A STUDY OF A TREE SWALLOW COLONY OVER WATER

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INTRODUCTION

A five-year nest box study of a Tree Swallow (*Iridoprocne bicolor*) colony was conducted in a flooded game management area to determine how a lack of competition from other hole-nesting species, and a generally predator-free environment would affect the reproductive rate of this species. The reproductive efficiency is compared to that of some terrestial colonies already reported in the literature.

While the water level of the ponds in the area kept the nest boxes generally predator-free for three years, low water levels in the last two years allowed climbing quadrupeds access to the trees to which the nest boxes were attached, and the extent of Raccoon (*Procyon lotor*) damage to the nests was assayed.

Since the peripheral boundries of the colony were constant during the study, and the density of available houses therein varied as did the occupancy rate, it was possible to compare fledging success with nesting density.

An additional intention of presenting these nesting data is to record the breeding productivity of the area in its present rural condition, in order to compare at some future date the affect on Tree Swallow productivity of 1) suburban housing adjacent to the area which is in the process of reaching construction in 1971; and 2) the influence of an expected change in the area brought about by anticipated mounting human recreational needs.

DATA COLLECTION

This study was conducted at the Vischer Ferry Game Management Area operated by the N.Y.S. Dept. of Environmental Conservation in southern Saratoga County ten miles east of Schenectady, N.Y. at coordinates 424–0734. The area consists of 810 acres adjacent to and mostly within the flood plain of the Mohawk River at about 190 feet elevation. One-half of the area consists of shallow ponds and marsh, and the remainder is flat, brushy, once-cultivated farm land that is in varying stage of regrowth. The area has been managed since 1935, and since 1950 it has been partially flooded and managed primarily for water fowl and pheasant hunting. The recent water level is the result of dike construction and a new spillway that was installed in 1950. At that time, flooding killed many trees. Through the aid of woodpeckers and aging, these trees became usable nesting sites for the Tree Swallow.

In 1966 nest boxes were made available to the already existing colony. The boxes were fastened at three to six feet above water level to dead trees standing in the ponds. The boxes had openings of 1¼–1½ in. At first

the boxes were a top-opening model having a 5 × 5-in. floor and the hole typically 4 in. above the floor (total inner volume of 160 cu. in.). Starting in the second year, an alternate and more handy side-opening box was used to expand the colony and replace missing boxes, which were many due to vandalism by users of the area. The latter box had a 3½ × 4½-in. floor with the opening 6 in. above the floor (total inner volume of 135 cu. in.).

The boxes were visited for replacement and repair either in late-February or very early March while the ice was still safe. By late-March, the Tree Swallows returned as the ice was thawing. Starting in mid- or late May, depending on the advance of the season, when egg laying was in progress, the first inspection of the boxes was made by boat. All of the boxes were inspected typically five or six times until they became vacant in July. Data on clutch size, hatching success, mortality and fledging success were gathered. In the first three years, eggs were not marked; however, marking became a standard practice in 1969. The data are summarized in Tables I, II, III and IV. Young and, where possible, adults were banded.

The extremities of the colony covered an area of about 25 acres that was approximately rectangular in shape (about 750 × 1350 ft.). Almost centered in this rectangle was a rectangular nine-acre peninsula which was usually planted in corn for pheasants and which was surrounded along its shore by cattail, loosestrife and alder. Thus the colony encompassed 16 acres of pond surface in the approximate shape of a letter "U."

DISCUSSION OF DATA

A. *Nest Box Availability and Occupancy* – Table I gives a summary of the number of nest boxes that were available and the extent to which they were used. In part, the difference between the number of boxes available in May and Feb.-Mar. is the result of the loss of trees due to wind and ice. This Table does not show, however, the extent of damage by humans that occurred mainly during the winter, and in part between Feb. and May. In the winter of 1967–68 alone about 20 boxes were torn down and/or stolen by ice skaters. A total of 135 boxes was erected in the five years in order to maintain the numbers indicated in Table I.

Two events have a bearing on data in this Table. In January 1967 the Conservation Department made a substantial cutting of the trees in the colony. While the cutting eliminated many of the natural nesting sites, the occupancy level in 1967 showed little difference from that of 1966, indicating that perhaps most of the natural sites had been evacuated in favor of the boxes in 1966.

Secondly, in the winter of 1970, another colony was begun aboout one-half mile from the first. On this second pond, 26 boxes were erected supplying 21 potential nest sites in May. Nine nests resulted (42.8 percent occupancy) and only one of these is believed to have fledged young.

