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BREEDING BIOLOGY OF THE GREAT EGRET IN SEDGWICK CO., KANSAS

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Although nesting studies have been conducted in other states such as California (Pratt 1970), Oklahoma (Sallee 1982), and North Carolina (McCrimmon 1978), little biological data are available for the Great Egret (*Casmerodius albus*) in Kansas. This study (1985-86) was undertaken at the Mosteller heronry and represents the third documented nesting record in Kansas. The first two were observed in 1926 (O. Smock, pers. comm.) and 1963 (Zuvanich and McHenry 1964, Siebel 1978), along Grouse Creek in Cowley County. The 1963 record of 2 nests was in a Great Blue Heron (*Ardea herodias* colony. The Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), Cattle Egret (*Bubulcus ibis*), and Black-crowned Night-heron (*Nycticorax nycticorax*) also nested at the Mosteller heronry from 1983 to 1986.

Objective of this study was to observe behaviors of adult and juvenile birds related to all aspects of breeding biology. Productivity data were also collected.

Study Area and Methods

The Mosteller heronry (T28S, R1E, SW1/4 Sec. 33) is located at the Sunnyside Nursery near Haysville, Sedgwick County. The topography is flat and the Arkansas River, numerous ditches, creeks, canals and shallow water ponds are nearby. Total area of the nursery is 16.2 ha of which the two nesting areas (A and C) together encompass 0.27 ha (Figure 1). The trees were planted for nursery stock about 35 years ago (Neil Mosteller, pers. comm.).

During the summer of 1985, all 5 species were studied and 45 visits were made between 20 May and 7 August. In 1986, most observations were made on the Great Egret and the heronry was visited on 23 occasions between 6 March and 12 May, and on 68 occasions from 18 May through 5 August.

A blind was erected both years, near 2 juniper trees that held the most nests. The blind, constructed of scaffolding with burlap around the top section, was about 5m above ground and allowed observation of all except the highest nests. Those nests were periodically checked by standing on top of the blind. Most observations were made in the morning, the period of greatest activity, but others were taken during afternoon and evening. All nest locations in areas A and C were plotted on paper and their progress monitored.

An attempt to use a Nelson 007 paint pellet gun to mark individuals was unsuccessful because its report caused excessive disturbance. A slingshot with paint pellets failed because it was inaccurate. Individuals could be identified by observing and recording minor differences in mandible color and crown markings (Mock 1979). Observations of copulation position ensured proper sex identification. The adult population of the entire heronry was censused on the evenings of 13 June 1985 and 12 June 1986.

Results and Discussion

Vegetation. Area A consisted of 0.15 ha of trees that had been planted or came up voluntarily in the past 25-35 years (smallest diameter = 15 cm) with the following species frequencies (%) and tree density (#/ha): 39.3% eastern redcedar (*Juniperus virginiana*), (485.7); 37.2% oriental arborvitae (*Thuja orientalis*), (458.7); 9.3% red mulberry (*Morus rubra*), (114.7); 8.2% siberian elm (*Ulmus pumila*), (101.2); 4.4% Austrian pine

(*Pinus nigra*), (54.0); and 1.6% slippery elm (*Ulmus rubra*) (20.2). Area C had similar species composition and consisted of 0.12 ha. Arborvitae and juniper predominated in area C with a total (#/ha) of 792 and 267 trees respectively (Gress, pers. comm.).

Arrival and selection of territories. Earliest spring arrival in the vicinity of the heronry was on 29 March 1985 and 28 March 1986. Selection of territories began the first week

