SOME EFFECTS OF DDT ON NESTING ROBINS

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ABSTRACT

SOME EFFECTS OF DDT

ON NESTING ROBINS

by Gilbert Twiest

The frequent reports of nesting failure of birds after the spraying of elms with DDT for the prevention of the Dutch elm disease prompted this study of the effects of such spraying on the nesting success of the robin. Nesting successes of this bird on sprayed and unsprayed areas were compared and no significant difference was found. However, most of the losses of nests on the sprayed area resulted from DDT poisoning and losses on the unsprayed area resulted mostly from predation.

A comparison of successful and unsuccessful nests with the density of elms on part of the sprayed area showed a high correlation of successful nests on areas with few elms and unsuccessful nests on areas of high elm density.

When the robin population on the campus of Michigan State University was compared with those of other areas of like habitat and size, the campus population was found to be much lower.

It was concluded that spraying with DDT for the prevention of Dutch elm disease lowers nesting success in areas immediately adjacent to the sprayed trees and greatly reduces the population of breeding robins.

SOME EFFECTS OF DDT

ON NESTING ROBINS

By

Gilbert Twiest

A THESIS

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The time-consuming job of the analyses for DDT was carried out by Mr. Ernest Boykins, who analyzed eggs and young from deserted nests and earthworms from robin territories.

The help and cooperation of Dr. C. T. Black, Director of the Rose Lake Wildlife Experimental Station, greatly aided in this study. The following people either reported robin nests to me or helped me find them: Dr. G. J. Wallace, Dr. Richard F. Bernard, Dr. R. M. Naik, Dr. Alfred Etter, and Mr. Ted Van Velzen.

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INTRODUCTION

The purpose of this study was to find if the nesting success of the robin (Turdus migratorius) is reduced in an area sprayed with DDT (1, 1, 1-trichloro-2, 2-bis [p-chlorophenyl] ethane) for the prevention of the Dutch elm disease. Previous studies on the campus of Michigan State University indicate that before the present Dutch elm disease program was operating in 1954, more robins were present during the nesting season than at the time of the present study (Mehner, 1958). Limited observations since 1954 seem to indicate that nesting by robins has been largely unsuccessful, but no thorough study of all campus nests has been made since the spray program was put into full-scale operation in 1956.

Two methods were used to carry out this study: (1) a direct comparison of nesting success between a sprayed and an unsprayed area and (2) a comparison of the density of elms in the sprayed area with the location of successful and unsuccessful nests.

The field work for the investigation was carried out in the spring of 1962 on the campus of Michigan State University at East Lansing and at the Rose Lake Wildlife Experiment Station about 9 miles northeast of the campus.

HISTORY OF CAMPUS SPRAYING

The first spraying of elms on the campus took place as part of a protection program in 1954. Only a few elms were sprayed that year, but the program was expanded in 1955. In 1956 a full-scale program was put into effect using both dormant and foliar sprays. From 1959 on only dormant sprays were used and these were applied in part in fall after leaf drop, the rest in spring before the opening of buds. Often buds were partly open before the spraying was completed.

Rotomist sprayers were used to apply the 12-1/2% solution of DDT. Under the dormant spray program all 2,000 trees on campus property received at least one spraying a year and some which were suspected of being diseased got two or more applications.

NESTING SUCCESS STUDY--PART I

Description of Study Areas

The first part of this study deals with a comparison of a sprayed and an unsprayed tract. The sprayed area consists of the campus of Michigan State University, chiefly the North Campus and adjacent parts of the South Campus (excluding woodlots and farm fields), and the unsprayed area the Rose Lake Wildlife Research Area.

The part of the campus under study is bounded on the west by the western edge of the Brody dormitory group and Harrison Road, on the east by Bogue Street, on the north by Grand River and Michigan Avenues, and on the south by the Grand Trunk Railroad tracks. It is mostly composed of open lawn broken by buildings, streets, parking lots, and shrubs, and is protected overhead by many trees. The area is park-like in nature and is good robin habitat.

The Rose Lake Wildlife Research Station is somewhat irregular in shape and consists of seven adjacent areas. It is administered by the Game Division of the Michigan Department of Conservation with the Station headquarters on Stoll Road. The whole area is contained within these limits: Center and Robson Roads on the west, M-78 on the south,

Woodbury Road on the east, except for the Brown Area, and Bath Road on the north, except for part of the Blue Area. Most of the study nests were located along Stoll Road between Peacock and Upton Roads; however, two nests were on Upton Road between Stoll and Bath Roads and one was in the corner of Bath and Woodbury Roads near an artificial flooding created for waterfowl.

The Rose Lake area is 3200 acres in extent. It is composed of moderately rolling farmland, abandoned fields, mixed woodlots, swamps and marshes, and includes a 700-acre livestock farm. Only the portion of the area that provided good robin habitat was used in this study.

As can be seen from these descriptions, the two areas are not similar, although both are good robin habitat and both support, or did support, fairly large robin populations. Originally this study called for a control or unsprayed area which was similar to the sprayed area. However, since all the similar areas in the general vicinity containing both elm trees and many buildings are sprayed, no comparable unsprayed area could be found. Therefore, I chose an area which best fitted the other requirements of the study, such as closeness at hand, ease of obtaining access, and a population of robins large enough to permit statistical treatment of the data.