TABLE I
NEST BOX OCCUPANCY AND DENSITY

	1966	1967	1968	1969	1970	Average or Total
Boxes available in Feb.–Mar. . .	34	50	54	51	54	243
Boxes available in May	31	36	37	46	42	192
Boxes unused	4	5	5	9	15	38
Percent unused	12.9	13.9	13.5	19.5	35.8	19.8
Boxes with incomplete nests* ...	4	5	1	7	3	20
Percentage incomplete	12.9	13.9	2.7	15.2	7.1	10.4
Boxes with eggs	23	26	31	30	24	134
Percentage with eggs	74.2	72.2	83.8	65.3	57.2	69.8
Occupancies per acre**	0.92	1.04	1.24	1.20	0.96	1.06

* An "incomplete nest" is one consisting of grass and other building material which did not reach the stage of having feathers added or eggs laid.
** An "occupancy" is defined as a nest with eggs.
All percentages in this Table are based on the number of boxes available in May.

The other eight were destroyed by Raccoons. This destruction is discussed in detail later. None of the data from this second colony is included in this study. However, the affect of starting the second colony is evident by noting the greatly increased number of unused boxes for the year 1970. Apparently the second colony served as a pressure release for the first one. This matter was explored further by examining the relationship between nest density and productivity.

The nesting density ("occupancies per acre," last line of Table I) was obtained by dividing the number of boxes with eggs by 25 acres. This nest density was then plotted against nesting productivity, which was measured in terms of the percentage of eggs laid that produced fledglings (line 15 of Table II), to give Figure I. The plot shows that as nesting density increased progressively from 1966 to the 1968–69 period, the colony's productive efficiency declined. Then by providing additional nest sites outside the confines of the colony, as occurred in 1970, the nest density declined to nearly the 1966 level and nesting productivity increased commensurately.

Since there is a wealth of published breeding data on the Tree Swallow, mostly gathered in the 1930's, these data were consulted to determine if a similar relationship existed in other colonies. Of particular interest are the monumental works of Austin and Low (1932), Low (1933, 1934), Chapman (1935, 1939, 1955) and Kuerzi (1941). In consulting these authors it is not always possible to make direct comparisons, because colonial size and box densities are not always apparent in their papers. Nonetheless, their data do provide some insight on this matter.

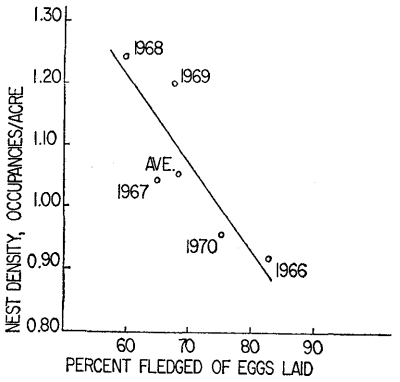

FIGURE I
A COMPARISON OF FLEDGING YIELD AND NEST DENSITY

Low's colony at the Austin Ornithological Research Station on Cape Cod began in 1931 with 98 boxes in an area that had had very few natural nest sites. In that year there were 61 occupancies (plus one renesting). The station occupied one square mile (638 acres) but it is not apparent whether the boxes were distributed to the edges of the station or were grouped in one area. The colony fledged 56.5 percent of the eggs laid. In 1932, the number of boxes available was 444 and there were 113 occupancies (plus two renestings) with a fledging rate of 60.0 percent. Thus a 4.5-times increase in the number of boxes produced 1.9 times as many occupancies and gave a nearly comparable fledging rate, unlike the Vischer Ferry colony. In 1933 there were 387 boxes at the main station and 113 of these were occupied. The fledging rate was only 38.0 percent, and in great part the poor success was due to mortality attributable to unfavorable weather. In four years, this colony exhibited a sharp increase from four pairs in 1930 to 61 pairs in 1931 to 113 pairs in 1932, only to level off at that figure for 1933 with a decrease in productivity.

Kuerzi's (1941) colony at Kent, Conn. demonstrated a similar, though not so rapid increase in size, but a different change in breeding efficiency. Starting with three houses on one acre in 1932, he obtained his first nesting pair in 1934, and had one pair also in 1935. In 1936 he had seven houses and three occupancies. For the 1937 season and thereafter he had a total of 3¼ acres. The data on the number of available houses and occupancies through 1941 are given in Figure II. In Figure III are Kuerzi's reproductive efficiency data. Figures II and III are adaptations of Kuerzi's Charts IIa and b (1941).

