STUDIES ON THE LIFE HISTORY OF THE ROBIN

(*Turdus migratorius* Linnaeus)

By

John Frederick Mehner

AN ABSTRACT

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DOCTOR OF PHILOSOPHY

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Approved D. J. Wallace

John Frederick Mehner

From 1953 through 1957, the life cycle of the robin was studied in Pittsburgh, Pennsylvania, and in East Lansing, Michigan.

In Pittsburgh the first spring migrants appeared between mid-February and the first part of March. Fall migration continued until mid-November when usually a small wintering population remained. Of 29 winter recoveries of robins banded in East Lansing, 69 per cent were between the latitudes of 30° and 35° N..

Several threat displays and postures, some similar or identical to ones that have been described for Catharus and Hylocichla, are used to intimidate other robins and other species.

The many vocalizations were recorded under a variety of conditions. The whisper song serves as a threat, and functions in the establishment and maintenance of the pairing bond, while the carolling song is probably for the declaration of territory. In two summers the beginning of song cessation was evident by the first part of July. Last songs were heard the first week of August. In Pittsburgh a period of song resumption usually followed in early autumn.

The populations of robins ranged from 12 pairs per 100 acres in an aspen community to 120 pairs per 100 acres in residential areas. In East Lansing DDT and other insecticides appear to be a major factor in declining robin populations.

Maximum territory, determined by 40 to 50 consecutive observations at five-minute intervals, was about 2.5 acres in three instances. Utilized territories, determined by 20 or more irregularly spaced observations, ranged in size from .24 to .87 acres in 12 cases. There appeared to be a

correlation between territory size and population density.

The first nest building began after a rise in temperature, followed by peaks of nesting in early and late spring. The average time for construction of 12 nests was 4.5 days. The nesting heights in residential areas were greater than those found in undisturbed areas by other workers. No preferred height was evident for individual females, but the second nest was usually higher than the first. An undescribed species of Protocalliphora was found in 40 per cent of 20 nests collected in Pittsburgh, but this parasite did not markedly affect nesting success.

The mean clutch size for 42 nests in Pittsburgh was 3.4 ± .11, and for 13 in East Lansing it was 3.5 ± .18. A decrease in clutch size was evident in June. The mean incubation period for 12 clutches was 12.9 ± .19 days. Several observations of males sitting on eggs were made.

The mean extent of the nestling period for 37 individuals was 13.9 ± .16 days. During approximately 16 hours of observations, feedings to nestlings averaged 6.4 per hour. Adults ate excreta in varying degrees at the nest.

The mean extent of the fledgling period for 15 broods was 14.9 ± .74 days. It was divided into three stages: Hiding Stage (0-3 days after fledging), Early-flying Stage (4-6 days after fledging), and Semi-dependent Stage (7 days after fledging until the young become independent). Three sets of fledglings confined their activities to areas ranging from one acre to 5.8 acres.

Nesting success averaged 66.7 per cent for 36 nests in East Lansing as well as for 48 nests in Pittsburgh. First nests in conifers were more

successful (75 per cent) than those in deciduous trees (44 per cent). Of 161 eggs, 70.8 per cent hatched and 49.1 per cent produced fledglings.

Depending primarily upon eyesight for obtaining food, the robin probes in the ground for food from either a crouched position or a normal posture. After breeding, robins feed in flocks, usually in woodlots adjacent to open areas, where there is a good supply of fruiting shrubs and exposed leaf litter.

Three night roosts were studied: one in shade trees along city streets, one in a second growth woods, and another on a shrubby embankment in a city park. Robins usually flew to roosts singly or in small, straggling groups. With the advent of darkness, they moved into the roosts in increasing numbers.

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INTRODUCTION

Scope and Purpose of Study

Various aspects of the life cycle of the robin (*Turdus migratorius*) have been studied by several workers. Breeding behavior and nesting have been studied by Howell (1942) and Young (1955), territorial behavior by Young (1951), local and migratory movements by Speirs (1946, 1953, 1956), and mortality rates and longevity by Farner (1945, 1949). Innumerable short papers and notes concerning this species have been published as well.