Methods

The field work in this study consisted mostly of observations. Starting in the middle of April, 1962, I made daily visits to the campus study area between 6 and 8 A. M. The Rose Lake area was visited approximately every other day for about three hours in afternoons. During April and the first half of May, much time was spent searching for nests.

Two methods were used in locating nests. The first consisted of driving slowly along campus streets, or roads at Rose Lake, and watching for robins. When one was sighted, I stopped and observed the bird more closely. If it appeared to be gathering nesting material, I watched until it flew to the nest. In this way I soon became familiar with prospective robin territories; this method simplified subsequent nest hunting.

The second method of nest hunting consisted of walking from bush to bush and tree to tree looking for nests without first seeing a bird. This method worked well at Rose Lake but not on campus. Most nests were found by observing robins carrying nesting materials, but some were found by direct search. These two methods resulted in the finding of about thirty nests. Twelve additional nests were located

by other people and reported to me.

After the first nests were found, the search routine was altered to allow time to check the condition of known nests. As the nesting season progressed, more time was spent in inspecting known nests than in searching for new ones.

The method of inspecting nests varied with their locations. Nests which could be looked into from a standing position were observed from a distance with 7 X 50 binoculars. If the bird was not around, the nest was examined for eggs and young. A mirror on a pole was used for nests which could not be seen into from a standing position. This device consisted of a stainless steel mirror attached by an adjustable wire to the end of a cane pole. The pole was in four sections, each about six feet in length. These were connected by means of rods which were inserted in the hollow ends of the cane sections. The ends of the sections were reinforced with wire wrappings. Using all four sections of cane, plus the added height of the observer, nests 30 feet above ground could be observed. At heights over fifteen feet, 7 X 50 binoculars were used to look into the mirror. The pole mirror was used as little as possible because of the disturbance it caused to the nesting adults.

Nests were numbered chronologically as found. Campus nests were given the prefix C and those at Rose Lake, R. For example, C3 and C6 were used for the 3rd and 6th nests found on campus and R7 and R16 for the 7th and 16th nests found at Rose Lake. Each nest was also given a name corresponding to its location, that is, if the nest was near the Museum it was called the Museum nest. These names were used in the notes taken on the daily inspections. After each day's field work the rough notes were transferred to a more permanent notebook where each nest was assigned a separate page. Thus, if the young finally fledged, I had a complete history of the nest.

Each nest tree was identified as to species, using Gray's Manual of Botany (Fernald, 1950). The trees were also measured with a Biltmore stick for height and diameter at breast height. The height above ground of the nests also was measured.

Whenever a nest containing either eggs or young was suspected of having been deserted by the parent birds it was watched much more closely than others. If deserted, the eggs or young were collected and analyzed for DDT by the Schechter-Haller method of analysis (Schechter et al., 1945).

At Rose Lake two adults from different nests were caught with a hoop net made of mist netting. This net was made and used as described by Nolan (1961), except that it was larger. The birds' tails were painted with colored airplane dope using the method described by Sowles (1950).

Results and Discussion

The two areas in this study differed in many respects. Some of these differences are shown by the location of nesting sites used by the birds. Tables I and II list the nest number, tree species, diameter of tree at breast height, height of tree, and nest height.

Table III shows the averages for the diameter and height of the nest tree and for the nest height for the two areas. It also indicates the nest position, or where the nest was located in the tree.

The differences in the nesting sites of the two areas can be seen in the accompanying three tables. Only three species of woody plants common to both areas were used for nesting sites: American elm, white oak, and white cedar. Altogether 21 different species of woody plants were used as nest sites on both areas - 13 at Rose Lake and 11 on campus. These data reflect the sites available. For example, Scotch pine

TABLE I

CAMPUS NESTS

Nest	Tree Species	Dia.	Ht.	Nest Ht.	Nest Position
C1	Picea abies Norway spruce	22"	70'	25'	Horizontal limb 12' from trunk.
C2	Picea abies Norway spruce	34"	65'	15'	Horizontal limb 15' from trunk.
C3	Pinus resinosa Red pine	24"	42'	10'	Horizontal limb 12' from trunk.
C4	Picea pungens Blue spruce	7.5"	35'	12'	Horizontal limb 3' from trunk.
C5	Ornamental shrub	13"	15'	10'	In main trunk crotch.
C6	Thuja occidentalis White cedar	5"	20'	4'	Crotch next to trunk.
C7	Salix babylonica Weeping willow	9"	24'	8'	Crotch next to trunk.
C8	Ulmus procera English elm	8.5"	30'	8'	Crotch next to trunk.
C9	Ulmus Americana American elm	20"	60'	12'	In main trunk crotch.
C10	Pseudotsuga taxi-folia-Douglas fir	11"	48'	12'	Horizontal limb 6' from trunk.
C11	Fraxinus Americana White ash	10"	80'	40'	Crotch next to trunk.

TABLE I--Continued

Nest	Tree Species	Dia.	Ht.	Nest Ht.	Nest Position
C12	Pseudotsuga taxifolia-Douglas fir	4"	15'	8'	In main trunk crotch.
C13	Ulmus Americana American elm	17"	50'	20'	Horizontal limb 12' from trunk.
C14	Quercus alba White oak	21"	80'	60'	In main trunk crotch.
C15	Picea abies Norway spruce	16"	55'	10'	Horizontal limb 8' from trunk.
C16	Acer saccharum Sugar maple	7.5"	27'	22'	In main trunk crotch.
C17	Picea pungens Blue spruce	6"	23'	8'	Horizontal limb 4' from trunk.
C18	Picea abies Norway spruce	28"	75'	9'	Horizontal limb 20' from trunk.
C19	Ulmus Americana American elm	15"	60'	30'	Horizontal limb 20' from trunk.
C20	Salix babylonica Weeping willow	16"	35'	20'	In main tree crotch.
C21	Ulmus Americana American elm	19"	57'	30'	Horizontal limb of main trunk.

