow, *Melospiza m. euphonia.*

OBSERVATIONS ON CRANES

Since my first visit to the sanctuary marsh I have kept a record of the time spent on the area, as well as the number of cranes observed. The summary of these observations is presented in Table 1. Although in actual numbers of cranes observed, each trip probably duplicated the cranes observed on a previous trip that year, it has seemed the logical way of comparison from year to year. The actual maximum numbers of cranes observed during each spring and fall are given in Table 2, as well as the family groups which produced those flocks. The first observation for each spring and the last for the fall are also given.

The Greater Sandhill Crane returns each spring to its last year's nesting ground with its young from the previous season. The young

TABLE 1

OBSERVATIONS OF SANDHILL CRANES, BERNARD W. BAKER SANCTUARY, CALHOUN COUNTY, MICHIGAN

Year	*1930*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*42*	*43*	*44*	*45*	*46*	*47*	*48*	*Total*	*Average number per hour*
February																					
Number seen						0			0			0	0	0		0			0	0	0.00
Hours						8			3			4	3	4		3			4	29	
March																					
Number seen			0	3	3	13	0	2	0	0	3	4	2	12	1	0	13	1	4	61	0.36
Hours			3	6	10	22	10	20	5	7	13	17	11	6	3	5	21	3.5	5	167.5	
April																					
Number seen			2	3	2	7	11	3	1	0	14	41	15	21	13	22	42	7	29	233	0.64
Hours			3	7	8	27	23.5	32	23	6	17	34	18.5	24.5	13	18	63	12	33	362.5	
May																					
Number seen		9	5	6	6	0	5	0	5	18	8	4	16	2	3	19	4	3	18	131	0.44
Hours		20	20	10	38	36	20	8	14.5	11.5	7.5	4	11	3	3	30.5	8.5	8.5	23	277	
June																					
Number seen			0	1						8	1	4	2	2		0		1	4	23	0.58
Hours			3	3						7	3	7.5	2	5		2		2	5	39.5	
July																					
Number seen		0		0	0					2		4	5	5		2	11	1	0	30	0.43
Hours		3		7	5					3.5		16	10	3		3	13	5.5	1	70	
August																					
Number seen	17	0			0			0		3	10	11			2		8			51	0.68
Hours	10	2			15			6		5	10	20			1.5		5.5			75	
September																					
Number seen	0		0	0		0	0	0	0	12	21	20	5	5	14	4	14		0	95	0.62
Hours	5		3	3		3	3	5	4	21	20	18	13	11	5.5	4.5	17		2	138	
October																					
Number seen			0	0	8		0		2	16	18	45	3	4	2	9	20	5	39	171	1.04
Hours			4	6	14		6		17.5	13.5	10.5	21	5	9	2	14	8	9	25	164.5	
November																					
Number seen											9	0		4	1	2	6	10	46	78	1.02
Hours											8	4		4	2	2	17	25	14	76	
December																					
Number seen												0								0	0.00
Hours												4								4	
Total seen	17	9	7	13	19	20	16	5	8	59	84	133	48	55	36	58	118	28	140	873	0.62
Hours in field	15	25	36	42	90	96	62.5	71	67	74.5	89	149.5	73.5	69.5	30	82	153	65.5	112	1403	
Number seen per hour	1.13	0.36	0.19	0.31	0.21	0.22	0.25	0.07	0.12	0.79	0.94	0.89	0.65	0.79	1.20	0.70	0.77	0.42	1.25		

are immediately driven away. Rarely, parents will tolerate one roosting near the nest at night in the spring. The Sarus Cranes, *Grus a. antigone*, in the San Antonio Zoo similarly attacked their young of the previous year. Fred Stark wrote that when the parents started to nest in the summer, the young of the previous year had to be removed from the pen. I observed the White-naped Cranes, *Grus vipio*, in the Detroit Zoo drive their 1946 young from them in April, 1947, even before they had been turned into their open enclosure.