This study is concerned with the general life cycle of the robin in residential areas where it is common. This is in contrast to previous studies which have been concerned largely with robins found in cemeteries, parks, and on campuses. Consequently, data on nesting populations of robins in residential areas have been lacking. Other studies have included little on late stages of the breeding cycle when adults are feeding young out of the nest. This aspect of the life cycle has been given careful attention here. The current study also supplements existing literature on territorial behavior, courtship, mating, nesting, feeding behavior, vocalizations, and flocking. The seasonal distribution of the robin in Pittsburgh, Pennsylvania, is also considered.

Taxonomic Status of the Robin

North American robins are classified in the family Turdidae together with the solitaires, the bluebirds, and the other thrushes. The range of *Turdus migratorius*, according to the *A. O. U. Check-List of North American Birds* (1957:431), is:

"From the limit of trees in northern Alaska, northern Canada, and Newfoundland south to southern Mexico and the shores of the Gulf of Mexico. In winter to southern Baja California, Guatemala, and southern Florida."

In this check-list Turdus migratorius is divided into five subspecies. T. m. migratorius is the breeding subspecies in the areas where this study was conducted. T. m. nigrideus breeds in northeastern Canada, T. m. achrusterus in the southern parts of the United States, T. m. caurinus in northwestern North America, and T. m. propinquus in western United States and Canada. The San Lucas robin (Turdus confinis), in southern Baja California, is listed as a separate species in the current check-list. Many other species of Turdus occur in Mexico and southward.

Methods of Study

The data for this study were gathered from August, 1953, through October, 1957, in Pittsburgh, Pennsylvania, and in East Lansing, Michigan. Many of the observations were made in three study areas, two in Pittsburgh and one in East Lansing. Observations were recorded in field notebooks and on mimeographed maps of the study areas, which were carried in the field at all times. Nests were designated by hyphenated numbers--i.e., 54-1, 55-6, etc.--the first part indicating the year of the active nest.

In order to recognize individual robins in the field, I placed aluminum government bands as well as combinations of red, yellow, green and blue celluloid bands on the tarsi of 71 birds. The males are referred to as M1, M2, etc., the females as F1, F2, etc., and the young as Y1, Y2, etc.. Robins were caught with collapsible flat traps, described by Lincoln (1947:15). In the Pittsburgh study areas, sliced apples and pieces of bread proved to be particularly effective baits from the time of the robins' arrival in early spring until mid-June. For unknown reasons, robins were not attracted by this bait during the summer months, and neither bread

nor apples were successful in the East Lansing study area at any time of the year. However, water dripping into a trap from a container suspended above it proved effective in East Lansing during the summer months. It should be pointed out that some residents in the Pittsburgh study areas regularly placed various food items on the ground for birds, and this could well be the reason for the difference in trapping success in the two localities. Often there was no hesitation on the part of a robin to enter a trap. On June 1, 1954, a collapsible trap was placed in a backyard and baited with apples. Five minutes later an adult entered the trap. By June 18, however, apples were not taken in any of the traps.

In an attempt to elicit threat displays and/or courtship behavior, dummy robins were placed in areas where robins were nesting, often in the immediate vicinity of a nest, and tape recordings of songs and various call notes were played at intervals. In his study of the English robin (Erithacus rubecula), Lack (1953) used stuffed dummies to good advantage. In his study of the genera Catharus and Hylocichla, Dilger (1956) used recorded vocalizations and/or models.