TABLE II

ROSE LAKE NESTS

Nest	Tree Species	Dia.	Ht.	Nest Ht.	Nest Position
R1	Pinus sylvestris Scotch pine	2"	12'	4'	Crotch next to trunk.
R2	Prunus serotina Black cherry	12"	40'	5'	Crotch next to trunk.
R3	Quercus alba White oak	28"	65'	15'	Horizontal limb 8' from trunk.
R4	Acer rubrum Red maple	3.5"	25'	8'	Crotch next to trunk.
R5	Prunus serotina Dead black cherry	5.5"	30'	2'	In main trunk crotch.
R6	Pinus sylvestris Scotch pine	2"	8'	3'	In main trunk crotch.
R7	Ulmus Americana American elm	11"	40'	16'	Crotch next to trunk.
R8	Robinia pseudo-acacia-Black locust	6"	25'	7'	In main trunk crotch.
R9	Prunus serotina Black cherry	20"	50'	20'	Crotch next to trunk.
R10	Corylus Americana American hazelnut		12'	4.5'	Entangled in many stems.
R11	Crataegus sp. Hawthorn	4"	12'	2'	Horizontal limb 5' from trunk.

TABLE II--Continued

Nest	Tree Species	Dia.	Ht.	Nest Ht.	Nest Position
R12	Dead shrub	4"	10'	3'	In main trunk crotch.
R13	Pinus sylvestris Scotch pine	5"	15'	4'	Crotch next to trunk.
R14	Pinus sylvestris Scotch pine	3"	8.5'	2.5'	In main trunk crotch.
R15	Syringa vulgaris Lilac		16'	3'	In crotch of a limb.
R16	Prunus serotina Black cherry	7"	28'	2'	Crotch of limb 4' from trunk.
R17	Juniperus Virginiana Red cedar	7"	25'	10'	In crotch next to trunk.
R18	Pyrus malus Apple tree	20"	30'	16'	In main trunk crotch.
R19	Rosa multiflora Multiflora rose		12'	6'	Entangled in many stems.
R20	Thuja occidentalis White cedar	8"	24'	8'	In crotch next to trunk.
R21	Prunus serotina Black cherry	12"	40'	20'	In crotch next to trunk.

TABLE III

NEST TREE STATISTICS*

	Campus	Rose Lake
Average diameter	15"	8.9"
Average height	46'	28.6'
Average nest height	17.8'	7.7'
Nest Position		
Horizontal limb	11	3
Main crotch	6	6
Crotch made by trunk and small limb	4	10
Entangled in many stems	0	2
Tree Type		
Evergreen tree	10	5
Deciduous tree	10	13
Shrub	1	3

*Based on 21 nests for each area.

and black cherry collectively were used 9 times at Rose Lake and not once on campus, presumably because they comprise much of the cover at Rose Lake, whereas few of these two species occur on campus. By contrast, Norway spruce was used four times on campus and not at all at Rose Lake where few trees of this species occur.

The average nest height (17.8') on campus was almost two and one-half times greater than that at Rose Lake (7.7'). However, the average at Rose Lake agrees favorably with the average heights of robin nests found on other undisturbed areas. Young (1955) found an average nest height of 7.4 feet in Madison, Wisconsin, with most of the nests located in the University of Wisconsin Arboretum. The nest height for 185 robin nests (Preston, 1946) on undisturbed laboratory grounds near Butler, Pennsylvania was 7.3 feet.

On campus the nest height was 17.8 feet which also agrees favorably with reports in the literature for nests in residential areas. Mehner (1958) found an average nest height of 23.5 feet for 23 nests in an area just east of the Michigan State University campus.

As stated above nest trees were larger on campus than at Rose Lake. The average nest tree was almost twice as large on campus in both diameter and height. This probably

accounts for the higher average nest heights found on campus.

The nest positions were somewhat different also on the two areas. Robins favored horizontal limbs on campus but often chose a crotch formed by a branch and the main trunk at Rose Lake. This relates to the size of tree used for nesting. Usually only large trees have large enough horizontal limbs to support a robin's nest adequately. Therefore, the campus with its numerous large trees offered many more nest sites on horizontal limbs than did the Rose Lake area.

The difference in the types of trees chosen for nests was not great between the two areas; however, these three categories are large and all three occurred in about equal frequency in both study areas. Therefore, the chance of any one being favored over another was not great.

The success of campus nests is shown in table IV and that of the Rose Lake nests in table V. These tables contain five columns: nest number, condition when found, number of eggs, number of young, and number fledged.

