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Parental Care of the Eastern Kingbird and the Great Crested Flycatcher

Elmer L. Morehouse

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PARENTAL CARE OF
THE EASTERN KINGBIRD AND
THE GREAT CRESTED FLYCATCHER

by

Elmer L. Morehouse

A thesis presented to the
Faculty of the School of Graduate
Studies in partial fulfillment
of the
Degree of Master of Arts in Biology

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Kalamazoo, Michigan
1965

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INTRODUCTION

The objective of this investigation was to obtain information regarding parental care in the Eastern Kingbird, Tyrannus tyrannus (L.), especially during post-hatching phases of the nesting cycle. In addition, some comparative observations were made on the Great Crested Flycatcher, Myiarchus crinitus (L.).

The two species are the two large flycatchers of eastern North America and are generally similar in such characters as body size, diet, and seasonal occurrence. The Eastern Kingbird, however, utilizes an open nest whereas the Great Crested Flycatcher nests in cavities. A comparison of the two is of interest as a contribution to the study of adaptation to hole-nesting (Von Haartman, 1957).

The problem was divided into two categories:

1. Behavior of the adults.
2. Behavior of the young.

The adults exhibited patterns of behavior which could be classified as both interspecific and intraspecific as well as self-directed in nature. Interspecific behavior included behavior toward other species of animals mostly in terms of belligerency toward and tolerance of intruders.

Intraspecific behavior included the pair relationship, activity directed toward adults outside the family group, activity directed toward the young birds of the pair under observation, and activity directed toward the young birds of other family groups in the vicinity.

The young birds exhibited characteristic reactions and behavior patterns to the other fauna of the area as well as showing self-directed activities.

Specific activities noted in this investigation were belligerency, tolerance, feeding, brooding, resting, guarding, shading, nest sanitation, avoidance, incubating, guiding of the young birds, roosting, and various vocalizations.

THE AREA

The site chosen for the project was the 500-acre Western Michigan University Ecological Research Tract, Fort Custer, Battle Creek, Michigan. The exact location of this tract is Sections 3,4,9,16, T 2 S, R 9 W, Kalamazoo County, Michigan.

The area consists mainly of old field areas lying between a secondary road (Fort Custer Drive) and a strip of forest fringing the Kalamazoo River. Wooded fence rows separate many of the fields. Thickets of aspen, Populus sp., cherry, Prunus serotina, and other species are numerous. Most of the area, however, consists of open areas with a sparse cover of broom sedge, Andropogon virginicus; panic grass, Panicum depauperatum; dewberries, Rubus sp.; knapweed, Centaurea calcitrapa; bluegrass, Poa compressa; goldenrods, Solidago sp., and other weedy perennials.

METHODS OF OBSERVATION

The method of data collection was exclusively by direct observation. Observations of Eastern Kingbird nests were from observation posts approximately 30 yards away. The observer used 7 x 35 binoculars and a spotting scope of 50 power.

The observer sat on the ground in order to reduce the height of his profile, so that a minimum amount of attention would be paid to his presence. Whenever the observer entered the area of a nest, the parents would usually come over and display some degree of aggressive behavior. By the time the equipment was set up, the parents would usually have resumed normal activity in the nest area. As long as the observer remained seated and relatively motionless on the ground, the parents carried on presumably normal activity. The only exception to these statements was Eastern Kingbird nest 2 which was located along Fort Custer Drive. The heavy traffic in the area may have resulted in a situation which made the parents unusually wary of disturbance. These parents were easily disturbed and consequently observation at this

site was particularly difficult. In connection with this, the family seemed to leave the area much more quickly after fledging than appears normal from observation at the other sites of investigation.

The Great Crested Flycatcher nest was observed from a car parked approximately 25 feet from the nest tree. Binoculars of the type already noted were used for observation at this nest. As long as the observer remained in the car, his presence did not seem to disturb the activity of the parents. However, the presence of an observer outside the automobile seemed to constitute a disturbing influence and normal activity did not seem to occur under the latter circumstances.

After the young Eastern Kingbirds had left the nests, observations were taken by following the birds in the field and sitting in a concealed position while observing activity through binoculars. The presence of the observer did not appear to be a disturbing influence as long as the observer remained at a reasonable distance (usually no closer than 30 yards and no farther away than 40 yards), made no sudden movements, and was flanked to the rear by a solid background (so that the observer's profile did not appear above the horizon). Once the observer had moved

into position, the parents soon ignored and apparently forgot his presence as evidenced by incidents in which the parents hunted and preened within a few feet of the observation post.

Because the young Great Crested Flycatcher disappeared from the area of observation almost immediately after fledging, no techniques for observing the young out of the nest were devised for this species.

The male Great Crested Flycatcher could readily be distinguished from the female as a result of the tendency of the former to carry its crest high, whereas the latter tended to carry its crest appressed low onto the surrounding plumage. This tendency was noted by both Gillespie and Walker as reported by Gillespie (1924). The sexes could not be differentiated on the basis of disarray of the tail feathers of the female as noted by Gabrielson (1915). However, the color in the breast of the female appeared to be dulled and constantly soiled, which may have resulted from her frequent contact with the walls of the cavity.

At Eastern Kingbird nest 1, the sexes could be readily distinguished by a more pronounced downturn of the end of the beak of the female. At the other nests, the sexes were less easily distinguishable. When observations

had proceeded for a period of time, however, each member of the pair could be followed, recognized, and sex distinguished by behavior. Once fledging had occurred, determination of the sexes was more difficult.

Periodically the entire study tract was surveyed for the presence of Eastern Kingbirds and Great Crested Flycatchers in order to verify the presence of established family groups in predictable areas as well as the presence of any groups that might have moved into the study area from the surrounding country-side. Observation was accomplished by walking in a zig-zag pattern back and forth across the entire tract, observing essentially the entire extent of the territory in a few hours time.

All times were determined by means of a pocket watch with a sweeping second hand. The watch was kept at an easily observable position at each observation post and times were recorded directly from it.

During observation periods, temperatures were taken at a level two feet above the surface of the soil, with the thermometer shaded by the investigator's shadow. The thermometers used for the purpose were laboratory grade, centigrade scaled, mercury column, 76 millimeter, and of the immersion type. Daily weather observations including

precipitation, wind, maximum and minimum temperatures, and cloud cover were recorded.

Tree heights were determined by triangulation. The instruments used for these measurements included an Abney type level and a steel tape.

Observations were begun on June 13, 1964, and ended on August 27, 1964. A total of over 427 hours of field observations were recorded during the investigative period.



NESTS - GENERAL INFORMATION

The total number of nests under observation was five, four Eastern Kingbird nests and one Great Crested Flycatcher nest.

Eastern Kingbird nest 1 was located in a 19.3 foot wild cherry, Prunus serotina. The nest contained 3 eggs which hatched on June 12, 1964 (Richard Brewer, personal communication). The top edge of this nest was located 69 inches above the ground. The inside diameter of the nest at the upper rim averaged 3.5 inches. The outside diameter of the nest averaged 5.5 inches. The nest was built atop a tent of the tent caterpillar, Malacosoma americanum, at a point where the tree trunk separated into five main stems. The nest was constructed of grass, some of which was intertwined among the stems as anchorage. The nest was lined with some cottony plant fiber. Exact location of nest 1 can be derived from Figure 1. The nest tree was located in a small clump of wild cherry trees near an old fence row division between two abandoned fields. Except for the few trees that made up the clump in which the nest was found, the area around was relatively open.

Legend for Map of the Study Area (Figure 1)

1 Eastern Kingbird Nest 1

2 Eastern Kingbird Nest 2

3 Eastern Kingbird Nest 3

4 Eastern Kingbird Nest 4

5 Great Crested Flycatcher Nest 1

 Kalamazoo River

 Fort Custer Drive

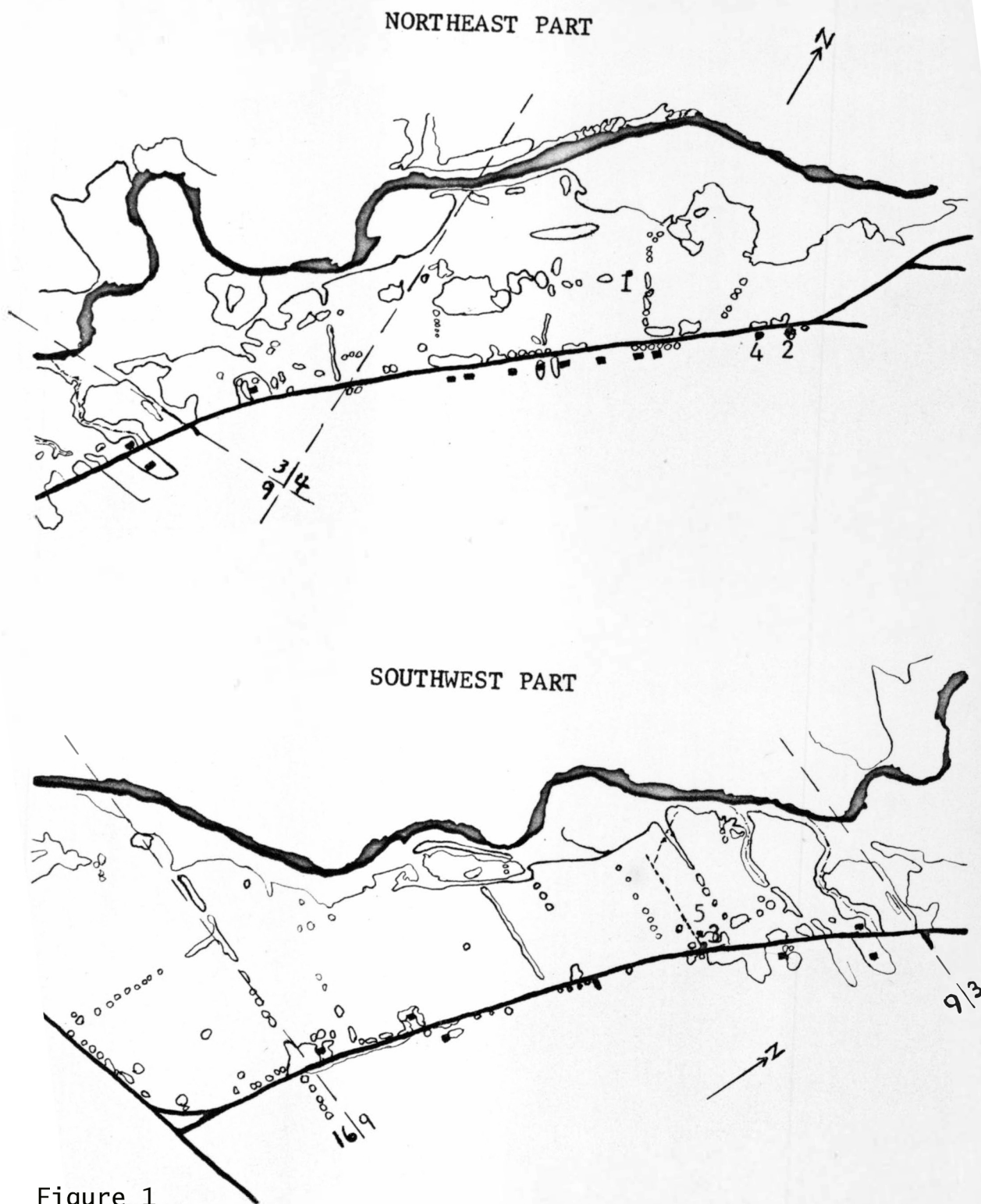
 Wheeltrack Road

 Section lines

 Thickets

 Houses

 Small streams



Map of the Study Area

Eastern Kingbird nest 2, with two young birds, was discovered on June 13, 1964. This nest was located in a 52.9 foot oak, Quercus sp., at the road edge (Figure 1). The nest was located on a lower limb which was horizontal to the ground. The distance from the ground to the top rim of the nest was 18.7 feet. The inner diameter of this nest averaged 4.4 inches. The depth of the nest cavity itself was 1.8 inches. The nest was well hidden by leaves on all sides with the top comparatively open. The nest material was woven in and around three small branches with the basic stability of the nest maintained by three branches arranged around the perimeter. The distance from the trunk of the tree to the nearest edge was 6.8 feet. The nest was at the northeast edge of the tree.