Acknowledgments

I wish to express my deep appreciation to Dr. George J. Wallace for his helpful advice and guidance while this study was being conducted and for his critical reading of the manuscript. I am indebted to Mr. William Malcolm for his help in the preparation of the figures, and to Mr. Bernard Van Cleve who gathered many of the data at the Highland Park Roost in Pittsburgh. Many thanks are due to the residents of the study areas for permission to use their grounds for observations. Of these, Mrs. Ruth Durkee, Mr. Edwin Graff, the late Mrs. George Graff, Dr. and Mrs. E. J. Miller, and Mr. and Mrs. Byron Townsend were particularly helpful. I am

grateful to Mrs. Dale Henderson for help with the bird banding files at Michigan State University, and to Mr. C. C. Ludwig for the use of his bird banding records. Dr. William Drew, Head of the Department of Botany and Plant Pathology at Michigan State University, advised me on the use of botanical nomenclature.

Dr. Gordon Guyer of the Entomology Department at Michigan State University, and Dr. George Wallace of the Carnegie Museum, Pittsburgh, were helpful in the identification of insect materials. I also wish to extend my thanks to Dr. E. W. Baker, Mr. H. W. Capps, Dr. P. W. Oman, Dr. Curtis Sabrosky and Dr. Alan Stone, all of the Insect Identification and Parasite Introduction Section, U. S. Department of Agriculture, for the identification of arthropod materials. Dr. Kenneth Parks and Mr. W. E. Clyde Todd gave me permission to use publications in the Ornithology Laboratory at Carnegie Museum. I am grateful to Mr. Gerlach of the Urban Planning Department, Michigan State University, for permission to use planimeters.

I also wish to express my thanks to the many students and friends who assisted me in the field and who furnished me with observations.

DESCRIPTIONS OF STUDY AREAS

Location

Areas 1 and 2 were located in Pittsburgh (40° 30' N., 80° 13' W., elevation 1151 feet). Area 3 was located in East Lansing (42° 44' N., 84° 29' W., elevation 856 feet).

Area 1 (Figure 1) was on the edge of the business district of Castle Shannon, a suburb of Pittsburgh. Approximately five acres in extent, it was bounded on the north by the business district, on the south by an unpaved road, and on the west by a paved street. A gully with a stream flowing in a northeasterly direction marked the other boundary.

Area 2 (Figure 2) was located in Mount Lebanon, also a suburb of Pittsburgh. Irregular in shape, it covered approximately 7.5 acres. Its northern limits were determined by property lines while a steep slope marked the southern boundary toward the west. Mount Lebanon park was on the west, and paved streets completed the other boundaries.

Area 3 (Figure 3) was adjacent to the eastern end of the Michigan State University campus. More or less rectangular in shape, it was approximately 15.5 acres in extent. Paved streets bounded it on the north and the west, and the Red Cedar River on the south while property lines formed the eastern limits, which were indicated in part by various trees and shrubs.

Climatic Conditions

The following summarizes some climatological information about Pittsburgh and East Lansing, as taken from data gathered by the Weather Bureaus in both cities over a period of 45 years.

Figure 1. Study Area 1, in Castle Shannon, a suburb of Pittsburgh.