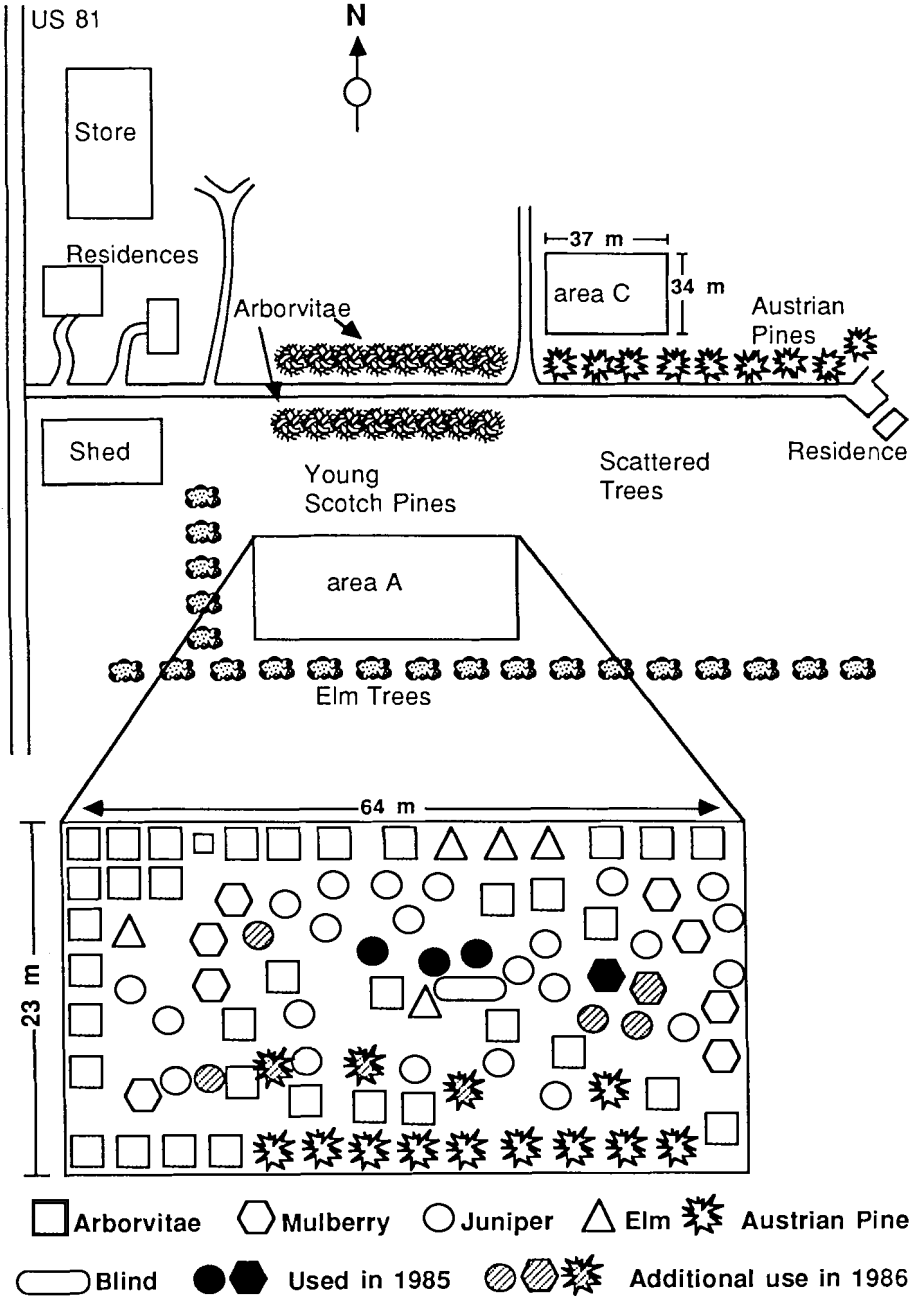

FIGURE 1. Map of study area, Mosteller heronry, Sunnyside Nursery, Haysville, Kansas.

of April 1986, with the first territories established in area A. These territories correlated with the availability of the tallest juniper, mulberry and Austrian pines in area A. Therefore, the distribution of territorial males was clumped. In 1986, 4 pairs nested in area C. It is believed this shift is due to the larger population, because in 1987 (no blind present in area A) at least 4 pairs again nested in area C.

In one study (Wiese 1976), establishment of the territory and courtship occurred around old nests (if present) or nest platforms assembled by males while awaiting females. In area A, however, no nests remained from 1985. No males were observed to assemble display platforms; instead they chose display perches in the tallest trees available. Similarly, in Atlantic coastal colonies, most species selected new nest sites each year because old nests had fallen apart (Beaver et al. 1980). Great Egrets sometimes use abandoned nests of Great Blue Herons or build on a site used by the herons the previous year (Pratt 1970).

The aggressive and courtship displays identified were completed by mid-April, 1986 (nomenclature of Wiese 1976, when possible). The "upright" display was not observed, but the "erect stance," "forward," "wingstroke," "stretch," "bow," "snap," and "bill rub" (my term) displays were all observed.