Eastern Kingbird nest 3 was discovered June 17, 1964. Four young birds were observed on June 27, 1964. The nest was located in a 77.6 foot sycamore, Platanus occidentalis, next to the road and overhanging the wheeltrack entry to the study tract (Figure 1). The nest was located approximately 68.4 feet above the ground on a swaying small branch of the tree. The nest was on the south side of the tree and anchored to several twigs as described previously. The nest seemed to be constructed in the axil of a branch

and was well concealed by surrounding foliage. It appeared to be elongated along the axil and had a generally unkempt and disheveled appearance from the ground. This nest was located approximately 16 feet from the trunk. The Great Crested Flycatcher nest was located only 105 feet away.

Eastern Kingbird nest 4 was discovered July 10, 1964, while the observer was hunting for the young birds of Eastern Kingbird nest 2. The nest was located in a 58.7 foot oak along the edge of the road and on the far side of the tree from the road. It was located only 480 feet from nest 2. The nest was approximately 41 feet from the ground located in the axil of a limb on the southeast side of the tree at an estimated distance of 15 feet from the main trunk. Three young were observed on July 19, 1964.

All of the Eastern Kingbird nests were located in similar surroundings. That is, they were surrounded by a relatively open area of old field habitat with ready access to one or two clumps of large trees in an area near to the nest. The major difference which was evident to the observer was the occurrence of nests 2, 3, and 4 along Fort Custer Drive, while nest 1 was located approximately 365 feet into the field and was relatively isolated from the drive. The isolation of the latter nest may account

for the establishment of this nest nearer to the ground even though large trees were present in the immediate area.

The Great Crested Flycatcher nest 1 was located in a pear, Pyrus communis, tree (Figure 1). The nest tree was 39.7 feet high and the landing to the nest cavity was located 15.9 feet from ground level. The entry slit was one foot long and extended from the landing to the point at which the main trunk had broken off and exposed a cavity which was open at the top. The cavity was probably natural and extended beneath the nest proper for a considerable distance. Evidence of interwoven grasses could be detected at a small opening three feet beneath the nest. The nesting pair evidently did extensive filling before the actual nest was built. The entry slit varied from 2 inches wide at the top to 3.2 inches at the bottom. A slit extended 4 inches downward from the entry landing. Its greatest width was 1.1 inches. The inner rim of the opening at the top was 3.2 inches in diameter in all directions. The entry slit faced south-southeast at the lower extremity, but the grain of the wood twisted counterclockwise so that the top faced east.

The nest itself was located approximately 18 inches below the upper opening or about 6 inches below the entry

landing. The nest was constructed of grass and lined with Blue Jay feathers. The area to the north, south, and west of the nest was open, typical, old-field habitat with a few scattered cherry trees. To the east and along the drive, a clump of trees was present, edged with thickets of locust, Robinia Pseudo-Acacia, and lilac, Syringa vulgaris.

The investigator suspected that eggs were present on the first day of the investigation, June 15, 1964, because of the amount of time that the female spent in the nest. These suspicions were not confirmed until the tree was first climbed on the evening of June 17, 1964, and three eggs were noted.

ATTENTIVE AND INATTENTIVE BEHAVIOR

Treatment of Data

As a guide for determination of attentive behavior, Kendeigh (1952) states

The periods of attentiveness are defined as those intervals of time when a bird of either sex is actually engaged in nesting activities, whether these activities be singing, nest building, incubating, brooding, feeding of young, or scolding at enemies. Periods of inattentiveness alternate with periods of attentiveness and are the time intervals devoted to feeding, bathing, preening, or resting.

The investigator computed the total time of attentive behavior (incubating or brooding) for each observation period, and the total time inattentive (away from the nest) for the same time spans. These total times during brooding periods were divided by the total number of times attentive and inattentive respectively. The quotients resulting from the above process are mean length of attentive periods and inattentive periods respectively. Incomplete portions of the cycle at the beginning or end of the observation period were not used in calculating the means. During the incubation period at the Great Crested Flycatcher nest, the percentage of time spent in attentive and inattentive behavior respectively were derived by means of the

following formula (used by Skutch, 1960);

$$\text{Percentage} = \frac{\text{mean attentive (or inattentive)}}{\text{mean attentive} + \text{mean inattentive}} \times 100$$

After the eggs had hatched at the Great Crested Flycatcher nest, and during the entire time of observation at the Eastern Kingbird nests, the percentage of time spent in attentive and inattentive behavior was determined by the usual formula

$$\text{Percentage} = \frac{\text{total time attentive (or inattentive)}}{\text{total observation time}} \times 100$$

During the course of nestling life the inattentive periods lengthened to such an extent that it became increasingly difficult to get significant numbers of complete periods. The second formula was used to calculate percentages once brooding had begun since it allows the use of incomplete periods for this determination.

During a given day, observations at a given nest or area were usually interrupted for observations elsewhere, meals, etc.. This procedure often resulted in two or three separate observation periods for a given nest during a given day. For most analyses, these separate observation periods were combined for computation of daily values. See Appendices I, II, III, IV, and V for actual observation times at given nests and areas.

Introductory Description

All Eastern Kingbird nests had progressed beyond incubation when the investigator first began observations; but in regard to incubation of the eggs at the Great Crested Flycatcher nest, it can be affirmed that the total task of incubation was accomplished by the female. The male was not seen to enter the nest hole until well after the young had been hatched. The male did not brood, and never remained in the nest cavity for more than a few seconds, and then only when feeding young birds and removing fecal sacs.

The Eastern Kingbirds also showed a complete lack of brooding or shading of the young birds by the male. Judging from the activities of the male after the young birds had hatched, it is extremely doubtful that the male in the pair of Eastern Kingbirds observed by Trafton (1908) was exhibiting typical Eastern Kingbird behavior when

Several times I watched the bird on the nest being fed by its mate. . . . On one occasion the birds changed places on the nest.

The males of both species exercised caution upon approaching the nest when the female was present. The males of both species characteristically landed on a vantage point from which the nest could be inspected before

entering or landing to feed. When the male of either species approached the nest at the same time the female approached, the female usually took precedence by feeding first.

The presence of the male in the immediate vicinity of the nest seemed to act as a stimulus to the Eastern Kingbird female to terminate brooding, while his counterpart at the Great Crested Flycatcher nest did not seem to affect his mate in this manner. Eastern Kingbird males invariably "guarded" (i.e., stayed in the immediate vicinity of the nest) while the females were gone, and these females left the nest without evident caution. Eastern Kingbird males appeared to spend most of their time in the general area of the nest, while the male of the Great Crested Flycatcher nest was notable by its absence from the nest area for great periods of time.

When arriving at the nest vicinity, when approaching the nest, and even upon leaving the Eastern Kingbird parents were prone to announce their movements by means of high pitched dzeeks (call notes having the quality of a sharp metallic rasp when heard from a nearby vantage point), which were often constant when they were on the move. The male and female Eastern Kingbirds were very similar with regard to vocalization.

The Great Crested Flycatchers, in marked contrast to the Eastern Kingbirds, were relatively quiet during the nesting period. These birds apparently do not give voice while on the wing except when giving alarmed shrieks while chasing enemies. The female Great Crested Flycatcher usually arrived at the nest or left the nest area silently. The exceptions to this general rule were times in which she emerged from the cavity, gave one or two high pitched whuits (call notes having a whistled quality), peered into the surrounding trees, and appeared to be listening for the distant answer of the male. The investigator recorded only three instances of vocalizations of the female Great Crested Flycatcher upon arrival at the nest vicinity. These incidents occurred on June 23rd, June 24th, and July 1st when young birds were present in the nest. The male was more vocal than the female upon arrival at the nest area. His vocal efforts seemed to be directed toward the female, since they were usually accompanied by neck craning and peering into the nest cavity.

Upon approaching the nest, the female Great Crested Flycatcher usually landed on an outer limb of the tree and inspected the surrounding area for a few seconds. A final inspection was made from the entry landing before she dived,

head-first, over the landing and into the nest. Her entire appearance was one of stealth and alertness. Her emergence from the nest was similarly deliberate. She usually appeared in the entry with breast exposed, and after peering around for a time she would drop low and leave the area, hop to a near limb and watch, call, or silently back into the cavity. The above describes activity as it was observed during both the incubation and brooding periods. However, as the female spent less time in brooding activity near the end of the nesting period, she was prone to hop directly out of the cavity onto a near limb with less caution evident.

The Eastern Kingbird female usually flew directly to the nest edge itself, without first alighting for an inspection of the nest area. Feeding usually occurred as a lightning swift jab of the beak into an extended gape. Seldom was a feeding attempt unsuccessful. The female would wait a moment for the appearance of a fecal sac and would then immediately brood or leave the area. On rare occasions she would perch on a nearby limb to rest for a time after she had fed the nestlings. This was especially evident on very windy days.

Eastern Kingbird - Nest One

The percentage of time attentive on the day following hatching (Table 1) was similar to that to be expected during incubation (Kendeigh, 1952).

The apparent downward trend in the percentage of time spent in attentive behavior between June 13th (+1 day from hatching) and June 14th (+2 days from hatching) was temporarily interrupted by a rainy, cool day on June 15th (+3 days from hatching). This downward trend was resumed on June 16th (+4 days from hatching) when the inclement weather was relieved by sunny skies and rising temperatures. On June 18th (+6 days from hatching), observations were made only in the evening between 4:15 P.M. and 5:51 P.M. when an increase in attentive behavior could be expected and probably do not reflect the true daily attentive record. The downward trend continued on June 20th (+8 days from hatching) and proceeded until there was almost a total lack of brooding, with the exception of shading the young birds from the sun, roosting on the nest at night, and a few brief periods of brooding in early morning and evening. This latter condition is responsible for the increase which is shown on June 24th (+12 days from hatching). The

Table 1 Attentive Behavior (Brooding) of the Female
at Eastern Kingbird Nest 1

Date	Day Relative to Hatching	Attentive		Inattentive		Total Observ- ation Time (Hours)
		Mean Att. Period (Hours)	PerCent of Time Att.	Mean Inatt. Period (Hours)	PerCent of Time Inatt.	
June						
13	+ 1	.69	79.5	.22	20.5	1.26
14	+ 2	.18	53.3	.15	46.7	4.93
15	+ 3	.18	75.7	.06	24.3	11.49
16	+ 4	.15	53.8	.14	46.2	3.39
18	+ 6	.23	57.6	.23	42.4	1.60
20	+ 8	.09	12.5	.62	87.5	2.78
21	+ 9	No brooding during day				7.00
22	+ 10	.03	13.1	.62	86.9	3.41
23	+ 11	No brooding during day				
24	+ 12	.04	4.6	.10	95.4	4.34
26	+ 14	No brooding during day				2.50

observations for this day were obtained early in the morning and late in the evening. In essence, daytime attentive behavior, with the exception of feeding and fecal sac removal, had almost ceased by day +9.