TABLE 2

FIRST AND LAST RECORDS FOR EACH YEAR, AND LARGEST NUMBER OF CRANES SEEN

Year	*First observation of year*	*Greatest number birds in spring*	*Last observation of year*	*Greatest number birds in autumn*
1930			August 17	8 (3, 3, 2)
1931	May 3	3		0
1932	April 3	2		0
1933	March 26	3		0
1934	March 25	3	October 4	8 (3, 3, 2)
1935	March 14	5 (3, 2)		0
1936	April 9	4 (2, 2)		0
1937	March 25	2		0
1938	March 26*	3	October 6	2
1939	May 4	8 (6, 2)	October 1	16 (7, 3, 3, 3)
1940	March 24	6 (2, 2, 2)	November 3	9 (3, 3, 2, 1)
1941	March 22	7 (3, 3, 2)	October 24†	14 (4, 4, 3, 2,1)
1942	March 15	6 (2, 2, 2)	October 8	7 (3, 2, 2)
1943	March 18	6 (2, 2, 1, 1)	November 11	7 (4, 3, 2)
1944	March 7‡	6 (2, 2, 1, 1)	November 12	8 (3, 2, 2, 1)
1945	March 13§	7 (2, 2, 1, 1, 1)	November 15	5 (3, 2)
1946	March 7	12 (3, 2, 2, 2, 1, 1, 1)	November 16	9 (3, 3, 2, 1)
1947	March 20	5 (2, 2, 1)	November 9	6 (2, 2, 1, 1)
1948	March 20	5 (2, 2, 1)	November 25	8 (4, 3, 1)

* Observation by B. C. Walkinshaw.
† Observation by Millard Vandervoort.
‡ Observation by John Bennett.
§ Observation by Ben Jenkins.

The pairs of Sandhill Cranes in the Baker Sanctuary have definitely had territorial boundaries. On one occasion I watched a crane repeatedly stab at another crane which was on the first crane's territory. The second crane kept his distance by jumping and flying, finally reaching his own territory. Nests have been found in the same area for four or more years in succession; the behavior of the cranes has helped to tell them apart. Egg markings and size have also helped to identify different female cranes.

One pair of cranes probably nested in the marsh from 1931 until 1936. During 1937, there were very few cranes on the area. In 1939 a pair began nesting on the northern 160 acres, and I feel sure that they were still nesting there in 1948. In 1939, a pair appeared along the west side of section 15 and nested there until 1946; nests were found during 1943, 1944, 1945 and 1946. None of these nests were more than 100 meters from each other, and three of them were in a small triangle, 13.7, 13.7 and 10.9 meters from each other. In all of these nests the eggs were colored almost identically, and each spring the male behaved in exactly the same way. He roosted and fed in the same area and always behaved in identical manner when I appeared.

The number of pairs of cranes nesting in the Baker marsh has varied but has been recorded as well as possible. The following observations are definite, but more pairs might have been nesting. During the period 1931 to 1936, one pair nested each year; 1937, none; 1938 and 1939, probably one; 1940 through 1948, two each year and possibly more in some years. One pair of cranes nested in Johnstown Township, Barry County, about 10 air miles away during 1931, 1932, and 1939 through 1948, and probably two pairs during 1937, 1938, and 1944. A pair nested in Bellevue Township, Eaton County, only five miles away from 1938 through 1948, except in 1943. Another pair nested only two miles away in the Mud Lake area in Convis Township, Calhoun County, from 1939 through 1948.

These other marshes are smaller and perhaps take care of overpopulations from the Baker Sanctuary marsh, even though it seems the latter should be able to take care of them all. Victor Jones and I found seven pairs in Caribou County, Idaho, including three nests and another pair evidently with young, on May 25, 1941, in an area much smaller than the Baker Sanctuary marsh.

During the spring, cranes are quite conspicuous when they first arrive. Later, they settle down to building nests and soon become very quiet. As nesting advances they are seldom seen and as seldom heard. However, they nearly always call at daybreak when changing places at the nest. If disturbed too much, they soon learn to become quiet at this time of day. After the young hatch it is almost impossible to find them. The vegetation becomes so tall that they easily disappear from sight. They seldom, if ever, call and do not fly unless frightened.