The pair bond usually is formed when the male allows a female onto his display branch and a 2-syllable greeting call is established, presumably to aid in individual recognition. The call is used by adults to signal returns to the nest and is directed at nestlings, apparently for parental recognition purposes. Copulation was observed from soon after territories were established and until the end of nest building activities. No promiscuous behavior or forced copulations were seen among neighbors. In California (Pratt 1970), first copulations were observed on 9 March. Wiese (1976) reported no vocalizations by birds, but I heard a "cowering call" from the female of pair 8. Wiese (1976) reported successful rapes by unmated males with their incubating female neighbors. However, neither Mock (1979) nor I observed either rape or promiscuous behavior.

Nest construction through hatching. In 1986, nest building began by 10 April (2 pairs). Mock (1980) noted that male egrets may complete the nest without female help after pair formation, but in my study both sexes participated. Many of the sticks used for nest construction were retrieved from the ground below the heronry. A male sometimes presented sticks to the female who worked them into the nest, but on other occasions, inserted the stick(s) himself.

One pair did not complete nest construction until 17 May. Nests were built on high limbs, often close to or against the trunk. Nests were built approximately 0.5m to several meters higher in the trees than were nests of related species. Nests in North Carolina coastal heronries (McCrimmon 1978) often were built in tall or more accessible trees with greater nest support than were nests of other related species. In Florida heronries (Bent 1926, Girard and Taylor 1979), nests often were built in tops of mangroves where the birds can obtain a clear view of their surroundings.

I agree with Burger (1979) that neighbors were typically conspecifics. In the Mosteller heronry, Great Egrets maintained the greatest inter-nest distance of any species present, as also reported by Girard and Taylor (1979). According to Burger (1978), larger species dominate the smaller ones by forcing them to nest lower in the vegetation.

In 1986, the first egg was laid on or before 20 April and all clutches were completed by 21 May. In California, egg laying began on 16 March (Pratt 1970). Eggs normally were laid at 2-day intervals, but one 3-day interval was observed between the laying of the third and fourth eggs. Incubation began after the laying of the first eggs, as also noted by Mock (1985) in Texas. In Florida, however, Maxwell and Kale (1977) reported that incubation began with the first egg in only 55% of all nests and with the second egg in the remainder. The 27-day incubation period observed for 3 nests (all directly in front of the blind) is longer than the 26 days reported by Maxwell and Kale (1977) and 23-24 days reported by Bent (1926). The presence of the blind may have disturbed the incubating birds sufficiently to slow incubation. Both sexes shared incubation responsibilities.

Pratt and Winkler (1985) reported 7 clutches of 5 or 6 eggs in California, but none were successful. In my study, mean clutch size was larger in 1985 than in 1986 (Table

1). The smaller clutch size in 1986 was not statistically significant (Mann-Whitney test, significance greater than 5%). The overall mean clutch size (3.70, 18 clutches) is one of the highest reported to date. Only the mean of 4.0 eggs/clutch at Reelfoot Lake, Tennessee, reported by Gersbacher (1939), is larger. Clutch size at other colonies of similar latitude as Sedgwick Co., Kansas, include 2.96 in New Jersey (Gladstone 1979) and 2.87 in California (Pratt and Winkler 1985). The latter was obtained during a 12-year study. More southern colonies had means of 2.4 in Florida (Girard and Taylor 1979) and 3.27 in Mexico (Gladstone 1979). This variation fails to reveal any relationship between clutch size and latitude. Maxwell and Kale (1977) suggested, and I agree, that differences in food availability, social stress, competition and weather conditions were probably of greater importance in determining clutch size than latitude.

In 3 nests, the average time interval between the hatching of the first and second eggs was 0.67 days, half the time (1.3 days) reported by Mock (1985). Maxwell and Kale (1977) reported that first and second eggs hatched on the same day as they did in 2 of 3 clutches in my study. The average time interval between hatching of second and third eggs was 2.0 days in both my study and a Florida colony (Maxwell and Kale 1977), which is longer than the 1.7 days reported by Mock (1985). Maxwell and Kale (1977) reported an average hatching time for complete clutches of 5.2 days with a range of 1-7 days, and Gladstone (1979) reported that successive nestlings hatched within 3 days of each other.