It is interesting to note that the increase in the percentage of time attentive on June 15th over that observed on June 14th was not due to increased length of attentive periods, but to decreased time spent away from the nest. The weather conditions on June 15th were by far the most severe of any imposed on the young birds while they were in the nest.

Fledging occurred on June 27th (+15 days from hatching).

Eastern Kingbird - Nest Two

The attentive behavior of the female at Eastern Kingbird nest 2 could not be observed because of the reluctance of the parents to behave in a normal manner while the observer was in the area. Observations were attempted on June 14th for a period of 50 minutes; on June 16th for approximately 1 hour; and on June 18th for 1 hour and 20 minutes. No brooding behavior was noted during any of the attempts.

The young left this nest sometime between the evening

of June 18th and mid-day on June 20th. The investigator would suspect that it would be closer to the latter than the former because at 2:20 P.M. on June 20th the young were still near the nest and their feces were still encased in gelatinous sacs. If June 20th is taken as the date on which the young fledged, and if this nest is compared with Eastern Kingbird nest 1, it will be seen that the young would have hatched on or about June 4th. The day of discovery, June 13th, would have been +8 days from hatching. At date of discovery, this nest would, therefore, have already passed through the period of extensive brooding.

Eastern Kingbird - Nest Three

On June 18th (estimated +6 days from hatching) during an observation time of 2 hours and 3 minutes, the mean attentive period consisted of .09 hours and the mean inattentive period consisted of .09 hours. The percentage of time attentive was 21.4 and the percentage of time inattentive was 78.6. Incomplete attentive periods were recorded at either end of the observation period and account for the percentage differential. These two incomplete periods alone, accounted for approximately one half of the total observation time. This seems to be well within the

range of behavior noted at Eastern Kingbird nest 1 for the estimated comparable period of June 18th and June 20th.

On June 24th, 1.38 hours of observation time yielded no observed attentive behavior other than very quick trips to the nest for feeding. This also falls well within the pattern shown by Eastern Kingbird nest 1.

Since the young birds in this nest fledged on the same day as those which occupied Eastern Kingbird nest 1, June 27th, it is likely that the young birds were hatched on or about the same day and should show a similar history.

Eastern Kingbird - Nest Four

This nest was first observed on July 11th (estimated +7 days from hatching), although it was discovered at an earlier date. The mean attentive period was .21 hours duration and the mean inattentive period lasted .08 hours. The female was attentive 55.1 per cent of the time and inattentive 44.9 per cent of the observation period. Since this observation occurred at mid-day, when the sky was clear but hazy and the temperature high (29.9°C), most of the attentive behavior probably consisted of shading of the young birds. Low visibility at this nest made verification of this surmise impossible.

On July 16th (estimated +12 days from hatching) the nest was again observed with the following results: mean attentive period, .01 hours; mean inattentive period, .70 hours; percentage of time attentive, 3.8; percentage of time inattentive, 96.2.

On July 18th (estimated +14 days from hatching), during an observation time of 8 hours and 40 minutes, the female was attentive, except for feeding, for only 1 minute and 45 seconds, or .3 of 1 per cent of the entire observed activity period. During this observation period one young bird left the nest temporarily, but returned to the nest in the evening.

On July 19th (estimated +15 days from hatching), during 9 hours and 45 minutes of observation time, there was no brooding. Two young birds were seen to leave the nest during the day and were not seen to return at night.

On July 20th (estimated +16 days from hatching), the nest was observed for 2 hours and 10 minutes with no brooding noted. The last nestling left the nest and dropped to the pavement. This bird was injured by the fall and unable to fly. The investigator retrieved the injured bird from the middle of the road, gave it time to recover from its injuries in case they were only temporary, and then when the injured

bird appeared unable to function normally, removed it to the laboratory. The bird was hand-reared by other investigators until it could safely be returned to the field.

If we assume July 19th as the average date of fledging for this nest, and using Eastern Kingbird nest 1 as the standard again, the first day of observation, July 11th, would be +7 days from hatching and the shown percentage of attentive behavior seems to be quite high. An attempt has already been made to account for this by postulating that the nest which was relatively open at the top was being shaded by the parents. July 18th would be +14 days from hatching and the very low rate of attentive behavior could be expected at this time, as could the complete lack of observed brooding during the daytime of July 19th and July 20th.

Great Crested Flycatcher - Nest One

During the observed period of incubation (June 13th to June 20th) the percentage of time spent in attentive behavior (Table 2) remained relatively constant. There was an observed drop of 17 per cent between June 17th and June 18th, but it returned nearly to its former level on the day that young birds were first observed to be present in the nest (June 20th).

Table 2 Attentive Behavior (Incubation and Brooding) of the Female at Great Crested Flycatcher Nest 1

Date	Day Relative to Hatching	Attentive		Inattentive		Total Observation Time (Hours)
		Mean Att. Period (Hours)	PerCent of Time Att.	Mean Inatt. Period (Hours)	PerCent of Time Inatt.	
June						
13	- 7	.51	72.9	.19	27.1	2.09
14	- 6	.70	81.3	.16	18.7	1.89
16	- 4	.33	71.3	.13	28.7	5.03
17	- 3	.34	73.1	.13	26.9	11.62
18	- 2	.24	56.1	.19	43.9	3.66
20	0	.25	68.1	.09	31.9	3.06
21	+ 1	.23	65.7	.13	34.3	5.64
22	+ 2	.09	35.9	.18	64.1	5.95
23	+ 3	.12	41.2	.17	58.8	3.67
24	+ 4	.17	44.9	.24	55.1	4.46
26	+ 6	.19	50.3	.18	49.7	3.15
27	+ 7	.11	28.5	.27	71.5	3.48
28	+ 8	.03	5.1	.51	94.9	3.29
29	+ 9	.02	11.1	.32	88.9	4.51
30	+ 10	.03	4.7	.82	95.3	3.43
July						
1	+ 11	.01	.2	—	99.8	6.77

After the eggs had hatched there was a gradual and progressive decline in attentive behavior until it became practically nonexistent during the daytime by June 28th (+8 days from hatching). The last significant attentive periods during the daytime were noted on June 27th (+7 days from hatching).

On June 26th (+6 days from hatching) it was noted that two of the young birds were missing from the nest. This may account for the reluctance of the female to leave the nest on this date. These young birds apparently were lost sometime between late evening June 24th and the beginning of the observation period on June 26th.

The remaining young Great Crested Flycatcher was found out of the nest by 8:30 A.M. on July 3rd. Since the young bird and the parents became very active and all but impossible to find in the area very soon thereafter, it is likely that fledging occurred late on July 2nd, or very early on July 3rd.

FEEDING AT THE NEST

Treatment of Data

The total number of feedings for a given observation period were divided by the number of hours and/or decimal portion of hours involved in the observation period. The quotient represented the feeding rate per hour during the observation period. The feeding rate per hour was divided by the number of young birds in the nest; this quotient represents the rate at which each young bird was fed per hour.

Similarly the total number of feedings by either parent during any given period, when divided by the hours or parts of hours which made up that period yielded a quotient which represented the rate at which that parent engaged in feeding activity during the designated period. The percentage of the total feeding activity which was borne by each parent was arrived at by dividing the number of feedings which each was observed to engage in, by the total number of feedings observed. The quotient was then multiplied by 100. The results of these calculations designated the percentage which each parent contributed to the feeding process.

Eastern Kingbird - Nest One

The male at nest 1 was responsible for approximately one-half the feeding activity on June 13th, 14th, 15th, 16th, 18th, and 20th (Table 3). These dates are included in the time span +1 to +8 days from date of hatching. On June 21st (+9 days from hatching) the male's feeding activity fell below 30 per cent of the total feeding for the day. By this date the female had almost ceased brooding. It can be seen that the female maintained the heaviest part of the responsibility of feeding from this date until the young fledged on June 27th (+15 days from hatching). The male maintained a rate higher than that of the female on June 15th and 16th (+3 and +4 days from hatching). June 15th was a day of inclement weather.

The male was observed to spend most of his time in the near or immediate vicinity of the nest, perched upon the top of the nest tree or other vantage point of a neighboring tree. Most of the hunting of the male and activity of the male occurred in the immediate vicinity of the nest, while the female invariably flew out of sight upon leaving the nest. It would be of interest to explore this aspect of their behavior further. It is possible

Table 3 Feeding Relationships at the Nest
Eastern Kingbird Nest 1

Date	Day Rel. to Hatch- ing	Total Rate Per Hour	Rate Per Hour by ♀	Rate Per Hour by ♂	No. of Times ♀ Fed	No. of Times ♂ Fed	Rate Per Young Per Hour	Per Cent by ♀	Per Cent by ♂
June									
13	+1	4.76	2.38	2.38	3	3	1.59	50.0	50.0
14	+2	6.54	3.36	3.18	18	17	2.18	51.4	48.6
15	+3	9.77	4.19	5.58	51	68	3.26	42.9	57.1
16	+4	8.02	3.56	4.46	12	15	2.67	44.4	55.6
18	+6	8.76	4.38	4.38	7	7	2.92	50.0	50.0
20	+8	13.22	6.79	6.43	19	18	4.41	51.3	48.7
21	+9*	11.57	7.97	3.44	51	22	3.86	68.9	29.7
22	+10**	10.83	8.20	2.34	28	8	3.61	75.7	21.6
23	+11***	11.53	7.55	3.57	55	26	3.84	65.5	30.9
24	+12	16.80	12.72	4.08	53	17	5.30	75.7	24.3
26	+14	15.54	9.93	5.61	23	13	5.18	63.9	36.1

* Unidentified fed 1 time - 1.4 per cent

** Unidentified fed 1 time - 2.7 per cent

*** Unidentified fed 3 times - 3.6 per cent

that this practice could be of great value in reducing competition for food between the male and female.

It can be seen (Table 3) that the male's feeding rate remained relatively stable throughout the entire nestling period, varying only from a low of 2.34 times per hour to a high of 6.43 times per hour. The feeding rate of the female was not so stable, however, but progressed steadily from a low of 2.38 times per hour on the first day of observation to a high of 12.72 times per hour on June 24th (+12 days from hatching), three days before fledging.

The male was not seen to pass food to the female except on certain rare occasions. If the female returned to the nest at the time the male was attempting to feed the young birds a large dragonfly or cicada, the two parents often tugged and pulled back and forth on it, mangling it in the process so that it might be fed to one of the young birds by either parent. On June 15th, which has already been pointed out as a day of inclement weather, the male often gave food to the female who passed it on to the nestlings before she terminated brooding behavior.

Eastern Kingbird - Nest Two

The sexes at this nest could not be distinguished.

On June 14th (estimated +9 days from hatching) the young birds were fed at a rate of 2.07 times per hour or 1.04 times per hour per nestling. Feeding was not observed at this nest on June 16th (estimated +11 days from hatching). On June 18th (estimated +13 days from hatching) the nestlings were fed at a rate of 1.50 times per hour or at a rate per young bird of .75 times per hour. These observed rates were far below either the total rates or rates per young bird which were found at any stage of development of the Eastern Kingbird nest 1. This, of course, appears to be a direct reflection of the parents' concern over the observer's presence in the area.