Kuerzi's data on reproductvie efficiency are quite contrary to those gathered at Vischer Ferry, for as his colony became more dense over the

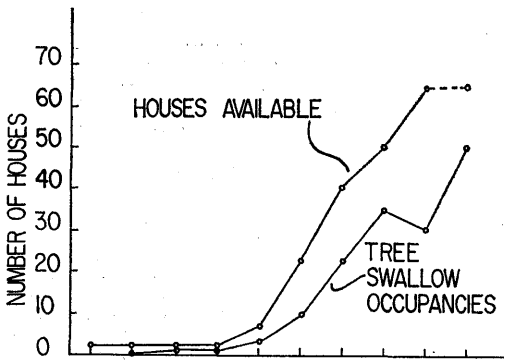

FIGURE II
KUERZI'S(1941) CHART IIa AMENDED

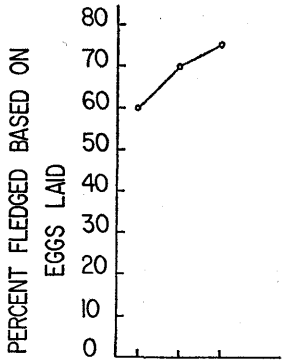

FIGURE III
KUERZI'S CHART IIb

three-year period, its reproductive efficiency increased. These and other data cited later indicate that Kuerzi did indeed have a very fertile colony. The mere fact that he housed 50 pairs of Tree Swallows on 3¼ acres is unprecedented. In his paper he commented on this as follows: "So far, there has been no tendency for the rate of increase to level off, as was found to be the case at Princeton (referring to Chapman's colony). This probably indicates that at Kent there is an ample supply of Tree Swallows passing through each spring, and that the sole limiting factor is availability of nesting boxes."

A look at Chapman's (1939, 1955) occupancy data and consideration of colony age offer a possible explanation for the difference between the data of Low and Kuerzi and that from Vischer Ferry. Chapman's upland farmland colony at about 1100 feet elevation stabilized at 37 to 46 available houses on an approximately 17-acre plot. Prior to 1937, the houses had been distributed over a wider area whose boundries varied somewhat from year to year. Chapman acquired the farm in 1926 when no Tree Twallows were known to be breeding in the area. He started the colony in 1927 with a "few" boxes. Subsequent data on his houses are given in Figure IV which is a modification of his Figure I (1955) including data from 1930 on and showing the number and occupancy of houses he had available at Princeton, Mass.

Chapman's colony, like Kuerzi's, started slowly and then experienced a pronounced rise in occupancy, taking eight years to achieve maximum occupancy (Kuerzi's also took eight years to reach its 1941 maximum, but data beyond that year are not reported) at which point Chapman's colony began a six-year decline and then more or less stabilized. It is

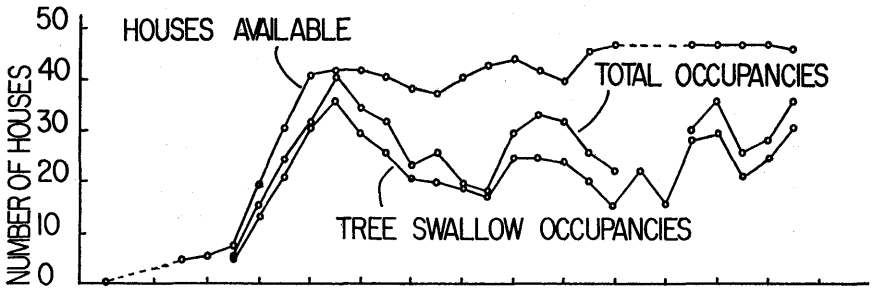

FIGURE IV
CHAPMAN'S FIGURE I (1955) AMENDED

especially interesting that Kuerzi's colony was prospering during the declining year of Chapman's colony, for the two colonies are only 100 miles away from one another.

If one allows about five years after flooding at Vischer Ferry for the trees to have died and aged sufficiently to provide suitable sites for Tree Swallow nesting, the Vischer Ferry colony was approximately 12 years old when this nest box study began. In all likelihood it was a stable colony when this study began. It is believed that for this reason the Vischer Ferry colony responded negatively to additional houses and became less productive as nesting density increased. Low's and Kuerzi's colonies did not respond in the same way, because they were new and expanding colonies. It would appear that factors other than house availability, as indicated by Kuerzi, have a bearing. Competition and density among other things make colonial survival a complex matter.