On campus many nests were over 30 feet above ground. At this height the mirror on the pole was useless so the number of eggs was not known. In these cases the number of

TABLE IV

CAMPUS NESTING SUCCESS

Nest	Condition When Found	No. Eggs	No. Young	No. Fledged
C1	Building stage	3+	3	3
C2	Building stage	1+	1+	1
C3	Building stage	3+	1	0
C4	Building stage			
C5	Building stage	2	1	0
C6	Complete, no eggs			
C7	Complete, no eggs	3	0	0
C8	Eggs	4	0	0
C9	Building stage	3	0	0
C10	Building stage			
C11	Building stage			0
C12	Complete, no eggs	4	2	2
C13	Building stage			
C14	Building stage			
C15	Eggs	2+	2	1
C16	Building stage	2+	2	2
C17	Eggs	2+	0	0
C18	Young	3+	3	3
C19	Eggs			0
C20	Eggs	4	0	0
C21	Building stage			0
TOTALS	Building stage - 12 Complete, no eggs - 3 Eggs - 5 Young - 1	36	15	12

TABLE V

ROSE LAKE NESTING SUCCESS

Nest	Condition When Found	No. Eggs	No. Young	No. Fledged
R1	Building stage	4	2	2
R2	Building stage			
R3	Eggs	4	0	0
R4	Eggs	3	0	0
R5	Eggs	4	0	0
R6	Eggs	4	0	0
R7	Eggs	4	3	2
R8	Finished, no eggs			
R9	Building stage			
R10	Finished, no eggs	4	2	0
R11	Finished, no eggs	4	4	0
R12	Eggs	4	0	0
R13	Building stage	4	0	0
R14	Eggs	3	2	0
R15	Finished, no eggs	3	2	2
R16	Eggs	3	1	0
R17	Young	4+	4	0
R18	Eggs	4	0	0
R19	Eggs	3	2	2
R20	Eggs	2	0	0
R21	Eggs	1+	1	1
TOTALS	Building stage - 4 Finished, no eggs - 4 Eggs - 12 Young - 1	62	23	9

TABLE VI

ANALYSIS OF NESTING SUCCESS

	Nests	Active	Successful	% Success of Active Nests
Campus	21	16	6	37.50
Rose Lake	21	18	5	27.78

	Eggs Laid	Eggs Hatched	% Hatched	Fledged
Campus	36	15	44.67	12
Rose Lake	62	23	38.71	9

	% of Nestlings Fledged	% of Eggs Producing Fledglings
Campus	80	33.30
Rose Lake	39.13	14.75

	Average No. Fledged Per Active Nest	Average No. Fledged Per Successful Nest
Campus	.75	2.00
Rose Lake	.50	1.80

eggs was considered to be the same as the number of young seen in the nest at a later date. A plus is used after the number to indicate that more eggs may have been present.

The same symbol is used with the number of young for those nests the contents of which could not be seen. In some cases the number of young was not known until their heads could be seen above the rim of the nest. They could then be counted when they were being fed.

Nest C18 was not found until the young were large; hence the number of eggs laid and hatched was not ascertained.

Twenty-one nests were found on each area. A nest was considered successful if one or more young fledged. Rose Lake had five successful nests and the campus had six. The campus had 37.5 per cent success and Rose Lake 27.8 per cent. These figures are low when compared with other robin studies which include both early and later nests. For example, Mehner (1958) found 66.7 per cent success in a three-year study of 48 nests in East Lansing, Michigan, and Pittsburg, Pennsylvania. Kendeigh (1942) found 70 per cent success in a sample of 557 nests and Koehler and Koehler (1945) found that 49 out of 64 nests (76.6 per cent) were successful in Madison, Wisconsin.

Young (1955) found that the success of earlier nests, nests containing one or more eggs before May 15, was the same as later nests in his study. However, most of his work was done in an area where both early and late nests were in evergreens which give maximum protection at any season. Howell (1942) found a definite reduction in per cent success for early nests. He found only 32 per cent success for 38 nests one year and 38 per cent for 86 nests the following year. The later nests (eggs after May 15) were much more successful, 75 per cent success with a sample of 44 nests. The average for all his nests was 46.7 per cent success which is close to the studies in which no differentiation was shown.

Except for nests C21 and R21, all nests used in this study contained eggs on or before May 15. The per cent success is not much lower than that found by Howell (1942) for the early nesting period. The suburban area used by Howell is much like that of the campus in that both areas consisted of open lawns with shade trees for nesting sites.

Howell (1942) stated that the poor success of early nests of robins was due to lack of cover for nests before deciduous trees leave out. As stated above, Young (1955) found no difference between early and late nests when all

the nests were placed in evergreens. In the present study all of the successful nests were in evergreens, densely leaved bushes, or high in deciduous trees.

Despite the fact that the per cent success of early nests on my study areas compares favorably with those cited by Howell (1942), I believe the reasons for the low success differ on the two study areas. On campus ten nests were deserted in the incubation and brooding stages. Five of these nests contained cold eggs or dead young when examined several days after desertion. In one case, nest C8, a female, presumably the nester, was found under the nest tremoring, with typical DDT poisoning symptoms. She died within two hours after being found. When analyzed later for DDT, 230 ppm were found in the brain. Two of the four eggs (numbers 4, 5, 6, & 7 in TABLE VII), which were cold and wet when collected at the time of the female's death, contained DDT. Nest C5 produced two nestlings, one of which disappeared after five days; the other was found dead at nine days of age. No adults were near the nest. The young bird had 55 ppm of DDT in the brain.