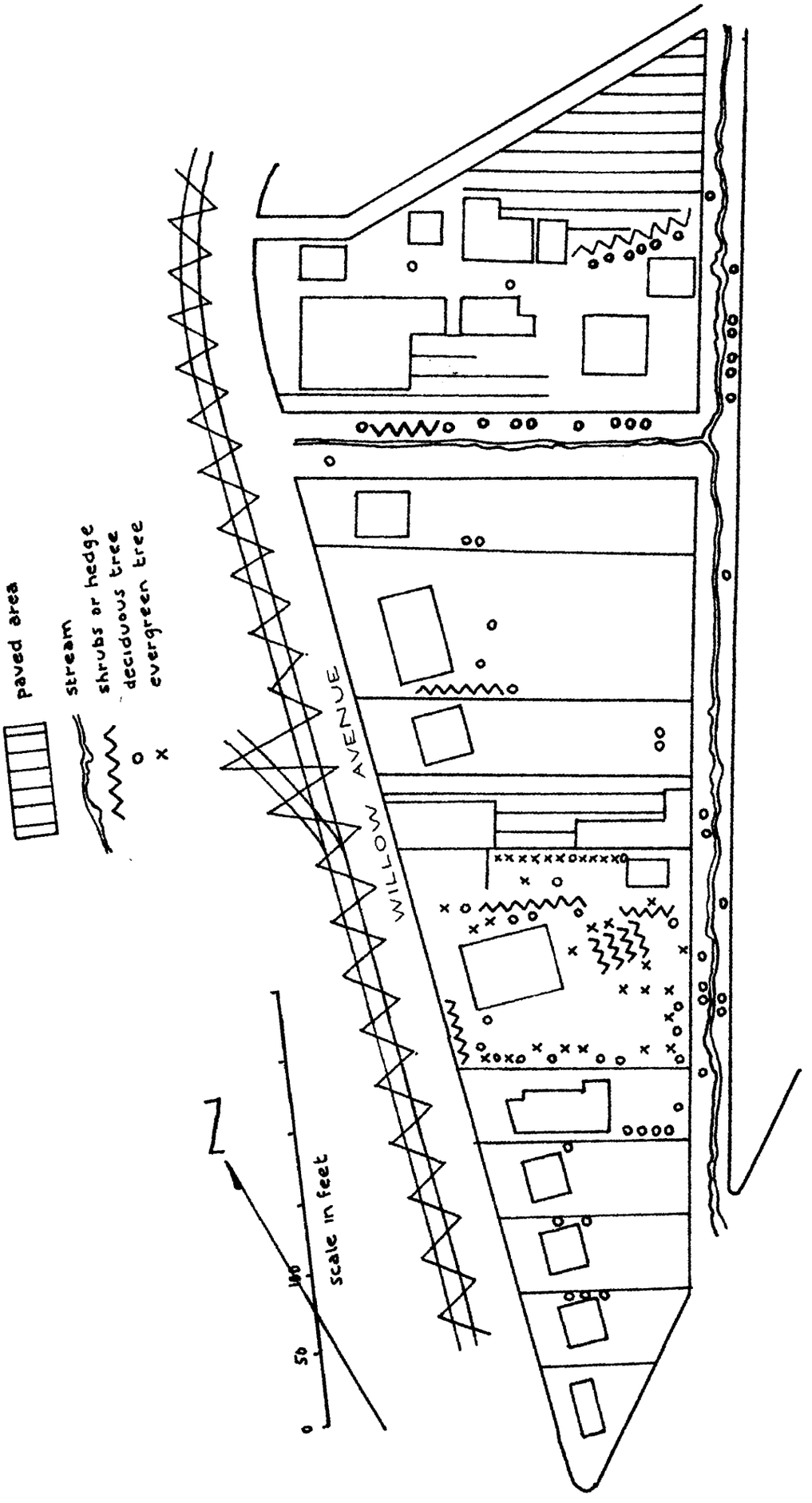

paved area
stream
shrubs or hedge
deciduous tree
evergreen tree
WILLOW AVENUE
N
0
50
100
scale in feet

Figure 2. Study Area 2, in Mount Lebanon, a suburb of Pittsburgh.