I observed an instance of renesting. A 2-egg clutch on 4 May was missing on 11 May and replaced with a 3-egg clutch (presumably by the same pair) by 18 May. Pratt (1970) noted that new clutches were laid in a few nests (apparently by the same pair) within a few days after the loss of eggs or nestlings.

TABLE 1.
NUMBER OF NESTS, AVERAGE CLUTCH SIZE, HATCHING SUCCESS, FLEDGING SUCCESS, AND PRODUCTIVITY AT THE MOSTELLER HERONRY (1985-86)

	1985	1986
Number of active nests	13.0	25.0
Mean clutch size	3.8 (n=8)	3.6 (n=10)
Hatching success (%)	80.0 (n=8)	81.0 (n=10)
Fledging success (%)	83.0 (n=8)	84.0 (n=10)
Productivity*	2.5 (n=8)	2.5 (n=25)

*Mean number fledged per nest.

Feeding method and sibling behavior. For the first 5 days of age, little competition occurred among siblings as they were fed indirectly (nomenclature from Mock 1985) by the parents. By 10 days, direct feeding (bolus transferred from adult directly to nestling) began. At this age, siblings 1 and 2 were larger than siblings 3 and 4 (if present) and obtained larger quantities of fish. Mock (1985), however, observed this shift at a younger age, and noted that siblings 1 and 2 also consumed greater than average shares of food. Lunging behavior by the nestlings toward the adult and repetitious chattering apparently were stimuli to initiate feeding.

By 15 days of age, siblings could scramble to the back of the nest and by 21 days could climb to nearby limbs, as they often did as I entered the blind. At 25 days of age, juveniles frequently moved in and out of the nest to preen and exercise their wings, but returned to the nest to feed. The calls and appearance of a returning adult often stimulated fighting between siblings. Sibling 1 often had better position than sibling 2 and took the first bolus(es). At 34 days of age, juveniles spent more time away from the nest. Adults arrived farther from the nest, requiring the juveniles to move toward the adult in order to feed. Juveniles may sometimes steal a fish from the mandibles of a neighboring juvenile and approach, but be rejected, by a neighboring adult. By 42

days and fledged, the juvenal plumage is complete and short flights are taken. Pratt and Winkler (1985) observed fledging at 49 days, whereas Wiese (1975) reported first flights at 52 days and fledging at 62-67 days. Longer flights pursuing parents to facilitate feeding became common at 51 days of age at the Mosteller heronry.

Mortality and brood reduction. In 1986, the youngest sibling in nests #6, #7 and #9 died between 16 and 23 days of age. In nest #7, sibling 4 was pecked out of the nest by sibling 3 (the result of dominant behavior larger siblings direct toward smaller ones when the adult arrives to feed) and fell to the ground. Fratricide is believed to be the cause of single deaths in each of the 3 nests. Three categories were described by Mock (1985) based on whether the bloodied, plucked bald victim was physically driven off the nest and fell to the ground, died in the nest from starvation and injuries, or vanished suddenly overnight. One of the 3 cases of fratricide that I observed in 1986 (nest #7) corresponded to category 1, whereas the other 2 (nests #6 and #9) corresponded to category 3. I observed only one instance per nest, but Mock (1985) documented double fratricides in 2 nests. Mock (1985) observed brood reduction in 14 of 17 nests over a 3 year period, with sibling attacks contributing to 52.4% of these deaths. Mock (1985) conducted provisioning experiments in which captive broods were raised on an unlimited food supply, but sibling aggression still occurred. I agree with him that senior siblings apparently use aggression to enhance their food intake.

Pratt and Winkler (1985) reported that 70% of 471 egret nestlings that died, succumbed between the second and fourth week, with the greatest number during the third week. Pratt (1970) noted a sharp rise in mortality between ages 14 and 21 days when competition for food increased and became a factor.

Hatching and fledging success. Thirteen active nests were present in 1985 with 8 observed from the blind, whereas 25 nests were present in 1986 (10 observed from the blind). Hatching success was slightly lower in 1985 than in 1986 (Table 1). Even though fledging success in 1985 was lower than 1986, both percentages are unusually high and suggests either a high degree of parental care or perhaps an undisturbed colony.