Nest C15 produced one nestling which was found dead under the nest beside a female, presumed to be its parent, on the day it fledged. Both were analyzed for DDT: the

TABLE VII

RESULTS OF EGG ANALYSES

Nest No.	Date Egg Taken	Nest	DDT (in ppm)	Comments
1	1 May 1962	C7	32	Shell & contents
2	1 May 1962	C7	10	Shell negative
3	1 May 1962	C7	111	Contents only
4	3 May 1962	C8	0	Contents only
5	3 May 1962	C8	53	Contents only
6	3 May 1962	C8	0	Contents only
7	3 May 1962	C8	124	Shell & contents
8	14 May 1962	C17	212	contents dehydrated
9	14 May 1962	C17	110	Contents dehydrated
10	14 May 1962	C20	270	Contents dehydrated

female contained 247 ppm, but the young was negative.

Thus, five out of ten active nests on campus were deserted while they still contained eggs or young. In two cases it is known that the adult female contained lethal amounts of DDT (50 ppm or more on the brain--Bernard, 1963) as did one of the young birds.

Ten eggs were collected from four deserted nests on campus and analyzed by Mr. Ernest Boykins for DDT. The results are shown in table VII.

Eggs no. 1 and 7 were analyzed complete with the shell. In egg no. 2 the shell was analyzed separately from the contents. Only the contents of the other eggs were analyzed. The shell of egg no. 2 contained no DDT, but the contents had 10 ppm. Eggs numbered 3, 8, 9, and 10 were somewhat dehydrated and this most likely contributed to the high concentration of DDT in them.

Bernard (1963) found DDT in the ovaries of dead robins as well as in unlaid eggs and in freshly laid eggs. It can be assumed that any DDT found within an unlaid egg had to come from the parent. Furthermore, three nests (C7, C17, and C20) from which the analyzed eggs were taken were in trees other than elms and not in the immediate vicinity of elms which had been sprayed. The only egg shell analyzed

separately was negative and eight of the other eggs had their shells removed before analysis. From this, one can assume that all DDT contained within the eggs came from the female robin.

Since the females which laid the above eggs had enough DDT in their bodies to deposit up to 100 ppm or more in their eggs, they most likely were feeding on a diet high in DDT content and therefore probably died from DDT poisoning. This idea is further supported by the fact that one of the females whose eggs were analyzed actually died with DDT poisoning symptoms.

Thus, counting the nest which contained a young bird which died of DDT, the three nests which contained eggs contaminated with DDT, the one nest in which both the eggs and adult female contained DDT, and the nest in which the female evidently died of DDT poisoning, six nests were unsuccessful. The evidence points to DDT poisoning as the cause in all 6 cases.

At Rose Lake 14 nests were deserted in the incubation or brooding stages. In no case were any eggs or young found in the nests after desertion.

At two of the nests there was evidence of predation. Nest R1 produced two fledglings; however, after the eggs

were laid, the broken remains of two unhatched eggs were found under the nest. About 14 days after nest R12 was discovered, I found it turned upside down in the crotch where it was built. The female had been marked with yellow paint on her tail and was seen several times after the nest was destroyed. Hence, desertion of this nest was not due to death of the female. One other marked female was seen after the desertion of her nest.

Most of the deserted nests at Rose Lake showed signs of being molested. This and the abundance of predators at Rose Lake as compared to campus as well as the number of nests at low elevations suggest predators as being the greatest single factor in nest desertion here.

Therefore, the females at Rose Lake had a chance to re-nest while the females on campus which died of DDT poisoning did not. Howell (1942) shows that the second nesting is more successful than the first.

NESTING SUCCESS STUDY
PART II

Until the spring of 1962 there was only one known successful robin nest on the North Campus of Michigan State University after the complete campus spraying program was put into effect in 1956. Hence, the success of the six nests on the sprayed area was unexpected. Therefore, the second part of this study was initiated to try to find out why these six nests did not fail. This was carried out by correlating the density of elms on campus with successful and unsuccessful nesting sites of the robins.

Some attempts were made to correlate successful nest sites with fall spraying of the elms as opposed to spring treatment, but data on spraying schedules would not be released by the grounds department of M.S.U. and no conclusions could be drawn.

Methods

Only the nests found on the North Campus were utilized in this part of the study. These sites are shown on the map in figure I and the boundaries of the North Campus are marked off.