Eastern Kingbird - Nest Three

Observations on June 18th (estimated +6 days from hatching) resulted in a total feeding rate of 23.43 times per hour or 5.86 times per young bird per hour. The total rate on June 24th (estimated +12 days from hatching) was 15.00 times per hour or 3.75 times per young bird per hour.

The rates for June 18th seem high when compared to the rates maintained by the parents at nest 1 on June 18th, but the observed rate on June 24th compares favorably with that observed at Eastern Kingbird nest 1 for the same day.

Eastern Kingbird - Nest Four

This nest was first observed on July 11th (estimated +7 days from hatching), and a total feeding rate of 27.74 times per hour or 9.25 times per hour per young bird was observed. On July 16th (estimated +12 days from hatching), the total rate of feeding was 17.68 times per hour or 5.89 times per hour per young bird. On July 18th (estimated +14 days from hatching) with one young bird fledged from the nest, the total feeding rate was 11.88 times per hour or 3.96 times per hour per young bird. The young fledgling was fed at a rate of 1.87 times per hour, while the two remaining in the nest were fed at a rate of 5.60 times per hour per nestling. It is obvious that the parents' activities were still nest-centered even though one of the young birds had fledged. The fledged bird returned to the nest in the evening.

On July 19th (estimated +15 days from hatching) a total of 126 feedings was recorded, 39 of these occurred between 6:20 A.M. and 8:32 A.M. at which time the first young bird fledged. Five more feedings occurred at the nest before 8:51 A.M., at which time the second bird fledged. From 8:51 A.M. to 9:55 A.M. the young bird which still

remained at the nest was fed 12 times, and the two fledged young birds were fed a total of 3 times. Between 10:05 A.M. and 10:45 A.M. the young bird at the nest was fed 6 times. At 10:45 A.M. one of the fledged young birds returned to the nest and the two at the nest received 11 feedings before 1:10 P.M.. The other young bird in the tree was fed only 3 times during this interval. Between 6:00 P.M. and 8:15 P.M. 47 more feedings occurred and appeared to be about evenly divided between the young bird at the nest and two young birds out of the nest. The young bird at the nest appeared to have 3 additional feedings over the other two combined. There is, therefore, little doubt that the nest was still the center of parental attention on this date.

On July 20th (estimated +16 days from hatching), with only one young bird present in the nest, the total feeding rate was computed at 9.12 times per hour. The one nestling was fed at a rate of 5.32 times per hour, and the two fledglings were fed at a combined rate of 3.80 times per hour (individual rate of 1.90 times per hour). The feeding rate on this day still indicates a nest-oriented parental relationship. The last nestling left the nest at mid-morning.

Great Crested Flycatcher - Nest One

On June 20th, the first two eggs were observed to have hatched. The investigator was not aware that two of the eggs had hatched until the end of the observation period. The feeding rate for this period (Table 4) appears low and it is possible that the presence of extremely small insects in the beak escaped the notice of the investigator until near the end of the observation period. It is also possible that the feeding rate actually was low. In any case, the feeding data gathered on June 20th are of questionable reliability.

The male was not seen to enter the nest until June 23rd, or three days after the first two young birds were first seen. The reluctance of the male to enter the nest hole can best be demonstrated by quoting directly from the observer's field notes for June 23rd. The following episode took place after the male had already spent approximately 25 minutes of similar activity, left for 2 minutes and 12 seconds, and then returned.

6:27:42 Male comes back - sits one foot from entry - looks in - flies to high vantage point on the tree (E. edge).

6:32:45 Male disappears.

6:37:45 Male returns from high N. - briefly - flies to the W. end of the S. swale.

Table 4 Feeding Relationships at the Nest
Great Crested Flycatcher Nest 1

Date	Day Rel. to Hatch- ing	Total Rate Per Hour	Rate Per Hour by ♀	Rate Per Hour by ♂	No. of Times ♀ Fed	No. of Times ♂ Fed	Rate Per Young Per Hour	Per Cent by ♀	Per Cent by ♂
June									
20	0*	1.30	1.30	0	2	0	.65	100	0
21	+1**	5.60	5.60	0	13	0	1.87	100	0
22	+2	4.06	4.06	0	24	0	1.35	100	0
23	+3	7.67	6.08	1.59	23	6	2.56	79.3	20.7
24	+4	3.19	2.73	.46	12	2	1.06	85.7	14.3
26	+6	1.78	1.48	.30	5	1	1.77	83.3	16.7
27	+7	3.87	2.50	1.37	11	6	3.87	64.7	35.3
28	+8	2.43	1.52	.91	5	3	2.43	62.5	37.5
29	+9	4.41	2.94	1.47	14	7	4.40	66.7	33.3
30	+10	4.16	1.94	2.22	7	8	4.16	46.7	53.3
July									
1	+11	3.72	2.53	1.19	17	8	3.72	68.0	32.0
3	+13***	11.20	2.24	4.48	3	6	11.20	20.0	40.0

* Two young birds, one egg in nest.

** Third egg hatched.

*** Unidentified fed 6 times - 4.48 times per hour,
40 per cent of feedings - Young bird had fledged.

6:40:20 Female leaves to the N.

6:46:26 Female returns from the N. and enters nest - closely followed into the tree by the male.

6:46:30 Female leaves to the E.

6:47:46 Female returns from the E. - carries cricket sized insect and enters nest.

6:48:03 Female hops out near male - female spreads wings - male immediately chases her to the E. - they fly low into the bushes.

6:55:00 Male enters tree from the N. - carries deer fly in mouth - sits on outer branch - turns head from side to side - hops to nest hole - turns head from side to side - looks in - hovers in mid air over nest hole - female leaves to S.E. - male makes dash for near by limb - makes small gurgling sound - hops to closer position - looks from side to side - makes small gurgling sound several times - hops to entry - hops back.

7:00:15 Male approaches entry - looks around - hops to high position as Eastern Kingbird lands in top of the tree - hops to entry as female approaches 7:02:45 - then hops away as female enters the nest - female immediately leaves (within seconds) - male approaches still making gurgling sound - female returns - male flutters away quickly - female enters and leaves quickly.

7:03:04 Male hops to entry and leaves quickly to near branch.

7:04:15 Male enters and comes out quickly - sits on near branch (just E. of nest).

7:05:06 Male gives 3 sharp trills - sits and looks toward entry.

The male assumed approximately one-fifth of the feeding responsibility on this day.

The male's feeding activity exceeded that of the

female on June 30th. This is the only time that he assumed the major part of the feeding responsibility while the young birds were in the nest.

It is noted that the total feeding rate took a sharp drop between June 24th and June 26th. This drop may be attributable to the loss of two out of the three young birds during this period. The whereabouts of the missing young birds and the cause of their disappearance was never established. Because of the presence of only one young bird in the nest after June 26th, the feeding rate did not increase as rapidly as might have been expected. Mousley (1934) observed the following feeding rates per hour at a Great Crested Flycatcher nest:

July 2 - 4.33	July 12 - 5.45
July 5 - 4.00	July 13 - 6.00
July 9 - 5.00	July 14 - 7.45
July 10 - 4.60	

The above are the investigator's calculations from Mousley's information. Fledging at the nest observed by Mousley occurred either late on July 14th or early on July 15th. The gradual progressions upward in the feeding rate which was obvious in his observations was completely lacking at this nest.

FEEDING AFTER FLEDGING HAD OCCURRED

Treatment of Data

In recording data in the field, the investigator listed the times at which young birds were sighted and the number of young birds in view. When a young bird or group of young birds moved out of the observer's area, it was so recorded. Feeding times were recorded as observed. From these notes, the amount of time in which all of the young birds, or portion of the young birds of a given family, were observed during a gross observation period could be determined. The amount of time the total number of young birds from a given family were in sight comprised net observation time number one (N_1). Corresponding to this, the total number of times the young birds were fed during N_1 comprised total feeding number one (F_1). The amount of time the total number of young birds in the family less one young bird were in sight comprised net observation time number two (N_2). Corresponding to this, the total number of times the young birds were fed during N_2 comprised total feeding number two (F_2). N_3 and F_3 (if needed) were derived in the same manner.

The actual number of feedings were obtained by adding F_1 to F_2 and F_3 . The total observed times were obtained by adding N_1 to N_2 and N_3 . The total rate per hour (T) was determined by the following formula

$$T = \frac{F_1 + F_2 + F_3}{N_1 + N_2 + N_3}$$

T does not reflect the rate per young bird, but rather the total observed rate of feeding per hour of observation time.

The rate of feeding per young bird (P) was determined by either of two equations. If there was no F_2 , F_3 , N_2 , or N_3 observed, i.e. where the value of all of these equaled 0, the rate per young bird could be derived directly from T divided by Y, with Y being the number of young birds being observed.

$$P = \frac{T}{Y}$$

Therefore, P in this case represents the actual rate per young bird per hour. Those values derived by use of this formula are marked with an asterisk in Tables 5 and 6.

When N_2 , N_3 , F_2 , or F_3 had a value greater than 0, it was necessary to first determine subrates, S_1 , S_2 , and S_3 as follows:

$$S_1 = \frac{\frac{F_1}{N_1}}{Y}$$

$$S_2 = \frac{\frac{F_2}{N_2}}{Y - 1}$$

$$S_3 = \frac{\frac{F_3}{N_3}}{Y - 2}$$

S_1 , S_2 , and S_3 each represent the observed rate per young bird for each time period involved. The rate per young bird for the total observation period would then be determined by:

$$N_1 \times S_1 = W_1$$

$$N_2 \times S_2 = W_2$$

$$N_3 \times S_3 = W_3$$

$$T_1 = W_1 + W_2 + W_3$$

$$T_2 = N_1 + N_2 + N_3$$

$$P = \frac{T_1}{T_2}$$

P is the average rate at which each young bird was fed per hour.

Eastern Kingbird - Family One

The feeding rate seemingly declined slightly immediately after the young birds had left the nest (Table 5). The peak in the rate of feeding occurred on July 7th (estimated +10 days from fledging), when the rate per young bird per hour was about twice the highest observed with the young birds still in the nest. Feeding nearly as rapid was observed on day +16. The last observed feeding of the young birds of this family occurred on August 1st (estimated +35 days from fledging or +50 days from hatching).

Table 5 Feeding After Fledging
Eastern Kingbird Nest 1

Date	Day	Actual	Total	Rate
	Relative	Number	Rate	Per
	to	of	Per	Hour
	Fledging	Feedings	Hour	Per
				Young
				Bird
June	27	0	18	10.13
	29	+ 2	8	14.66
	30	+ 3	21	11.74
July	3	+ 6	39	17.26
	4	+ 7	49	12.45
	5	+ 8	86	23.22
	7	+ 10	55	19.43
	8	+ 11	69	10.48
	9	+ 12	16	5.90
	10	+ 13	15	7.61
	11	+ 14	14	16.10
	12	+ 15	53	10.78
	13	+ 16	51	18.65
	16	+ 19	53	11.15
	18	+ 21	3	7.59
	20	+ 23	1	.65
	22	+ 25	9	2.18
	23	+ 26	0	0
	24	+ 27	0	0
	25	+ 28	1	.89
	27	+ 30	5	2.29
	29	+ 32	3	1.22
August	1	+ 35	2	.97
	3	+ 37	0	0
	6	+ 40	0	0

* Figured directly from straight total - actual
rate per young bird as observed.

Eastern Kingbird - Family Two

Table 6 gives the data obtained for this family.