Flocks of non-breeders have often been found on the area. During 1931, one non-breeding bird was present; during 1934, one; 1939, six; 1940, two; 1941, three; 1942, two; 1943, two; 1944, two; 1945, three; 1946, six to eight; 1947, one; and 1948, one non-breeding bird. These birds ranged over the marsh and the neighboring fields making con-

siderable noise at daybreak and during the early morning and late evening. They nearly always roosted in the wet area of section 15.

About the time of sunrise all cranes not sitting on eggs leave for neighboring fields where they feed. Each pair has a definite place where it is apt to feed. This location may change several times during the summer, but when one place is found suitable they may be found there for several weeks, and in some instances for months. The non-breeders do much more roaming. During the nesting season the paired individuals often feed in the heart of the marsh, seldom flying very far. If they do fly, they proceed to the closest high land, feed for about an hour or two, then return to the nest region.

NESTING

Laying of eggs usually occurs about a month after arrival. Temperature definitely affects the time of laying. During an early, warm spring eggs are laid earlier, in a cold year much later. In 1933, the first cranes were seen on March 26. A nest with two eggs (hatched May 20) was found April 30. In 1935, the first cranes were observed March 14; a nest with eggs was found April 18. Cranes appeared March 22 in 1941, and a nest with the first egg was found May 1. During 1943, March 18 and May 2 were the dates; 1944, March 7 and April 23 (hatched May 12–13); 1945, March 13 and April 12; 1946, March 7 and April 7 (first egg laid); 1947, March 20 and May 11; 1948, March 20 and April 17.

Eggs were laid much earlier in 1945 and 1946; March in these years was exceedingly warm. The mean temperature for Battle Creek, Michigan, for March, 1945, was 48.5 degrees and for March, 1946, 47.4 degrees, 13.3 and 14.4 degrees above normal.

Arrival and departure of cranes are definitely affected by temperature. Usually, they arrive in March when the mean daily temperature reaches about 36° F. At that time the ice begins to leave the marsh and the ground. In the fall they disappear when the mean temperature goes lower than 36° F. for a day or two, and ice forms on the pools and the earth begins to freeze. I feel confident that the last observation given in Table 2 for each of years, 1946, 1947, and 1948, was the date of departure. I knew where the cranes fed and watched them at least every other day. In 1946 a severe storm came the afternoon of November 15; two cranes were still present. It was very cold that night and the next day and, although I spent the entire day on the area, no cranes were found. In 1947, the mean temperature did not go below 46° F. until November 8 when it reached 34°. It remained in the low 30s during the next week, going as low as 26° on

November 13. The last five cranes were seen November 9, flying back and forth over the area most of the day. In 1948, the first time the thermometer went below 32° F. was November 22 when it reached 31° F. On November 24 it went to 30° F. and to 31° on November 25 (mean 39° F.). Cranes disappeared November 25. Amount of daylight and other factors probably have some effect, but the temperature factor must be the deciding one. In 1948 when the cranes left, there was a great deal of loose corn upon which they could still feed, so apparently it was not a lack of food.

Nineteen breeding records have been obtained from the area. Of these 17 were nests. All contained two eggs when the sets were completed. Nests were found on: May 5, 1931; May 8, 1932; April 30, 1933; April 18, 1935; April 26, 1936; June 11, 1939 (two young about one-half grown observed); May 1, 1941 (one egg; one egg only May 2, but a second laid later); June 10, 1941; May 2, 1943; April 23, 1944; April 12, 1945; May 11, 1945 (Elizabeth B. Beard and Miles D. Pirnie); April 7 and 11, 1946 (with John Stophlet); May 11, 1947; July 1, 1947 (parent sitting on two rotten eggs); April 17, May 14, and May 15, 1948 (last record parent with two young just out of nest). The extremes of nesting have been April 7 and July 1; the average date of egg laying April 19–21 (four records), the average date of hatching May 17–18 (May 5 to June 10). At one nest I was uncertain of the outcome. Of 36 eggs in the remaining 18 nests, 18 eggs hatched (50 per cent); seven eggs were deserted; nine eggs were not fertile; and two were destroyed by some predator, probably a raccoon. Eggs are apparently laid every other day. During 1946, John Stophlet and I found a nest with one egg April 7. This nest contained the second egg on April 9. Hatching, however, occurs on successive days.