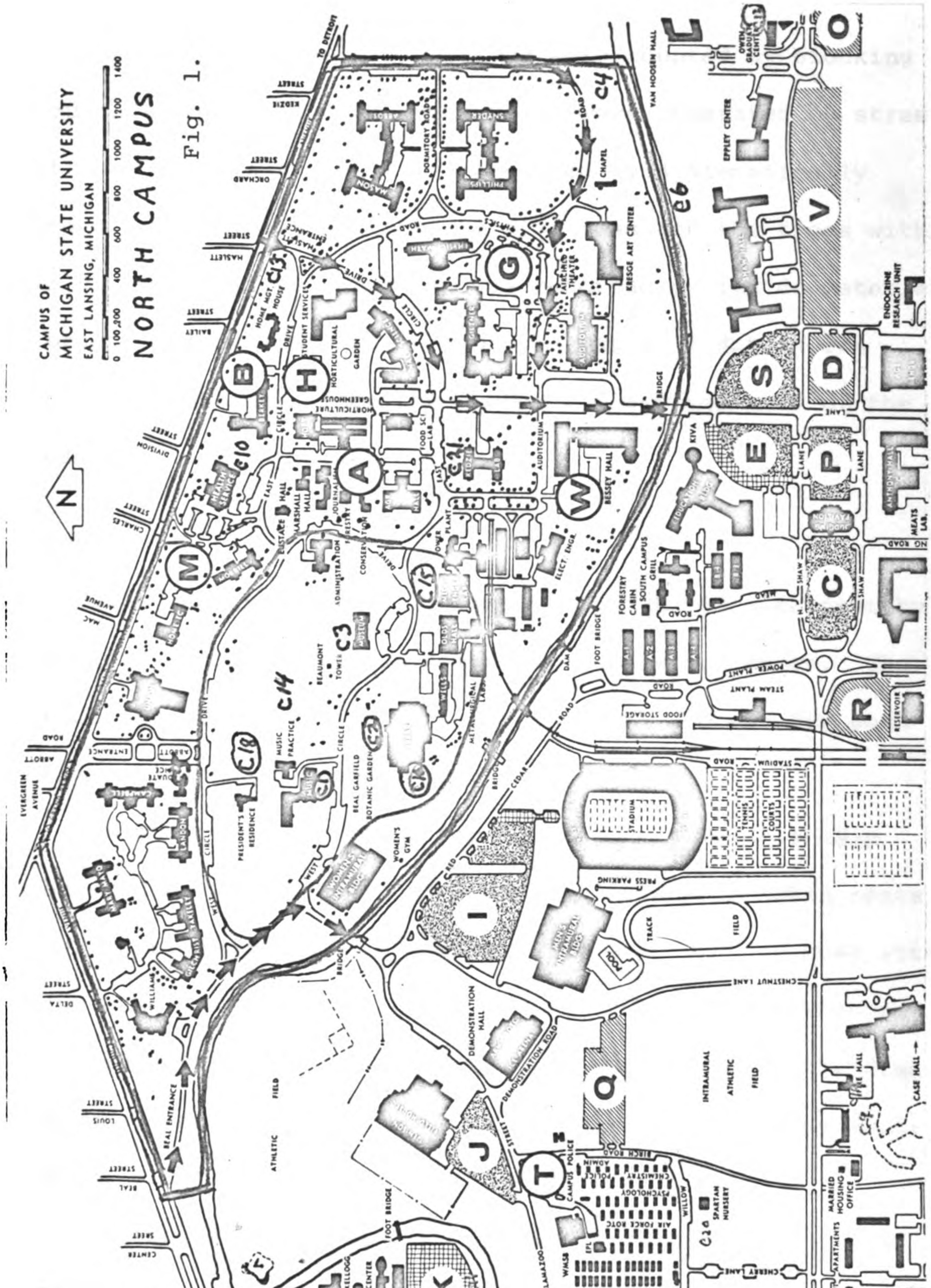
CAMPUS OF
MICHIGAN STATE UNIVERSITY
EAST LANSING, MICHIGAN
NORTH CAMPUS

Fig. 1.

The elms on the North Campus were counted by blocking off on a map convenient areas which were separated by streets. I then counted the elms in each area by systematically covering the plot on foot. I also measured the trees with a Biltmore stick. Each elm was recorded by its diameter at breast height and indicated on the map by a dot in its proper position. Then the number and average size of the elms for each area was computed.

Results

The map in figure I shows the location of each nest by number. Encircled numbers are the successful nests. The elms are represented on the map by dots, one dot for each elm in its exact location.

A statistical test to determine if any relationship existed between density of elms and success of robin nests was carried out in this manner: The map with the nest sites and elms was overlain with a 5/8 inch grid. Each plot entirely within the North Campus area was numbered, the elms counted, and the successful or unsuccessful nests counted. These figures are shown in table VIII.

These data were then subjected to Fisher's exact probability test (Siegal 1956) which showed that the

TABLE VIII

ELM ROBIN NEST CORRELATION

Plot No.	Nest	No. of Elms
1		8
2	1 U	26
3		36
4		22
5	1 U	19
6		12
7	1 U	23
8		23
9		10
10		0
11	1 S	3
12	1 U	6
13	1 U	9
14		16
15		3
16		15
17		26
18		23
19		7
20	1 S	2
21	1 S	12
22	1 S	4
23		15
24	1 U	117
25		17
26		33
27		10
28		6
29		3
30		22
31		25
32		22
Totals	6 U 4 S	475

U Unsuccessful
S Successful

Average no. of elms per plot - 14.8

probability of obtaining these results if no relationship existed is .071.

Discussion

The North Campus of Michigan State University is nearly all good nesting territory for robins. From the standpoint of nesting sites and feeding areas no one part appears better than another, except that the area around the stores and engineering laboratories is not good robin habitat. As can be seen from figure I the successful nests are in the areas where few elms are found; in the plots where there are more elms, the nests were unsuccessful, and in areas of the greatest elm concentration, almost no nests were found.

I searched all campus areas with equal thoroughness, so the lack of nests in areas of greatest elm concentration is not due to lack of search. The correlation between lack of elms and successful nests and abundance of elms and unsuccessful nests would suggest that the success of a nest is dependent upon a low density of elms.

The earthworm is known to constitute a major part of the diet of the robin during April and May in the Midwest (Barker, 1958). He has also established that earthworms

can concentrate DDT in their tissues which may be transferred to robins which are feeding on them. Therefore, I collected samples of worms in the vicinity of several study nests. One sample was taken on the feeding area near nest C16 and another near nest C21. The feeding areas were determined by observing the adults during their early morning foraging periods. The feeding area of the adults of nest C16 was unique in that it consisted of a small lawn on top of the terrace where the nest was located. This terrace was surrounded by a wooded bank which separated it from the surrounding lawns. It contained no elms.