The last observed feeding date for this family was on July 8th (estimated +18 days from fledging or an estimated +32 days from hatching). This date was also the highest record of feeding rate; however, this feeding rate was determined from only a single feeding when the young birds were visible for a very short time, and is therefore not reliable. On July 1st (estimated +11 days from fledging), the feeding rate of 13.44 based upon 9 feedings over a greater period seems to indicate the most reliable peak in the feeding cycle after fledging. It will be noted that this figure correlates well with the feeding rate of family 1 on +14 days from fledging.

Eastern Kingbird - Family Three

The young birds of this family were observed feeding only 3 times after they fledged. The first observation was made on June 27th (day of fledging). Four young birds were fed 24 times for a total rate of 13.46 times per hour or 3.37 times per hour per young bird. On June 28th (+1 day from fledging), the young birds were observed in the area,

**Table 6 Feeding After Fledging
Eastern Kingbird Nest 2**

Date	Day Relative to Fledging	Actual Number of Feedings	Total Rate Per Hour	Rate Per Hour Per Young Bird
June 20	0	4	3.11	3.11*
21	+1	In area, but not observable.		
22	+2	In area, but not observable.		
23	+3	In area, but not observable.		
24	+4	5	8.37	8.37*
26	+6	17	12.80	6.40*
27	+7	12	12.00	6.00*
28	+8	16	10.58	5.29*
29	+9	2	12.00	6.00*
30	+10	23	7.95	3.98*
July 1	+11	9	13.44	6.72*
3	+13	4	4.95	2.37
4	+14	2	16.85	8.23*
5	+15	1	1.75	.88*
6	+16	None in area.		
7	+17	In area, but raining.		
8	+18	1	18.55	9.28*

* Figured directly from straight total - actual rate per young bird as observed.

but they were too high and too well hidden to record activity. On June 29th (+2 days from fledging), the young birds were fed 14 times, a total rate of 21.54 times per hour or 5.39 times per young bird per hour. On July 6th (+9 days from fledging), the young birds were fed 3 times for a total rate of 16.37 times per hour or an individual rate of 4.09 times per hour.

Eastern Kingbird - Family Four

On July 22nd (+2 days from fledging) one young bird from this family was watched for 18 minutes and was not fed. On July 23rd (+3 days from fledging), two young birds were fed 2 times for a total rate of 4.44 times per hour or an individual rate of 2.22. On July 25th (+5 days from fledging), the young were not fed in 31 minutes. On July 29th (+9 days from fledging), two young birds were not fed in 24 minutes of observation. On August 1st (+12 days from fledging), the young birds were seen to be fed 2 times for a total rate per hour of 4.62 or an individual rate per hour of 2.31.

General Observations Regarding Feeding Behavior

The young birds from Eastern Kingbird nest 1 were

still dependent, to some degree, on the parents as long as +50 days from hatching, although they were observed to have begun to capture food for themselves by July 5th (+8 days from fledging or +23 days from hatching). The young birds of Eastern Kingbird nest 2 were first seen "hawking" for insects on June 30th (+9 days from fledging).

Two vocalizations of the young birds appear to be important in the feeding process. The first consisted of a low pitched begging call, chee-chee, which seemed to result from the intake plus expulsion of air while the young birds gaped. This vocalization was most prominent when the parents were in the vicinity of the young birds and was obvious immediately after they had fledged. The investigator suspects that it is also part of the nesting behavior. The second vocalization was the well-known dzeek given repeatedly at about one-second spacings, and interspersed with the notes see-see, so that the total effect was one of see-see-dzeek-see-see-dzeek. The dzeek was the only part heard at a distance, or when the young birds were alarmed. This call seems to be a guiding beacon to the parents and may be thought of as the "location" note of the young birds. The latter call was most certainly used as a contact call by members of the same family group.

The noisiest young bird seemed to be the one which was most apt to be fed on the next feeding trip by the parent.

Food eaten during the entire summer's observation varied considerably. A list of foods which were identified as being fed to and eaten by the Eastern Kingbirds follows:

Insects

- Order - ODONATA
 - 1. Dragonflies
- Order - OTHOPTERA
 - 1. Crickets
 - 2. Grasshoppers
 - 3. Katydid
- Order - COLEOPTERA
 - 1. Many kinds
- Order - HOMOPTERA
 - 1. Cicadas
 - 2. Leafhoppers
- Order - NEUROPTERA
 - 1. Ant lions
 - 2. Green lacewings
- Order - LEPIDOPTERA
 - 1. Butterflies
 - 2. Moths
- Order - DIPTERA
 - 1. Deer flies
 - 2. Black flies
 - 3. Horse flies
 - 4. Assassin flies
 - 5. Blow flies
 - 6. Small gnat like flies
 - 7. Various others
- Order - HYMENOPTERA
 - 1. Ichneumon wasps
 - 2. Carpenter ants
 - 3. Reddish brown wasp

Various kinds of insect larvae were also noted.

Dew berries and black raspberries of the genus Rubus,

plus wild cherries, Prunus sp. and red mulberries, Morus rubra were the only vegetable foods seen to be fed to the young birds. The latter made up a considerable part of the diet of the young birds at nest 3 before fledging, and appeared to be fed to the other young Eastern Kingbirds after fledging had occurred. The only young Eastern Kingbirds which were not observed to eat mulberries and cherries were those from nest 2; this was probably due to the unripe condition of these fruits in the territory of this family when most of the field feedings occurred.

All of the young Eastern Kingbirds were occasionally observed to pull on the leaves and buds of trees. The dead buds of Sassafras, Sassafras albidum, trees seemed to be of particular interest to the young birds, and one of these was seen to be swallowed by a young bird from nest 1.

The following is a list of the identified foods which were seen to be carried into the Great Crested Flycatcher nest cavity:

Millipedes

Too small to identify

Phalangids

Daddy-long-legs

Insects

Order - EPHEMEROPTERA

1. Mayflies

- Order - ODONATA
 - 1. Damselflies
 - 2. Dragonflies
- Order - COLEOPTERA
 - 1. Click beetle
 - 2. Black larva
 - 3. Others
- Order - NEUROPTERA
 - 1. Ant lions
 - 2. Green lacewings
- Order - LEPIDOPTERA
 - 1. Moths
 - 2. Butterflies
- Order - DIPTERA
 - 1. Deer flies
 - 2. Blow flies
 - 3. Horse flies
 - 4. Crane flies
 - 5. Others

Various insect larvae were also seen to be utilized as food for the nestlings. A conspicuous difference from the Eastern Kingbird was the complete lack of vegetable food.

The majority of the food at any of the nests was so small or so disfigured by capture that it could not be recognized at the distance that observations were made.

In order to get more refined data in this respect, it would be necessary to observe in the proximity of the nest itself.

Once the young birds had fledged, the task of feeding was still shared by each of the parents.

NEST SANITATION

Treatment of Data

The total number of fecal sacs disposed of during a given period of observation was calculated and divided by the total span of time involved. The quotient represents the total disposal rate per hour. The same procedure was used in calculating the number of fecal sacs eaten by the male and female respectively, and the number carried away by each. The sums of the rates of the male and the female resulted in the total disposal for those categories. The percentage disposal for each was determined by calculating the total number of fecal sacs disposed of by each member of a pair, dividing each by the total number of fecal sacs disposed of during the observation period, and multiplying the quotient by 100.

Eastern Kingbird - Nest One

At first, all of the fecal sacs were disposed of by eating, but as time elapsed some of the sacs were carried away by the parents. The older the young nestlings, the greater the percentage of fecal material carried away

rather than eaten.

The female was not seen to carry a fecal sac away from the nest until June 20th (+8 days from hatching) (Table 7). This date corresponds approximately with the time at which the task of brooding at the nest during the daylight hours was considerably lightened. The male carried fecal material from the vicinity of the nest area on June 15th (+3 days from hatching) or four days before the female was observed to dispose of fecal material in this manner.

The last date at which the male was seen to dispose of fecal material by eating it was June 16th (+4 days from hatching) or two days before the female carried her first fecal sac away from the nest. The female ate fecal material on June 24th (+12 days from hatching) which was six days after the male was seen to react in a like manner.

The role of the sexes in nest sanitation varied considerably and seemed mainly determined by which bird happened to be present when fecal sacs were produced.

Eastern Kingbird - Other Nests

There were no relevant observations at nest 2 except that one fecal sac was seen to be removed on June 20th after the young birds had fledged. This practice was also

Table 7 Nest Sanitation Record - Eastern Kingbird Nest 1

Date	Day Rel. to Hatch- ing	♀ Ate	♂ Ate	♀ Carried	♂ Carried	Per Cent by ♀	Per Cent by ♂	Total Dispo- sal	Rate Per Young Bird
June									
13	+1	1.59	.79	0	0	66.7	33.3	2.38	.79
14	+2	.56	1.31	0	0	70.0	30.0	1.87	.62
15	+3	.90	.74	0	.33	45.8	54.2	1.97	.66
16	+4	.59	.30	0	.30	50.0	50.0	1.19	.40
18	+6	0	0	0	1.25	0	100.0	1.25	.41
20	+8	0	0	1.79	.36	83.3	16.7	2.14	.71
21	+9	.63	0	1.56	1.09	66.7	33.3	3.28	1.09
22	+10	0	0	1.17	1.46	44.4	55.6	2.63	.88
23	+11	0	0	1.10	.82	57.1	42.9	1.92	.63
24	+12	.24	0	.96	1.44	45.5	54.5	2.64	.88
26	+14	0	0	1.30	.43	75.0	25.0	1.73	.58

observed at nest 3 on the day of fledging, when two fecal sacs were seen to be carried after the young birds were out of the nest. The rates of sanitation at these nests correlated well with that observed at nest 1.

Great Crested Flycatcher - Nest One

Because of the location of the nest in a cavity, the early sanitation activities of the parents to the nestlings could not be determined. No observations of nest sanitation were made until June 27th (+7 days from hatching) when the female was first seen to remove a sac from the cavity. It can be postulated that the fecal sacs were consumed by the parents up to this time. Even after the parents were observed to carry fecal material from the cavity, the observed rates of disposal (Table 8) were very low in comparison to Eastern Kingbird nest 1. This difference can be attributed partly to the presence of only one young bird in the Great Crested Flycatcher nest at this time while the Eastern Kingbird nest 1 had three nestlings in it during comparable periods. The observed rate per young bird at the Eastern Kingbird nest 1 was much greater than that observed at the Great Crested Flycatcher nest. No explanation appears plausible without

Table 8 Nest Sanitation Record
Great Crested Flycatcher Nest 1

Date	Day Rel. to Hatch- ing	Hourly Rate of Fecal Sacs Removed by ♀	Hourly Rate of Fecal Sacs Removed by ♂	PerCent Removed by ♀	PerCent Removed by ♂	Total Disposal Rate Per Young
June						
20	0	0	0	0	0	0
21	+ 1	0	0	0	0	0
22	+ 2	0	0	0	0	0
23	+ 3	0	0	0	0	0
24	+ 4	0	0	0	0	0
26	+ 6	0	0	0	0	0
27	+ 7	.23	0	100.0	0	.23
28	+ 8	0	0	0	0	0
29	+ 9	0	.42	0	100.0	.42
30	+ 10	0	.56	0	100.0	.56
July						
1	+ 11	.15	.30	33.3	66.7	.45

further information.