Productivity. Productivity (Ave. # fledged/nest) was 2.25 (4 nests) in 1983 (Gress and Schaefer 1984), 2.5 (12 nests) in 1984 (Gress. pers. comm.), 2.5 (8 nests) in 1985, and 2.48 (25 nests) in 1986 (Table 1). Productivity was higher than the 2.1 to 1.75 reported by Pratt (1970) in successive seasons (1967-68). Total production in 1985 (13 nests) was between 28 and 33 juveniles and in 1986 (25 nests) was about 62 juveniles. Eventually, this population may disperse to similar habitats adjacent to rivers to the north and east in Kansas, thereby establishing a larger, stable population.

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BOOK REVIEWS

Arkansas Birds, Their Distribution and Abundance. James, Douglas C., and Joseph C. Neal, illustrations by David Plank and Sigrid James Bruch. The University of Arkansas Press, Fayetteville, AR. 402 pages, 129 maps and figures, including color photographs, paintings, and black-and-white line drawings of birds. $34.00. 1986.

A total of 367 species are described; no subspecies designations are used. Accounts for the majority of the species include descriptions of the species' seasonal distribution and abundance. When available, recovery data on banded birds are provided, which for some species includes a map showing the direction and abundance of returns. Distributional maps are provided for only 16 species, e.g., Greater Roadrunner, Whip-poor-will, Red-cockaded Woodpecker, Brown-headed Nuthatch, Blue-winged Warbler, Swainson's Warbler, Bachman's Sparrow. But many of these are of interest to Kansas birders. Species with few records within the state receive a shorter entry.

The introductory chapters offer a concise history of ornithology in the state, a brief overview of where to find birds in Arkansas, a discussion of Arkansas birds in prehistory that not only includes tabulation of species at 15 archeological sites but discusses the aboriginal cultural significance of many bird species, and the ecological distribution of Arkansas birds. This latter chapter provides tabular data on wintering and breeding bird populations in different regions of the state and a vegetative analysis of the habitats represented. This is a valuable contribution to the understanding of bird distribution in the region and will provide helpful insight for any of us enjoying birds.

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A Guide to Bird Finding in Kansas and Western Missouri. Zimmerman, John L., and Sebastian T. Patti. Illustrated by Robert M. Mengel. University Press of Kansas, Lawrence, KS,

66045. 188 pages, 26 maps, 18 black and white drawings. Paper $9.95, Hard cover $22.50. 1988.

Members of the Kansas Ornithological Society do not have to be told about the high quality bird-finding experiences that are possible in the region covered by this book. But this site guide will provide information about these little-known jewels of American birding to the rest of the continent. The bird tours form the main body of the book, and they are arranged according to biotic communities from east to west. Six tours are detailed in the area of the Ozark forest, 19 tours in the forest-prairie mosaic, 5 tours in a section that combines both the oak-hickory forest and riparian forest, 13 tours in the tallgrass prairie, 8 tours in the sand prairie area, one tour in the cedar hills of Comanche and Barber counties, 12 tours span the mixed-grass prairie, and 9 tours in the last part that covers both the sandsage prairie and the short-grass plains. It has been said that Kansas is just a place to drive across to get to where you really want to go. The 170 Transect tour at the end of the book provides the birder driving this interstate more than a dozen birding spots that are easily reached from the highway and are carefully described and designed to blend into the trip.

Except for a few privately owned sites like the Nature Conservancy's Dingus Natural Area and Konza Prairie where access is possible with prior permission, all the locations to which this guide provides directions are on public lands. The tours are written in a "Lane"-like fashion with detailed accuracy in mileage and route and with additional historic and geologic facts.

An extensive introduction discusses the different biotic communities present in the region of the guide and their associated birds. This section is fascinating from both a biological and geologic-historic perspective. I have no argument with the scholarly approach. All birders can benefit from a fuller understanding of their birding areas.

A graphical representation of abundances and seasonal occurrences is included for all but the rarest species. It is well laid out, but there are some problems. The authors seemed conservative in their estimates of seasonal occurrence, shrinking the time span for many species. And some species, on the other hand, are given too much time, e.g., the Canada Warbler is listed for most of April. It doesn't arrive in the area until May! There is also a check-list for all the species of birds known to occur in the region, and a section on speciality species. This latter list is annotated with accurate habitat and site data that should let birders hit the bullseye in their quest for needed species.

The illustrations by Robert M. Mengel of the University of Kansas are beautifully done. The guide would be worth having for the artistry alone.

This guide is a valuable publication that will be equally useful to experienced and beginning birders.

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