During the five years these boxes were observed, there was only one indication of attempted use by any other hole-nesting species. In that one case in 1968, a pair of House Sparrows (*Passer domesticus*) competed for a house, and due to the death of the female sparrow in the box, the Tree Swallows won out and used the box. This pair of House Sparrows was believed to be the same pair that nested in a tree hollow in a cattail marsh immediately adjacent the colony the year before (Yunick, 1968). House Wrens (*Troglodytes aegon*), though found in the area, did not venture out over water to compete for any of the boxes. Evidence of the typical twig gathering habit of this species was never found. Starlings (*Sturnus vulgaris*) nested in some of the larger tree holes, but never gave any indication of attempting to use the swallow boxes. Thus it appeared that the only competition for the use of these boxes was that of the Tree Swallows among themselves.

TABLE II
EGG, HATCHING AND FLEDGING DATA

	1966	1967	1968	1969	1970	Average or Total *	Average or Total including predation **
Eggs laid	116	134	162	109	61	582	683
Clutches	23	25	30	22	10	110	132
Eggs per clutch	5.0	5.4	5.4	5.0	6.1	5.3	5.2
Eggs hatched	103	105	125	79	52	464	512
Percentage hatched	88.8	78.3	77.1	72.5	85.3	79.8	75.0
Eggs unhatched	9	15	21	13	1	59	81
Percentage unhatched	7.8	11.2	13.0	11.9	1.6	10.1	11.9
Eggs unaccounted for	4	14	16	17	8	59	90
Percentage unaccounted for	3.4	10.5	9.9	15.6	13.1	10.1	13.1
Died in nest	7	18	22	4	4	55	57
Percentage died	6.8	17.1	17.6	5.1	7.7	11.9	11.1
Young unaccounted for	0	0	9	2	2	13	54
Percentage unaccounted for	0.0	0.0	7.2	2.5	3.8	2.8	10.5
Believed fledged	96	87	96	73	46	398	398
Percentage fledged on eggs laid	82.7	64.9	59.2	67.6	75.4	68.3	58.3
Percentage fledged on eggs hatched	93.2	82.8	76.8	92.4	88.5	85.8	77.7
Fledged per clutch	4.17	3.48	3.20	3.32	4.60	3.62	3.02
Raccoon predation, percent of clutches	0.0	0.0	3.2	26.7	56.5	—	—

* All data listed above for the years 1966–70 and the first "Total" column are from first nestings only, and exclude data from boxes attacked by Raccoons.

** This "Total" column summarizes data on all clutches including those preyed upon by Raccoons.

B. *Clutch Size.* — Table II summarizes part of the data on clutch size. In addition, a comparison is made in Table III of clutch size distribution for several colonies. All of the clutches included from this study were first nestings. Nine renesting attempts gave an average of 3.7 egg per clutch. Except for the egg distribution data of Mason, the data show that five- and six-clutches account for about 70–80 percent of the clutches laid.

In two cases eight eggs were found in a box. In one case egg marking proved it to be the result of two separate layings. In the other case, two different egg shapes pointed suspiciously to two separate nestings; however, the data from this box were excluded from comparison.

C. *Hatching Success, Nestling Mortality and Fledging Success* — These data are summarized in Table II, wherein year-to-year variations in these data are assesable. All young were identified by banding once they were old enough to carry a band. Head counts of the occupants of the boxes were conducted as the young developed. Also, unhatched eggs

were noted, dead birds were removed, and missing birds were recorded. When a nest was finally vacated, it was examined to determine whether the nest appeared to be normal, i.e., not dishevelled by a predator. The nesting material was examined on removal for unhatched eggs and dead birds that may have been buried in the nesting material. The number of occupants found on the next-to-last inspection, minus any dead birds, was counted as "believed fledged."

A comparion of clutch size, hatching, mortality and fledging data for this colony with those of five other colonies is given in Table IV.