By contrast the feeding area for nest C21 was larger and consisted of the lawn surrounding the elm nest tree and contained many other elms (at least 15). The feeding area of the robin is that part of its territory on which it feeds and varies with the size of the territory. The size of the breeding territory of the robin usually varies from 1/3 to 2 acres (Young, 1951), but may have been larger on campus.

The sample of worms taken from the area of nest C16 contained 8 ppm of DDT and the sample near nest C21 had 50 ppm. Nest C16 was successful and C21 was not. This limited observation suggests that a robin can avoid lethal doses of DDT if its feeding territory is small enough to contain

no DDT-treated elms.

In several studies carried on in the past, the average size of a robin's territory has been found to be from 1/3 to 2 acres. In these studies it was found that on good robin habitat one to two pairs per acre was the average density. Young (1955) found three pairs per acre in exceptionally good habitat on the University of Wisconsin Arboretum. Howell (1942) found two pairs per acre and states that "It is in the suburban areas that the requirements of the robin are best filled. Open lawns are very productive feeding grounds and the shade trees growing about houses and along streets are used successfully as nesting sites."

The Michigan State University campus is very similar to a midwestern residential district that Howell describes. However, only 12 nests were found on the North Campus which is 184 acres in extent. This would give a density of approximately 15 acres per pair. Even if the number of nests were doubled to allow for possible nests overlooked, the density, in pairs per acre, would be low. However, I believe that I found at least 90 per cent of the nests on the North Campus, so the figure of 15 acres per pair is close to the actual.

The reasons for this low number of nests on campus are varied. In the years since the spray program was started, large annual die-offs of robins have occured (Wallace, 1959, 1960; Wallace et al., 1961). This would result in few or no birds returning to their old territories on campus. Another reason is that many birds apparently die before nesting can take place. This year (1962) the first dead robin was found on campus on April 12 and the first nest was not found until April 23. By April 23 at least ten dead robins had been found on the North Campus (Wallace, pers. comm.).

As can be seen from the map on figure 1, there are large areas where no nests were found. These areas did have robins on them; however, their numbers fluctuated and even though I watched and searched diligently no nests were found. The areas where no nests were found are the ones where the heaviest concentration of elms occur. These are also the areas where most of the dead birds have been located in the past (Wallace, pers. comm.).

Of the 40 dead or dying robins turned in or reported to Dr. Wallace from the North Campus this year (1962), only 4 were known to be from my nest sites. However, several adults from the study nests were seen tremoring before their

nests were deserted.

Bernard (1963) has shown that the death of robins on campus can be attributed to DDT poisoning. Therefore the low density of robins on campus appears to be due to high mortality from DDT.

SUMMARY AND CONCLUSION

1. The purpose of this study was to find if the spraying of DDT for the prevention of the Dutch elm disease caused a lowering of nesting success in robins.

2. Previous studies indicated low nesting success. However, no detailed study of the effects of the spraying program on nesting success had been made until the present research project was undertaken.

3. The first part of the study deals with the success of nests on the M.S.U. campus as compared with that on an unsprayed area at the Rose Lake Wildlife Experimental Station.

Twenty-one nests were found on each area. No significant difference was found for the per cent of success of these nests between the two areas. The per cent success was similar to other studies which used only early spring nests.

4. The reasons for failure of the nests in the two areas differed. At least 6 out of the 16 active nests on campus were unsuccessful because of DDT poisoning of the adults or young. At Rose Lake at least 2 out of 18 active nests were known to have been destroyed by predators. The fact that many of the other nests had the linings torn out and that the nests were very low in elevation suggests that predation was responsible for most of the nest failures at Rose Lake.

5. The second part of the study attempts to correlate the success or failure of the nests on the North Campus with the density of sprayed elms on the feeding grounds of the nesting birds.

6. Using the Fisher's exact probability test, the successful nests correlated with areas of few elms and the unsuccessful nests with areas of high elm density at the .10 per cent level of significance. This strongly suggests that robins can survive if no DDT-treated elms are located on their feeding grounds.

7. Two samples of earthworms indicated that worms near successful nests contained much less DDT than those near unsuccessful nests on sprayed areas.

8. The population of nesting robins on the Michigan State University campus was found to be at least 15 times less dense than that found on most good robin habitat as reported in the literature.

9. Thus, the spraying of elms with DDT for the prevention of the Dutch elm disease causes a lower nesting success and a much lower population of nesting robins than other areas found in good robin habitat.

APPENDIX

History of Campus Nests

C1 Found in the building stage on April 23. By April 29 the female was incubating and on May 18 the adults were feeding young. On May 24 the three young looked old enough to fledge and the nest was empty on the next day.

C2 Female seen building the nest on April 23. She flushed from the nest on April 26 and on May 3 was incubating. By May 18 the adults were feeding young and on the 25th a single young bird was seen to fly from the nest.

C3 Nest in the building stage on April 23. On May 3 the female was incubating. She seemed to be tremoring on May 11. On May 15 the nest contained two eggs and a young bird. The following day one egg was gone and the female was not seen again. On May 18 the nest was empty.

C4 Found on May 24 in the building stage. The female was seen again on the 25th near the nest but no eggs were laid. Nest apparently deserted after this date as no adults were seen there again.

C5 Female found building nest on April 24. On May 3 one egg was in the nest. When the nest was checked again on the 15th, 2 eggs were present. On May 16 two young were in the nest. On May 24 one young bird was found dead in the deserted nest.