General Comments on Nest Sanitation

Eastern Kingbird family 1 was the Kingbird family which seemed to remove fecal sacs the greatest horizontal distance from the nest. These parents were never seen to drop the fecal sac in the nest area itself. All were carried to at least a distance of 75 feet from the nest and dropped from or deposited on a very high perch. Many of these sacs were carried out of sight of the investigator. The typical waste disposal technique exhibited by the Eastern Kingbird parents at nests 3 and 4 was to hop out of the nest with the fecal sac, carry it downward to a nearby wire, only a few feet in horizontal distance in most cases. Upon landing on the wire, the parent would dislodge the fecal sac from the beak by wiping it against the wire or by a quick twist of the head. The difference in behavior between the parents of nest 1 and those of nests 3 and 4 may lie simply in the convenient perch of sufficient height immediately adjacent to the last two nests.

AGGRESSIVE BEHAVIOR

Eastern Kingbird

Almost everyone who has written about the Eastern Kingbird has made note of their ferocity. Barrows (1912) attributed its name 'Kingbird' to ". . . its courageous attacks on crows and hawks." Congdon (1954) related an incident in which a man was repeatedly attacked whenever he approached the nest area. Williams (1935) told of this bird attacking a low-flying airplane.

Davis (1941) indicated three motivations for fighting "Defense of the sex partner. . . defense of the piece of land (nest site). . . pursuit of predators." He indicated that both sexes cooperate to drive other Eastern Kingbirds from the territory, but that only the male engages in interspecific chasing, except for predators. Both sexes pursue predators. He also indicated that interspecific fighting is brought about by the male observing birds moving into, about, around, or from the nest tree; and that motionless birds, non-predatory birds passing over the nest tree, and birds on the ground are not attacked. Another of his observations was that the male seems to lose his

desire to defend the territory in early evening "shortly after sunset".

Two hundred-fifty contacts between the members of Eastern Kingbird nest 1 and other birds were recorded. (Table 9) By the term 'contact', the investigator refers to two birds being very near to each other. The single species which was responsible for the most recorded contacts was the Starling, Sturnus vulgaris. Starlings were chased 28 times and tolerated only 9 times. The Starling made no aggressive responses. Robins, Turdus migratorius, and Yellow-shafted Flickers, Colaptes auratus, were the next highest species with regard to contacts. Robins were chased 19 times, were tolerated 8 times, chased an Eastern Kingbird adult once, and chased the young Eastern Kingbirds 4 times. Yellow-shafted Flickers were chased 20 times, were tolerated 7 times, and chased a young Eastern Kingbird once. The sparrows, as a group, show a high contact record, but if the various species were considered individually, the totals would be unimpressive.

The adult Eastern Kingbirds were chased or appeared to be chased on only 4 occasions. Two of the chasings of the adults were by mature Baltimore Orioles, Icterus galbula, one was by a Blue Jay, Cyanocitta cristata, and

Table 9 - Aggressive Behavior - Eastern Kingbird Family 1

	Chases	Tolerates	Adults Chased By	Young Chased By
American Goldfinch <u>Spinus tristis</u>	1	7	0	0
Baltimore Oriole <u>Icterus galbula</u>	7	1	2	1
Black-billed Cuckoo <u>Coccyzus erythrophthalmus</u>	1	0	0	0
Black-capped Chickadee <u>Parus atricapillus</u>	1	1	0	0
Blue Jay <u>Cyanocitta cristata</u>	11	2	1	1
Bronzed Grackle <u>Quiscalus</u>	5	0	0	1
Brown-headed Cowbird <u>Molothrus ater</u>	1	0	0	0
Brown Thrasher <u>Toxostoma rufum</u>	3	3	0	0
Cardinal <u>Richmondia cardinalis</u>	1	0	0	0
Catbird <u>Dumetella carolinensis</u>	1	0	0	0
Cedar Waxwing <u>Bombycilla cedrorum</u>	5	2	0	0
Common Crow <u>Corvus brachyrhynchos</u>	1	0	0	0
Eastern Bluebird <u>Sialia sialis</u>	8	5	0	1
Eastern Meadowlark <u>Sturnella magna</u>	1	1	0	0
Great Blue Heron <u>Ardea herodias</u>	1	0	0	0
Hawk (Various)	8	2	0	0
Mourning Dove <u>Zenaidura macroura</u>	1	0	0	0
Purple Martin <u>Progne subis</u>	2	1	0	0
Red-winged Blackbird <u>Agelaius phoeniceus</u>	2	1	0	0
Robin <u>Turdus migratorius</u>	19	8	1	4
Rose-breasted Grosbeak <u>Pheucticus ludovicianus</u>	2	1	0	1
Rufous-sided Towhee <u>Pipilo erythrophthalmus</u>	4	2	0	0
Sparrow - Chipping, Field, Vesper, etc.	18	14	0	1
Starling <u>Sturnus vulgaris</u>	28	9	0	0
Woodpecker - Downy, Hairy <u>Dendrocopos, sp.</u>	4	1	0	0
Yellow-shafted Flicker <u>Colaptes auratus</u>	20	7	0	1
Unidentified	11	0	0	0

one was by a Robin.

No attempt was made to distinguish the degree of aggressiveness, i.e., whether noted behavior was a bluff, a chase, passage near, or actual fight. The pursuit or chase usually involved a swooping flight to the vicinity of an intruder with a quick and last moment deviation by both participants from their line of flight. This latter maneuver usually resulted in avoidance of contact, although contact was sometimes made. Contacts, when actually occurring, seemed to be made by beak, breast, and feet. The Eastern Kingbird upon interception would then usually turn quickly and chase the intruder, often beating it with its wings, and snapping its beak. If an intruder dropped to the ground, or alighted on a near branch, the pursuer either perched nearby and renewed the battle when the intruder next moved, or else returned to normal routine.

It was the investigator's observation that the Eastern Kingbird might attack any bird which came into its territory, but concentrated its aggressive behavior around the immediate vicinity of the nest. After the young birds had taken to the field the Eastern Kingbird also attacked any bird which evoked fright and flight in the young birds. Encounters with other birds were mostly silent, occasionally dzeeks.

or kitters (Hausman, 1925. "The call note may be varied from a single kit or kitter to a rattling call produced by a rapid repetition of the kitter element.") were elicited, however.

The coming of an Eastern Kingbird into an area was usually sufficient stimulus to cause other birds to leave the immediate vicinity. It was, therefore, often difficult to judge the actual "intent" of the Eastern Kingbird in many encounters.

After the young birds had gone into the field, they would usually vacate an area whenever a bird, other than the parent, approached them, regardless of species. The following excerpt from the investigator's field notes of July 8th, illustrates the point.

9:48 A.M. Right young leaves to the swamp area as a sparrow flies near to it - left young kitters as its former nest mate leaves - flies to a higher perch on a near-by wild cherry, Prunus sp., tree - then leaves to the swamp area and kitters all the way.

The largest bird attacked by the Eastern Kingbird was the Great Blue Heron, Ardea herodias. The Heron was attacked by both parents on June 24th while the young birds were still in the nest.

One of the most surprising attacks of this pair was directed against a red fox, Vulpes fulva.

June 18, 1964 - 4:51 P.M. Red fox appears below the nest tree - coming from the west and along the treeline - Male dives on it several times and chases it far out into the field and to the north - Fox changes direction several times (indicating effectiveness of the pursuit) - Male was dzeeking as he chased - The fox did not try to catch the diving bird or even look up - did not attempt any aggressive behavior - just ran out of the area and toward the river.

The fox was seen to approach the young birds on two occasions after they had fledged (July 4th and July 8th). On both occasions the parents did not attack the intruder, but led their brood to more secure positions instead.

A deer, being chased by two barking dogs, crossed the nest field on June 16th. The Eastern Kingbirds became excited, but did not chase the intruders.

Whenever the observer went near the nest, the parents attacked with vigor. The major portion of the attack was of a vocal nature. The vocalization was a very high pitched metallic dzeek of penetrating quality. The noise that a pair was capable of, at such times, was intense enough to be uncomfortable. Although the investigator was often threatened with passes, no physical contact was made.

On June 20th, a chase occurred which was typical of the technique used on larger birds.

12:22 Male dashes up and helps the female chase a crow from East to West across the end of the field - Crow humps back between glides as it is dived on from above by the Eastern Kingbirds.

After some of these chases, the returning parents showed aggressive behavior toward each other by spiraling up into the air in mock combat and flying on wing-tips. While engaged in this mate-directed behavior, one of the pair usually kittered.

Although sparrows of various kinds were tolerated almost as many times as they were chased, when either of the parents did chase them they did so with the same vigor with which they attacked other birds. On June 23rd the parental pair was seen to pull two feathers from a sparrow which had wandered into the nest area.

The only animal which seemed completely unconcerned with the onslaught of the Eastern Kingbird was a gray squirrel, Sciurus carolinensis. The incident occurred on June 24th, while the young birds were still in the nest. The squirrel sat low on a branch, eating something among the leaves; the female attacked it once, but the squirrel only crouched lower to the limb. The female soon gave up her attack and began hunting. About five minutes later, the male attacked the squirrel briefly, but with no more effect than the female. The squirrel finally left of its own volition.

The number of contacts recorded before the young

birds fledged was one hundred. Of these, sixty-three per cent represented aggressive behavior and thirty-seven per cent represented tolerant behavior. The total number of contacts recorded after fledging was one hundred and fifty. Of the one hundred and fifty contacts, one hundred and four (69.3 per cent) were listed as aggressive behavior, thirty-one (20.7 per cent) were listed as tolerant behavior, eleven (7.3 per cent) were listed as young birds being chased, and four (2.7 per cent) were listed as adults being chased. It is of interest to note that there was only 6.3 per cent difference between the contacts which were chased before fledging occurred and those which were chased after fledging. While the young birds were in the nest, the parents never flew away from an encounter. This avoidance of others was noted only after the young birds were out of the nest.

Intraspecific behavior in regard to aggression was also noted. One instance occurred on June 15th, before the young birds were fledged. An adult Eastern Kingbird approached the nest area and the male battled it face to face, spiraling from high in the air to the ground. After fledging had occurred, direct contacts with other adults were noted eight times. In each case, the invaders were

driven away by both parents chasing. In these chases, much swooping and diving through the vegetation occurred. During these chases dzeeks, kitters, and zeebs (a low pitched harsh note) were a very prominent part of the behavior pattern. In one of these encounters (July 12th) feathers were seen to be pulled from the breast of the young bird by the "invader". On July 20th, one adult from the nest 1 area was seen to fly around nest 4. The adult was chased back into its own territory.

The first aggressive behavior of this pair toward its offspring was noted on July 7th, 11 days after fledging occurred. From this date onward, the parents gradually increased aggressiveness toward their charges. The parents usually reacted aggressively toward the young birds as a result of the young birds chasing them when they obtained food. The parents usually drove the young bird to the ground, then proceeded on their way. Often when being chased, a parent would complete a backloop and come down directly onto the back of the young bird.

This investigator cannot agree with the conclusions of Davis (1941) in his remarks about the lack of interspecific fighting of the female Eastern Kingbird, other than that directed toward predators. The female

Eastern Kingbird at nest 1 was often observed to chase Blue Jays. On June 21st, the parents at Eastern Kingbird nest 1 cooperated in chasing Blue Jays, Downy Woodpeckers, Dendrocopos pubescens, and a Bronzed Grackle, Quiscalus versicolor. The female alone on this date attacked a Baltimore Oriole, a Starling, a Yellow-shafted Flicker, and an immature Robin. Although some of the above might be considered nest predators, the Downy Woodpeckers, Baltimore Oriole, and immature Robin could not be classed as such.