From the 18 young hatched, 15 apparently have survived until autumn. This has been determined by study of the sizes of family groups in the autumn. However, during the 19-year period (1930–1948) possibly 25 young have been raised.

The location of nests has always been in the rank sedges, *Carex* and *Scirpus*, in cat-tails, with some grasses, or in rushes and at times near *Phragmites*. Materials at hand have been used in nest construction, the parent evidently dragging up the nearest available sedges, cat-tails and reeds. In the Baker Sanctuary, nests have always been found in water, usually only three to eight inches deep.

The average water depth at the edge of the nest was 15.6 centimeters, varying from one to 70 centimeters. The average nest was 12.3 centimeters (eight to 21 centimeters) above the water, slightly cupped in the center for the two eggs. The average cross dimensions

of nests were 82.3 by 90.2 centimeters. The largest nest was 93 by 205 centimeters, and the smallest 42 by 45 centimeters. Nest sites have varied from three to about 175 meters distant from surrounding bushes and trees, always in the open, and usually where the incubating crane had a clear vision for a long distance. Each nest was a crane-made island or mound.

All 19 egg-sets contained two eggs. The average measurement of 26 crane eggs from Baker Sanctuary was 92.97 by 59.68 millimeters, and the average weight of five newly laid eggs (Jackson, Calhoun and Chippewa counties, Michigan) was 182.06 grams (158.7 to 202.3 grams). Although two sets of eggs observed in Barry County, Michigan, had measurements of 102 by 59 and 101 by 59 millimeters and 108 by 62 and 103 by 64 millimeters, those laid in one definite area in section 15 in the Baker Sanctuary were smaller, measuring 95.5 by 63, 98 by 59, 94 by 57.3, 93 by 59.3, 91 by 59, 91 by 59 and 93 by 58 millimeters. These latter eggs were all marked similarly with spots of wood brown, lavender, and varying shades of brown and buff over a ground color of olive buff. Extremes in measurements were: 87 by 61 millimeters; 108 by 62; 97.3 by 54.3 and 103 by 65 in southern Michigan. The average weight of 11 eggs in the Baker Sanctuary was 169.6 grams.

The weight of one of the eggs in nest number 5 on May 21, 1936, was 149 grams. From this egg a young crane hatched weighing 105.8 grams. Some eggs have weighed as low as 140 grams at hatching time.

At hatching, nine downy young varied in weight between 98.5 and 133.5 grams, averaging 109.8. Wing measurements taken with a straight edge ruler averaged 36.5 (30 to 42) millimeters from the bend to the tip of the longest down; the exposed culmen was 23.07 (21.0–24.9); tarsus, 47.52 (40.0–52.0); bare tibia, 22.0 (21.0–23.0). Two claws are found on each wing, one at the bend and one at the end of the wing.

The period of incubation has not been established definitely. I visited nest number 5 during April, 1936, and found the birds in the region April 23 and 25. They had not been there April 16 and 19. The nest was first found April 26 with two eggs; the first egg hatched May 21. On May 21, the second egg had a peeping young inside of it but was deserted. Incubation evidently required about 29 or 30 days, as it did in nest number 18 (second attempt) found with two eggs on May 14, 1948. One egg hatched June 10, and the other was not fertile. W. E. Browne (letter) stated that it required 28 to 30 days for the Florida Sandhill Crane, *Grus c. pratensis*, eggs to hatch at Grandin, Florida, where they nested in the wild near his home.