C6 Nest found on April 24 (on a tip from Dr. Wallace). On the 25th the female was seen next to the nest, but was never seen again.

C7 Nest located by Dr. Wallace on April 24. It contained no eggs. On April 26 one egg was present and by the 29th three eggs were in the nest. However, the eggs were cold and the nest wet. On May 1 the eggs were still present but cold so they were collected.

C8 Nest found on April 25 with one egg. By the 29th it contained four eggs. On May 3 the female was found beneath the nest in violent tremors and died in a short time. The nest was cold and the eggs wet so they were collected.

C9 Found April 29 in the building stage. By May 5 the nest contained three eggs but was deserted apparently because of nearby construction work.

C10 Nest found on April 29, the female working on it and the male nearby tremoring. On May 7 the nest was

complete but both birds were tremoring and were never seen again.

C11 Found on April 30 in the building stage. By May 9 the female was incubating and on the 25th she was feeding young. Neither adults nor young were seen after May 30. As this date was premature for fledging the nest must have failed.

C12 Completed nest found by Dr. Naik on April 28. It contained four eggs by the 15th of May. On the 31st it contained two large young ready to fledge. The young were not seen again but since the adults continued to defend the nesting area I assumed that the young were nearby.

C13 Nest found May 1 in the building stage. It was completed by May 3, but the adults were never seen again.

C14 Nest found by Mr. Ted Van Velzen on May 1 in the building stage. The adults were never seen again.

C15 Nest found by Dr. Etter and reported to me. The female was incubating by May 3. On May 15 there were two young in the nest, but on May 18 there was only one. By the 25th the young bird looked old enough to fledge but the female was tremoring. On the next

day a young bird and an adult female were found dead under the nest. The female contained 247 ppm DDT on the brain but the young was negative.

C16 Nest located on May 7 in the building stage. On May 14 the female was incubating and was brooding young on May 31. By June 7 the young looked old enough to fledge. On June 9 the nest was empty and presumed successful.

C17 Found on May 8 with two cold deserted eggs which were collected on the 14th.

C18 Nest found on May 14 with three young a few days old. By May 22 they looked old enough to fledge and were gone on the 23rd. Nest presumed successful.

C19 Female incubating when nest was found on May 14. Female not seen after June 1.

C20 Nest found May 14 with four cold eggs which were collected since the nest was obviously deserted.

C21 Nest located on May 23 in the building stage. June 12 was the last day the female was seen on or near the nest.

HISTORY OF ROSE LAKE NESTS

R1 Nest found in the building stage on April 19. By April 24 there were two eggs in the nest. On April 27 there were still only two eggs but the remains of two more broken eggs were found beneath the nest. The two young fledged on May 17.

R2 Nest located on April 21 in the building stage. On April 24 it was complete and the adults were nearby. No eggs were found and the adults were never seen near the nest again.

R3 Nest found on April 26 with four eggs. Up to May 10 the female was always on the nest when I inspected it thereafter the nest was deserted.

R4 Nest found on April 26 with three eggs. By May 1 the nest was deserted and the eggs gone.

R5 Nest found May 1 with four eggs. On the 14th the nest was deserted and the eggs gone.

R6 Nest with four eggs located on May 1. On May 10 it was deserted and the eggs gone.

R7 Nest found with one egg on May 5. On May 17 the nest contained two eggs and two young. On May 30 two large young were in the nest and on June 1 they had fledged.

R8 Nest located on May 1, complete but with no eggs. On May 3 the female was on but due to high nest desertion from predation I did not disturb her. On May 8 the nest was deserted.

R9 Nest found on May 1 in the building stage. No eggs were laid and nest was deserted by May 8.

R10 This nest was complete when found on May 3 but contained no eggs. On May 10 it contained four eggs and on the 24th two young. By May 28 the nest was deserted.

R11 Nest found April 26, complete but with no eggs. On May 3 four eggs were present. Four young were present on the 15th. On May 17 the female was caught and marked by painting her tail. By May 20 the nest was deserted. The female was seen in the vicinity on several later dates, but no new nest was found.

R12 Nest found with two eggs on May 3. By May 10 it contained four eggs. On the 15th the female was caught and marked by painting her tail yellow. On May 17 the nest was found turned upside down and obviously plundered. The marked female was seen several times later in the area.

R13 Nest located on April 26 in the building stage. On May 3 it contained four eggs but it was deserted by the 10th of May.

R14 Nest located on May 8 with three eggs. By May 15 it contained one young and two eggs. On the 17th two more were present and by the 18th it was deserted.

R15 Nest empty but complete when located on May 8. The first egg was found on the 13th and by the 17th the complete set of three eggs had been laid. The two young which were in the nest on May 30 fledged on June 12.

R16 Nest with three eggs found on May 8. By the 20th it had been deserted and the contents were gone.

R17 Nest located on May 10 with four young. By the 20th the nest had been deserted.

R18 Nest contained four eggs on May 10 when found. The female was seen incubating or brooding several times up to May 24 which was the last time she was seen.

R19 Nest contained one egg when found on May 15. By May 24 three eggs were present. Two young fledged from the nest between the 9th and the 13th of June

R20 Nest with two eggs found on May 15 but was deserted on May 20.

R21 Nest found on May 17 with the female on. On June 9 at least one young could be seen in the nest. This bird was assumed to have fledged but I did not check the nest again until June 13 by which time the nestling was gone.

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