Not enough evidence is available from nests 2, 3, and 4 to be of significance in this discussion.

Great Crested Flycatcher

The Great Crested Flycatcher is sometimes mentioned as a pugnacious bird, but few examples of this alleged pugnacity can be found in the literature.

During the nesting activity of the parents at the Great Crested Flycatcher nest 1, a total of one hundred thirty-seven contacts were noted (Table 10). Since the male spent a good part of his time away from the nest and the female spent most of her attentive time within the cavity, many birds came into the nest tree without coming

Table 10 - Aggressive Behavior - Great Crested Flycatcher
Family 1

	Chases	Tolerates	Chased By
American Goldfinch <u>Spinus tristis</u>	0	4	0
Baltimore Oriole <u>Icterus galbula</u>	0	12	0
Blue-winged Warbler <u>Vermivora pinus</u>	0	1	0
Bronzed Grackle <u>Quiscalus versicolor</u>	0	4	0
Brown Thrasher <u>Toxostoma rufum</u>	0	1	0
Cardinal <u>Richmondia cardinalis</u>	0	1	0
Catbird <u>Dumetella carolinensis</u>	1	5	0
Chipping Sparrow <u>Spizella passerina</u>	4	11	0
Downy Woodpecker <u>Dendrocopos pubescens</u>	2	4	0
Eastern Kingbird <u>Tyrannus tyrannus</u>	1	20	1
Field Sparrow <u>Spizella pusilla</u>	0	7	0
Hairy Woodpecker <u>Dendrocopos villosus</u>	1	0	0
Hawk	0	1	0
Mourning Dove <u>Zenaidura macroura</u>	0	1	0
Red-winged Blackbird <u>Agelaius phoeniceus</u>	5	30	0
Robin <u>Turdus migratorius</u>	0	2	0
Rose-breasted Grosbeak <u>Pheucticus ludovicianus</u>	1	2	0
Rufous-sided Towhee <u>Pipilo erythrophthalmus</u>	1	0	0
Starling <u>Sturnus vulgaris</u>	2	2	0
Yellow-billed Cuckoo <u>Coccyzus americanus</u>	0	2	0
Yellow-shafted Flicker <u>Colaptes auratus</u>	1	1	0
Yellow-throated Vireo <u>Vireo flavifrons</u>	0	4	0
Unidentified	1	1	0

into "contact" with them. Only twenty (14.6 per cent) of the one hundred and thirty-seven contacts were aggressive behavior directed toward others. One hundred and sixteen (84.7 per cent) tolerances were recorded, and on one (.7 per cent) occasion, an adult was chased. No instance of the chase of a mammal was noted.

The investigator was never attacked or approached upon climbing the tree to inspect this nest. One reason for this was that both parents were absent every time an attempt was made to climb the tree. This is in direct contrast to the Eastern Kingbird nest where no matter how cautiously the investigator approached the nest, he was discovered and was rewarded with at least a scolding for his intrusion.

These parents even upon attempting to chase, lacked the ferocity, suddenness, and vocal vigor which was characteristic of the Eastern Kingbird.

REINTRODUCTION OF THE HAND-RAISED
EASTERN KINGBIRD FROM NEST FOUR

The third young bird from Eastern Kingbird nest 4 was injured upon first fledging from the nest on July 20th. It was hand-reared until August 2nd. On this date, at 7:41 A.M., the young bird was returned to the Eastern Kingbird nest area 4. The bird had been marked with yellow model airplane paint just below the neck on the white breast. Other marks were also present on the lower mandible where the young bird had bitten the paint brush as the former marks were being placed. The marks on the lower mandible proved to be the more enduring.

The cage bearing the young bird was placed within sight of the Eastern Kingbird 4 family group which were resting in the top of a tall oak. The following are excerpts from the investigator's field notes for this day:

7:54 A.M. Young bird hops out on the edge of the cage and preens and dzeeks as the cage is opened - intervals of stillness between activity.

7:54:26 Parent goes to the west - stops zeebing and kittering - young bird stops preening.

8:00:07 Young bird, after several false starts, flies to the southeast to the wire along the road - preens and dzeeks.

8:03:02 Parent back to the oak and kittering - young bird turns head in that direction - dzeeks - parent is hidden in foliage.

8:06:06 Young birds at the number 4 area dzeek and beg - young introduced bird turns head in that direction (north) and watches - much Flicker noise is heard from the number 4 brood tree - introduced young bird stops dzeeking.

8:08:45 Young bird commences dzeeking again - number 4s not dzeeking - introduced young bird dzeeking about every 5-10 seconds then listens carefully - no response from where number 4s last located.

8:13 Young bird now dzeeks constantly and moves to new place on the fence.

8:14:46 Young bird grabs moth from the air in a short foray as it flies by - eats it then pecks at the wire - flies to elm.

8:17 Introduced young bird flies six feet high and out, then back and lands at elm hanging out over the road.

8:18 Two young birds and one adult bird from number 4 fly into the area - young introduced bird sits and preens.

8:19:20 Two young birds and adult birds dzeek sharply as they fly over the introduced young bird - one young bird and adult are still in the area - sitting about 60 feet from the introduced young bird and dzeeking back and forth.

8:22 Young bird and parent return to the vicinity of the introduced bird and all fly over it - kittering very strongly - introduced young bird sits in the resting position and not dzeeking.

8:27:05 All young birds and parents from number 4 go across the road to the east - kitter and dzeek.

Between the above time and 11:01 A.M., the reintroduced young bird and his former nest-mates and parents each stayed in their general areas and dzeeked constantly back and forth.

At 11:01 A.M. the reintroduced young bird discovered a locust-mulberry thicket in the near area. This thicket

was often frequented by the Eastern Kingbird family 1. The reintroduced young bird quickly dived into this thicket and spent most of its time here during the next few days.

The reintroduced young bird spent the rest of the day in the immediate vicinity, while the members of Eastern Kingbird family 4 dzeeked, kittered, etc. from their side of the road. The reintroduced young bird was capable of catching insects and obtaining fruit from the mulberry tree when reintroduced to the wild. This bird remained in the area until the termination of the study, and was not seen to join any family group.

On the second day of its freedom (August 3rd), the investigator fed the young bird by means of impaling a grasshopper on the end of a stick. This is the last time that the young bird allowed anyone to approach this close. Eventually it was distinguishable from the other Eastern Kingbirds in the area by only its isolation and disheveled tail feathers, evidence of their former contact with the cage.

The ability of the young bird to "hawk" for insects, i.e., pick them out of mid-air, suggests that this is an inborn behavior pattern and not the result of imitative behavior.

RESULTS OF GENERAL SURVEYS, FAMILY IDENTITIES,
AND LATE SUMMER ACTIVITY

As far as the investigator could determine by several general surveys of the area, only one Eastern Kingbird family, other than the four formerly discussed in this report, actually nested on the research tract. This fifth pair was discovered with one young bird on July 6th, near the southern portion of the tract in a line of catalpa, Catalpa sp., trees. The nest itself was not discovered, but from parental concern over certain parts of the area, the investigator could determine the presumed general area of the nest site. This was the only family, besides the four already mentioned, which could be regularly located on the tract. Several additional groups occasionally were observed along the edges of the tract.

Several other pairs of Great Crested Flycatchers were probably present on the tract, but this species is relatively inconspicuous during much of its breeding cycle and no satisfactory count of pairs was made.

Although the investigator did not mark, color band, or in any way disturb the appearance of individual young birds or adults, except the reintroduced young bird, little

concern was felt in regard to the identity of any family group after the nest had been abandoned. The investigator was reasonably sure that there was no confusion of family groups because of the territorial behavior which was evidenced, as well as the investigator's ability to predict, with a high degree of accuracy, the number of young birds which would be found with parents in an area. It was also possible to predict the stage of development the young birds would be in when found. While very young, the fledglings displayed a very pronounced notch in the tail flanked by two outer rounded lobes at the extremity. The tail of the very young bird appeared heartshaped, therefore, and was shorter than that of the adults. As the tail feathers grew longer, this notch gradually smoothed out and the tail became more fan-shaped when displayed as the bird planed up over an obstruction. Another mark which could be used in early stages was the noticeable ventral apterium. As the birds got older, development of the ventral pterylae obscured this character.

When the young birds had been out of the nest for about a month, they became very difficult to distinguish from adults. This distinction was to some extent made possible by behavior and minor differences. The young

birds displayed a shorter black-white relationship when viewed from the side while they were in the process of flight. The flight pattern of the young birds was softer and less acrobatic than that of the adults.

The Great Crested Flycatchers vacated their nesting location soon after fledging, while the Eastern Kingbirds showed definite territorial behavior for a considerable time after fledging. From early August onward, the Eastern Kingbirds from the first three nests showed less and less territorial behavior. By early August the occupants of Eastern Kingbird nest area 2 could no longer be found in their territory during the daytime, while the Eastern Kingbirds from nest areas 1 and 3 were becoming increasingly difficult to find and were spending a greater proportion of their time in the swamp and river area.

By early to middle August, the family relationship seemed to be a very loose one, but the families seemed to be intact even at the end of the study period (August 27th).

Gatherings of large groups of Great Crested Flycatchers or Eastern Kingbirds in preparation for any mass migration to the South, which might have occurred, was not observed by the investigator. The study was terminated before observations on southward migration could be made.

DESCRIPTION OF THE YOUNG EASTERN KINGBIRDS
LEAVING THE NEST

The young Eastern Kingbirds at all nests were seen to exercise their wings vigorously a few days before fledging. Only those birds at nest 4 were actually observed leaving the nest, however.

Fledging was preceded by the young bird first perching on the edge of the nest, probably taken there by trial exercise of the wings. The young bird then worked its way up on a nearby limb, a distance of only a few inches to a foot from the nest. This cautious edging away from the nest was interspersed with moments of wing flapping and rest. Eventually the young bird launched itself into space and plunged downward, flapping the wings vigorously and attempting to clutch at vegetation. The first young bird landed in a small bush, the second landed on a lower limb of the nest tree and the last plunged directly to the pavement. As the young birds plummeted downward, the parents invariably spiraled downward with them, and this activity evoked kittering from both sexes.

After resting for a few minutes at their first landing point, the young birds were led to higher and safer positions

by the parents. This flight was accompanied by the same vocalization as formerly noted, while the young birds seemed to "fly on the tail" of one of their escorts. Guiding of the young birds during their early trips may have been accomplished by physical contact of the parent. The investigator also suspected that the young birds were actually knocked from perches during their early days away from the nest. As time wore on less guidance and physical contact seemed evident.

It has already been noted that the young birds of nest 4 left the nest on different days and that the young bird which left first returned to the nest the first night at 7:17 P.M.. The second fledging of this young bird on the following day was a more sophisticated flight and it appeared to get around the nest tree quite well on this date (July 19th). The second young bird left the nest on this date, returned temporarily in the evening but came out again and evidently spent the night out of the nest in company with the first young bird. It was not ascertained whether or not the female spent the night on the nest. The last bird left the nest at mid-morning on the 20th.

ROOSTING

Tables 11 and 12 show the roosting times of the females at Eastern Kingbird nest 1 and the Great Crested Flycatcher nest. The sunset times for dates involved are also indicated.

The male Great Crested Flycatcher usually disappeared from the vicinity of the nest before the female had permanently retired for the night. Permanent retirement of the female usually occurred after a series of appearances at the entry and disappearances back into the cavity. The male was often present in the tree during this nightly ritual or shortly preceding it. The female spent the night in the nest cavity up to the evening of June 30th (+10 days from hatching). On this date she spent the night elsewhere.