Barlett (Blyth and Tegetmeier, 1881: 7) gave the incubation period of the Manchurian Crane, *Grus japonensis*, as 30 days. Evans (1891: 79) gave this period for the Common Crane, *Grus g. grus*, as 28 days, while Hoffman (1936: 38) listed it as 30 days. Rothschild (1930: 67–68) reported the incubation period for the Sarus Crane, *Grus a. antigone*, as 35 and 36 days. Mrs. Belle Benchley (letter) said it was 32 days, as did Fred Stark and R. H. Friedrich (letters). Blaauw (1897: 50) gave 30 days as the incubation period of *Grus vipio* while Hagenback (1940: 348–354) stated it was 30 to 32 days. Crandall (1945: 119) gave 36 days as the incubation period of the Wattled Crane, *Bugeranus caranculata*, and Plath (1943: 383) stated it as 33 days for the Stanley Crane, *Anthropoides paradisea*.

Incubation is performed by both adults. Starting before sundown on April 24, 1946, I watched a pair of cranes at nest number 14 in the Baker Sanctuary. One parent remained on the nest from before sundown until the next morning. John Stophlet and I watched them all through the next day, April 25, and the following notes were taken:

6:28 a. m. Cranes called in various parts of marsh. The two birds at the nest called in unison, one standing right on nest; other approaching on foot. The one approaching displayed tertials high over his rump.

6:31 a. m. Parents changed places at nest. Female who had been incubating all night, flew a short distance and started feeding in marsh along creek about 125 meters from nest. The male had roosted in open marsh about 100 meters southeast of nest. We were hidden about 203 meters to the northeast.

6:54 a. m. Male spent one minute turning eggs.

12:10 p. m. Crane came in and landed along edge of woods about 500 meters from nest.

12:30 p. m. The crane now flew along tamaracks and landed about 100 meters from nest.

12:45 p. m. Male turned eggs, looking around several times.

12:55 p. m. He left nest and the two fed near by, and at 1:00 p. m. both flew across creek about 500 meters from nest to feed.

1:20 p. m. The two cranes flew from the stream area. One landed at nest; other flew south.

3:10 p. m. Cranes changed places at nest. The bird leaving nest went west on foot to feed in marsh.

4:23, 4:50 and 7:40 p. m. The incubating crane turned the eggs, the last time almost in dark. This one crane was still incubating the eggs the next morning at 7 a. m., a period of 15 hours and 50 minutes of continuous incubation.

Thus, during 36 hours' incubation: the female incubated the night of April 24–25 until 6:31 a. m.; the male from 6:31 a. m. until 12:55 p. m. (6 hours and 24 minutes); the eggs were not incubated between 12:55 and 1:20 p. m. (25 minutes); probably the male returned to incubate from 1:20 p. m. until 3:10 p. m. (110 minutes); the female

(*Top*) ADULT SANDHILL CRANE AT NEST, BARRY CO., MICHIGAN, MAY 10, 1942.
(*Middle*) NEST OF SANDHILL CRANE, MADE OF CATTAILS. NEST NO. 4, BAKER SANCTUARY, MICHIGAN, APRIL 21, 1935.
(*Bottom*) YOUNG SANDHILL CRANES, LESS THAN 48 HOURS OLD. NEST NO. 2, BAKER SANCTUARY, MICHIGAN, MAY 15, 1932.

then incubated from 3:10 p. m., April 25, until after 7 a. m., April 26 (15 hours and 50 minutes).

One pair of cranes nested in the northern portion of the marsh (apparently the same pair) from 1945 through 1948. They had two infertile eggs in 1945, one egg in 1946, none in 1947, and one in 1948.

When first hatched the downy, young Sandhill Crane is wet and bedraggled, but in a very few hours the down becomes very fluffy. The bird also becomes much stronger. It requires about 24 hours before it does much walking around. The down is darker than 'Tawny' at first. The back, crown and occiput are 'Burnt Sienna,' the central back and rump 'Chestnut,' and the wings about the same. Underneath is a mixture of 'Tawny' and gray. The sides more nearly approached 'Tawny.' When a few weeks old, the young crane becomes lighter tawny in color. The eye is dark brown at hatching. The legs are larger the first day than the second day when they become stronger. The first day they are flesh-colored, becoming darker colored the next day. The bill is similarly flesh-colored the first day, with a prominent, white egg-tooth near the front part of the upper mandible.

Usually, if not disturbed the adults remain near or at the nest until the young are about 48 hours old. Then, the parents slowly lead the young toward dry land where they feed during the coming weeks. Young are expert swimmers and often have to swim after leaving the nest.