TABLE III
CLUTCH SIZE DISTRIBUTION

Source	No. of Clutches	Percentage Having the Following Egg Counts								
		1	2	3	4	5	6	7	8	9
Low (1932, 1933) .	195	0.5	2.1	5.6	19.0	51.8	16.9	4.1	0.0	0.0
Chapman (1955) ..	147	0.0	0.7	8.8	12.9	40.8	30.6	4.8	0.7	0.7
Mason (1968)	121	3.3	5.8	10.7	30.6	31.4	16.5	1.7	0.0	0.0
Kuerzi (1941)	68	0.0	0.0	2.9	14.7	44.1	35.4	2.9	0.0	0.0
This Study	131	2.3	1.5	3.8	10.7	36.7	39.7	5.3	0.0	0.0

TABLE IV
A COMPARISON OF COLONY PRODUCTIVITY

	This Study	Chapman	Weydemeyer	Kuerzi	Low	Mason*
Percentage eggs hatched	79.8	79.5	98.5	72.1	83.7	71.6
Percentage died	11.9	24.6	3.8	1.6	41.0	2.1
Percentage fledged on eggs laid	68.3	60.0	94.7	70.5	49.4	70.3
Eggs laid per clutch ..	5.3	5.2	6.2	5.2	4.9	5.2
Fledged per clutch ...	3.62	3.11	5.90	4.46	2.39	3.62
Clutches	110	285	52	68	290	26
Years of study	5	12	8	3	3	2

* For purposes of comparison in the Table Mason's data for only 1940 and 1941 were used.

Except for Weydemeyer's colony in Montana, the clutch size and hatching success at these various colonies were quite comparable indicating a practically uniform breeding potential despite the variability in habitat at the four colonies. The nestling mortality, however, is quite variable with the Vischer Ferry data in between the extremes.

The percentage of young fledged, based on the number of eggs laid, is also fairly constant if one excludes Low's colony where mortality was

exceptionally high, and Weydemeyer's colony where hatching and fledging success were very high.

Thus, it is apparent that when the pond level was sufficient to protect these boxes from Raccoons, this colony over water which was free from competition from other hole-nesting species produced Tree Swallows at a rate comparable to that of terrestial colonies where competition from House Wrens and Eastern Bluebirds (*Sialia sialis sialis*) was present.

D. *Predation* – When the ponds were at normal water levels, practically every box was protected from terrestial predators. In 1966 and 1967 the nesting occurred undisturbed. In 1968, one nest near the shoreline was destroyed by a Raccoon. In 1969, the retaining dike was opened in an attempt to drain the area to aid in waterfowl management. The water level dropped about three feet and allowed access to numerous box-supporting trees. Raccoons destroyed every nest that was accessible. In 1970, continued effort to dry the ponds and expose their soil to bacterial action led to drastically low water levels, and again Raccoons destroyed every accessible nest totalling over one-half of those present. Only those boxes at the centers of the ponds where some water prevailed were protected.

Raccoons typically left their tracks in the mud beneath the tree and all over the box to which they clung to reach in and remove the contents. Frequently the mud from their paws caused some of the removed nesting material to stick all over the outside of the box. The nest inside would be completely dishevelled. As such, their damage was very characteristic and easily recognized. Given the opportunity, these creatures appear capable of destroying the eggs or nestlings of an entire colony.

Only one other form of predation was observed. For at least four of the five years, a pair of Sparrow Hawks (*Falco sparverius*) nested in a cavity atop one of the taller trees. During swallow fledging time one of these birds was seen to capture a fledgling in flight. No evidence was ever found to indicate that these birds preyed upon young or adults in the boxes. Weydemeyer (1935) commented that Sparrow Hawks nested in the presence of his colony without interference, except for one male that developed the habit of nest robbing.

E. *The Habitat and its Future* – For at least the last ten years the Vischer Ferry Game Management Area has given the appearance of being in an essentially static state. Much of the dead timber has fallen, but otherwise seems unchanged. Water levels have been nearly the same except for very low water in 1964 and more recently in 1969–70. The 1964 low water was the result of an intense drought. The area relies on spring flooding, snow run off, rain and two very small creeks for water. Usually the creeks run dry in the summer. The area is expected to be drained again in 1971 and reflooded in the fall of 1971.

One of the inlet creeks is planned to be the outlet for the sewage treatment system of a 300-house development being planned adjacent to

the northeast corner of the area. The effluent will only aggravate an already fertile situation in the ponds. At present only four houses adjoin the area on an upstream side of the lay of the land. Within a mile to the north, east and west are less than 15 dwellings. To the south lies the Mohawk River. Included among these dwellings are three farms.

No known spraying of the immediate management area has been done, although one nearby apple farm has undergone annual spraying. Information is being gathered on these aspects of the treatment of the area.

Recreationally the area is used for fishing in the spring and hunting in the fall. At all seasons it is used on weekends for a variety of activities including snow shoeing, canoeing, hiking and bird watching. It is expected that these activities will grow in popularity and displace the hunting and fishing as the prime attractions of the area. Possibly at some future date the area will be managed for these activities. What affect this might have on the wildlife remains to be determined.

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