The female Eastern Kingbird spent each night on the nest until fledging occurred. She always went onto the nest for the last time in the evening while the male was still active and moving about the area. Shortly after sunset the male began intense hawking behavior and was less nest oriented after this time. The male would first perch at a low vantage point, and make a series of short

Table 11 Roosting Times
Eastern Kingbird Nest 1

Date	Day Relative to Hatching	Roosting Time	Sunset Time
June 14	+2	7:36 - Raining	8:06
15	+3	8:19	8:06
21	+9	8:22:45	8:08
24	+12	7:55:25	8:09

Table 12 Roosting Times
Great Crested Flycatcher Nest 1

Date	Day Relative to Hatching	Roosting Time	Sunset Time
June 13	-7	7:26:08	8:05
16	-4	7:38:40	8:06
17	-3	7:39:20	8:07
22	+2	8:03:45	8:09
26	+6	8:13:19	8:10
29	+9	8:37:36	8:10
30	+10	Female left nest hole 7:41:20 - did not return.	

rapid flips into the air, often completing a backward loop in the process. As the evening advanced, the male worked his way to higher vantage points and eventually hawked from the very tree-tops in the area. The male would often call toward the female while engaged in this activity, but was seldom joined by his mate for any great length of time. The male did not retire until it became so dark that it was difficult to follow his movements. The exact roosting position of the male was not determined, but judging from his last observed position on several evenings it may have been a small tree a few feet from the nest tree.

SUMMARY AND CONCLUSIONS

A study of parental care exhibited by Eastern Kingbirds and Great Crested Flycatchers was undertaken between June 13th and August 27th, 1964.

Brooding in both species and incubation in the Great Crested Flycatcher were shown to be performed by the female alone. Feeding of the young birds, nest sanitation, and guarding of the nest site were the responsibility of both sexes in each of the species studied.

The Eastern Kingbird males were responsible for about fifty per cent of the feeding until +8 days from hatching. This date coincides with the almost total cessation of brooding during the daylight hours. After +8 days from hatching, and until the young birds left the nest, the males were responsible for approximately one-third of the feeding activity. The male Eastern Kingbird hunted in and fed the young birds from an area around the nest site, while the female went to a more distant point in these activities.

The young Eastern Kingbirds fledged about +15 days from hatching and soon moved through the surrounding fields

with the parents. They were observed to be fed by the adults +50 days from hatching. The rate of feeding per young bird per hour dropped slightly just after fledging and then gradually increased to approximately twice the highest level observed at the nest on the 10th day following fledging. On the following days, lower rates of feeding were recorded.

The male Great Crested Flycatcher was not observed to feed the young birds until +3 days from hatching and gradually assumed a greater share of this activity. Unlike the Eastern Kingbird, the Great Crested Flycatcher male assumed his greatest share of the feeding responsibility near the end of the nestling period. The one day of observation of the young bird out of the nest resulted in a calculated feeding rate over twice as great as the highest nest feeding.

Both species show a marked similarity of length of attentive period during the time that young birds are found in the nest.

Nest sanitation relationships were similar at the nests of both species with the male of each species carrying fecal sacs from the nest area before the female engaged in such activity.

Vocalizations of the Eastern Kingbird were a much more prominent part of the nesting activity than were such endeavors by the Great Crested Flycatcher. While the Eastern Kingbird made little obvious effort to avoid drawing attention to the nest site, the Great Crested Flycatcher demonstrated an absence of activity which might readily call attention to the nest cavity.

Appendix I Observation Times at Eastern Kingbird Nest 1

Date	Time																
	A.M.								P.M.								
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
June																	
13											X	X					
14				X	X	X	X										
15		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
16										X	X	X					
18													X	X			
20							X	X	X								
21											X	X	X	X	X	X	X
22					X	X	X	X	X								
23									X	X	X	X	X	X	X	X	X
24			X	X	X	X											
26					X	X	X								O		
27									X	X	X						
28							X										
29														X	X		
30									O					X	X		
July																	
1										X							
3										X	X	X	X				
4										X	X	X	X	X	X	X	X
5			X	X	X	X	X	X	X								
6														X			
7			X	X	X	X	X	X	X								
8				X	X	X	X	X			X	X	X	X	X	X	X
9							X	X	X	X							
10				X	X	X	X										
11					X	X	X										
12							X		X	X	X	X	X	X	X	X	
13	X	X	X	X	X	X	X										
16							X	X				X	X	X	X	X	X
18						X	X										
20														X	X	X	X
22					X	X		X		X	X	X	X	X	X	X	X
23					X	X	X										
24					X	X	X	X									
25		X	X	X	X	X											
26				X													
27			X	X	X	X	X										
28								X	X								
29			X	X	X	X	X										

X Observation for 30 or more minutes.

O Total observation period of less than 30 minutes.

Appendix I continued.

Date	Time																
	A.M.								P.M.								
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
August																	
1			X	X	X	X	X	X			X	X	X				
2														X	X	X	
3					X	X	X										
5						X	X	X									
6				X	X	X	X										
8			X	X	X	X	X										
10							X	X									
12			X	X	X												
14						X	X	X									
16				X	X	X											
17						X	X	X						X	X		
19			X	X													
21					X								X	X	X	X	
22			X	X	X	X											
26			X	X	X	X											
27			X	X	X	X							X	X	X	X	X

X Observation for 30 or more minutes.

Appendix II Observation Times at Eastern Kingbird Nest 2

Date	Time															
	A.M.								P.M.							
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	
June	14					X										
	16					X										
	18												X	X		
	20								X	X				X	X	
	21							O								
	22		O					O								
	23				X	X										
	24				X											
	26						X	X	X	X						
	27									X	X					
	28												X	X	X	
	29							X	X							
	30			X	X	X										
July	1							O								
	3					X	X									
	4			X	X	X										
	5								X	X	X					
	6												O			
	7								O							
	8	X						X								
	9								X							
	10					X	X									
	11	X														
	16						O									
	23					O										
	24		O													
	25					O										

X Observation for 30 or more minutes.

O Total observation period of less than 30 minutes.

Appendix III Observation Times at Eastern Kingbird Nest 3

Date		Time															
		A.M.								P.M.							
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	
June	18									X	X						
	24												X				
	27											X	X	X	X		
	28											O					
	29						X										
	30											O					
July	6						O										
	9				X												

X Observation for 30 or more minutes.

O Total observation period of less than 30 minutes.

Appendix IV Observation Times at Eastern Kingbird Nest 4

Date		Time														
		A.M.							P.M.							
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
July	11							X								
	16								X							
	18						X	X		X	X	X	X	X	X	X
	19	X	X	X	X	X	X	X						X	X	X
	20			X	X											
	22					O	X									
	25						O									
	26				X	X										
	29						X									
August	1											X	X			

X Observation for 30 or more minutes.

O Total observation period of less than 30 minutes.

Appendix V Observation Times at Great Crested Flycatcher Nest 1

Date	Time															
	A.M.								P.M.							
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	
June 13						X							X	X		
14								X	X	X	X	X	X	X		
16			X	X	X						X	X	X	X		
17	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
18		X	X	X	X		X									
20			X									X	X			
21	X	X	X	X			X									
22									X	X	X	X	X	X		
23	X	X	X	X												
24								X	X	X	X	X				
26											X	X	X	X	X	
27	X	X	X	X	X											
28									X	X	X			X	X	
29		X	X	X	X											
30									X	X	X			X	X	
July 1		X	X	X	X				X	X	X					
3			X	X	X							X	X			
4	X	X				X										
5													X	X	X	
7								X								

X Observation for 30 or more minutes.

Appendix VI Weather

Date		Temperatures (°C)		Sky
		Low	High	
June	13		32.1 - 2:02P.M.	Clear
	14	23.6 - 7:48A.M.	32 - 1:30P.M.	Clear to rain
	15	13.2 - 8:25P.M.	21 - 10:31A.M.	Rain
	16	10 - 8:00A.M.	23.5 - 4:20P.M.	Clear
	17	9 - 6:04A.M.	26 - 12:40P.M.	Clear to cloudy
	18	19.1 - 7:16A.M.	30 - 4:55P.M.	Cloudy
	20	19.2 - 6:15A.M.	30 - 1:00P.M.	Cloudy
	21	19 - 8:30P.M.	29 - 4:12P.M.	Cloudy to rain
	22	24 - 7:59A.M.	32 - 2:14P.M.	Cloudy
	23	20.7 - 8:21P.M.	31.7 - 1:44P.M.	Clear
	24	16.8 - 9:47A.M.	22.8 - 3:51P.M.	Clear
	26	24.5 - 8:13P.M.	34 - 4:00P.M.	Clear
	27	17.9 - 6:07A.M.	33.2 - 2:34P.M.	Clear
	28	18 - 9:00P.M.	34 - 3:48P.M.	Clear
	29	23.6 - 8:42P.M.	35 - 1:15P.M.	Clear to rain
	30	22.2 - 8:43P.M.	35.4 - 2:00P.M.	Clear
July	1	22 - 7:00A.M.	35.6 - 12:11P.M.	Clear to rain
	3	26.3 - 12:35P.M.	29.8 - 11:03A.M.	Cloudy
	4	12 - 6:00A.M.	26.9 - 3:59P.M.	Clear
	5	9 - 6:20A.M.	29 - 11:20A.M.	Clear
	6		29.3 - 1:12P.M.	Cloudy to rain
	8	16.9 - 5:45A.M.	27.2 - 3:43P.M.	Cloudy
	9	23.1 - 10:20A.M.	26 - 1:20P.M.	Hazy
	10	19.3 - 7:15A.M.	29.6 - 11:40A.M.	Clear
	11	12.7 - 6:00A.M.	29.7 - 1:22P.M.	Hazy
	12	17 - 8:00P.M.	22.8 - 4:06P.M.	Cloudy
	13	8.2 - 4:30A.M.	16.9 - 9:30A.M.	Clear to rain
	16	23.3 - 8:30P.M.	33 - 2:17P.M.	Clear
	17	22 - 7:30A.M.	29.8 - 11:05A.M.	Clear
	18	21 - 8:25P.M.	28.2 - 3:46P.M.	Cloudy to clear
	19	17.1 - 6:10A.M.	32.2 - 1:10P.M.	Clear
	20	24 - 8:15P.M.	34 - 5:25P.M.	Cloudy to rain
	22	21.8 - 8:20A.M.	33.4 - 2:00P.M.	Clear
	23	23.9 - 8:00A.M.	29.2 - 11:30A.M.	Cloudy
	24	27.2 - 8:25A.M.	31.2 - 11:50A.M.	Clear
	25	19.1 - 5:50A.M.	27.2 - 9:40A.M.	Cloudy
	26	22.9 - 7:56A.M.	28.6 - 11:20A.M.	Clear
	27	12.9 - 6:11A.M.	31 - 10:38A.M.	Clear
	29	12.8 - 6:15A.M.	20.6 - 10:44A.M.	Cloudy to clear
August	2	24 - 8:20P.M.	37.2 - 3:28P.M.	Clear
	3	22.2 - 7:45A.M.	31.8 - 11:16A.M.	Rain to cloudy
	5	23.5 - 9:30A.M.	26.9 - 11:40A.M.	Clear
	6	13.2 - 7:30A.M.	24.2 - 10:30A.M.	Clear
	8	6.6 - 5:45A.M.	21.6 - 10:53A.M.	Fog to clear

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