On June 11, 1939, we found two young, about a month old, feeding with their parents where the marsh was completely dry and had been recently burned. They immediately hid in the tall sedges while the parents circled overhead calling loudly. I found two newly hatched young at nest number 11 on May 6, 1945. Edward M. Brigham, Jr. and William Dyer found them two weeks later, May 20, 1945, about half a mile to the south. They were far up on a pastured field about 125 meters from the marsh and made no attempt to get away.

Later in the summer I have watched the parents with young learning to fly, usually in the drier portion of the marsh. Young Sandhill Cranes in Michigan learn to fly when about 79 to 80 days of age. They remain with their parents during this entire period. In the fall the family groups of two, three or four can be found along the fields bordering the marsh, feeding only a short distance from the original nest site.

These flocks are still present in September, but during late September or October these family groups often assemble in larger flocks, from five to 16 at the Baker Sanctuary. They feed together in the

grain fields and pastured meadows near the marsh and one-half to three miles from their roosting place. They roost in shallow water in the sedge, grass and rush-grown areas and fly at daybreak to the feeding areas. Here they remain until mid-morning when they return to the marsh to rest, preen, and drink. Drinking water is an essential in crane management. During the afternoon they again proceed to the feeding area and usually return to the roosting area at sundown. When arriving and departing from the roosting area they usually bugle considerably but, unless disturbed, they become very quiet on the feeding areas.

With the coming freezing temperatures they disappear. There are only two winter records for southern Michigan, and one of these was apparently a crippled bird. The other was of two cranes observed by Dr. and Mrs. F. N. Hamerstrom, Jr. in Livingston County, December 15, 1946, but the autumn was an unusually warm one with few frosts.

SUMMARY

The Sandhill Crane was studied on the Bernard W. Baker Sanctuary area from 1930 through 1948. The area was established as a sanctuary during 1941 and consists of 571 acres, part of the 1,000 acre marsh in Convis township, Calhoun county, Michigan. Much of the area always has some shallow water over it, slightly alkaline with a pH of about 7.6. The area consists of several irregular marshy arms extending between wooded ridges, tamarack peninsulas and ash-maple bottomland.

The open marshy area was used by the cranes for nesting, roosting, and occasionally for feeding. Nearby fields were used for feeding areas. Cranes show strong territorial defense. The number of cranes observed, listed in Table 1, showed peaks in 1930, 1939, 1940, 1941, 1943, 1944, 1946 and 1948 with 1.13, 0.79, 0.94, 0.89, 0.79, 1.2, 0.77, and 1.25 birds observed per hour. During 1937 and 1938, only 0.07 and 0.12 cranes were seen per hour of observation. During 1,403 hours (1930 to 1948 inclusive) 873 cranes were counted (0.62 per hour). Average time of arrival was March 18 (earliest, March 7); latest departure in fall, November 25 (average, October 29). Numbers in the spring varied between two and 12 (average, 5.16); fall numbers between five and 16 (average, 8.2).

Nineteen sets of eggs contained two eggs, averaging in measurements 92.97 by 59.68 millimeters. Eleven eggs averaged 169.6 grams in weight. Nine downy young varied between 98.5 and 133.5 grams, averaging 109.8 grams in weight. Incubation apparently lasted about 29 or 30 days and was performed by both adults. The female incu-

bated for 15 hours and 50 minutes at one time, and the male for six hours and 24 minutes in one sitting. Eggs were left unattended for 25 minutes during 24 hours of observation. Young remained at the nest for about 48 hours. Adults then led them slowly to higher ground.

Young cranes learned to fly when about 70 to 80 days of age but were watched over diligently by the parents until all birds departed in the fall. Late in the fall before their departure the family groups in the marsh assembled when ice began to form and to remain on the water. In the fall, feeding took place on grain fields from one-half to three miles from the roosting area. Cranes roosted in shallow water at night, going to roost at sundown and leaving at sunrise. In the spring, adults drive their past season's young away from them.

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1703 Central National Tower, Battle Creek, Michigan, December 28, 1948.