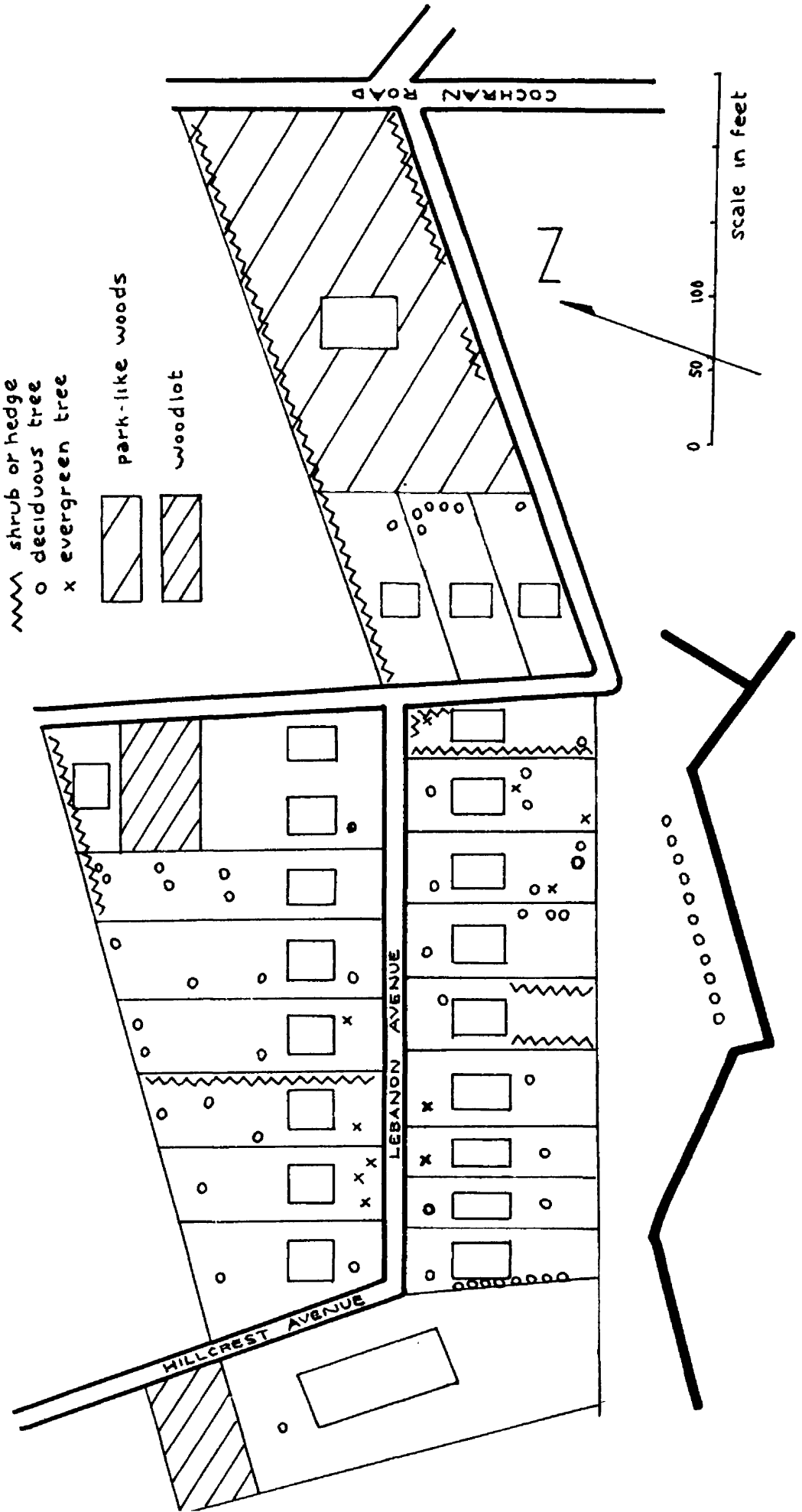
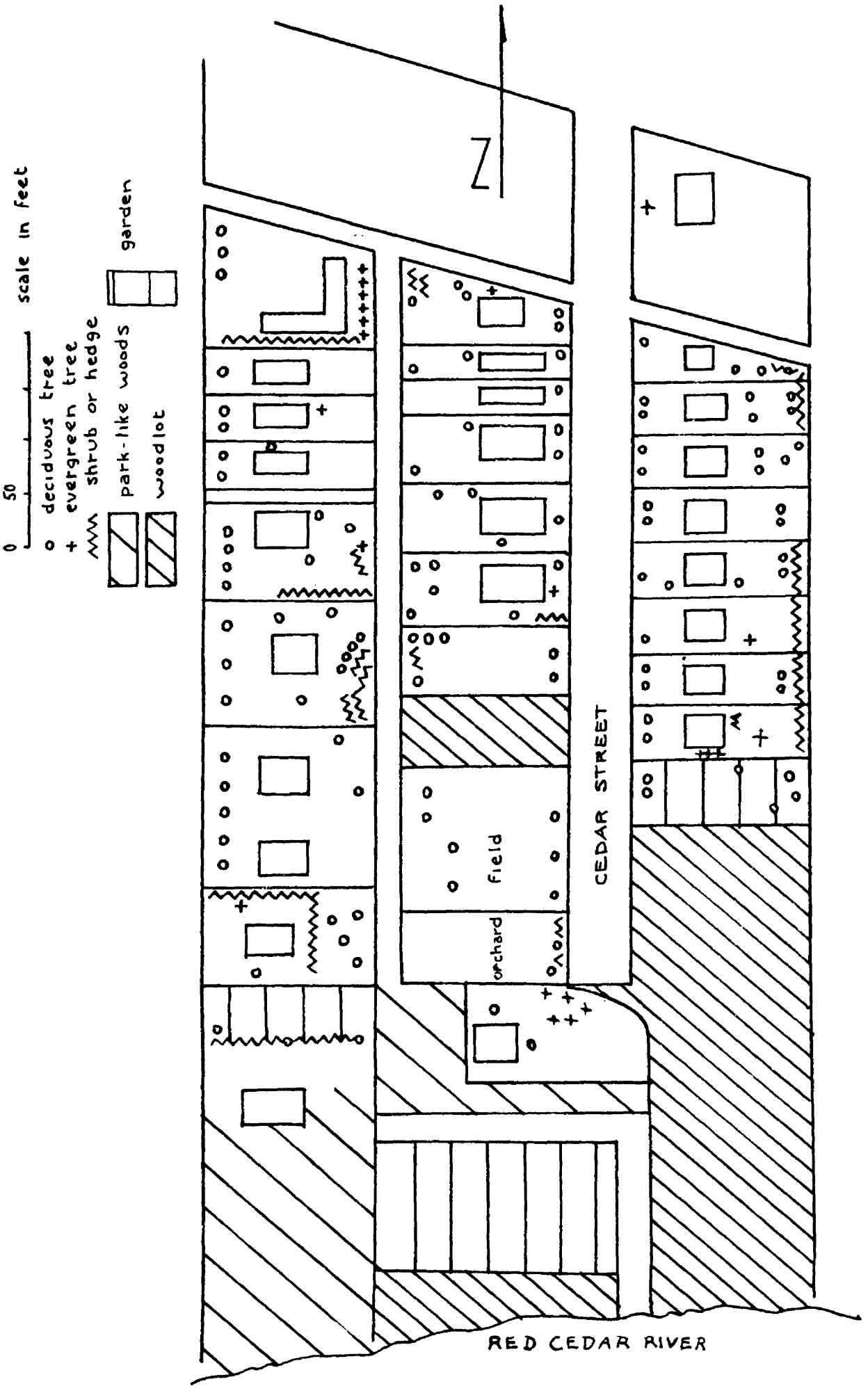

COCHRANE ROAD
LEBANON AVENUE
HILLCREST AVENUE
N
scale in feet
0
50
100
shrub or hedge
deciduous tree
evergreen tree
park-like woods
woodlot

Figure 3. Study Area 3, in East Lansing.


N
0 50 scale in feet
o deciduous tree
+ evergreen tree
shrub or hedge
park-like woods
garden
woodlot
CEDAR STREET
field
orchard
RED CEDAR RIVER

	Temperature			Precipitation
	Av. Mean	Av. Max.	Av. Min.	Mean Annual
Pittsburgh	52.6	61.5	43.6	36.23
East Lansing	46.7	56.1	37.2	31.11

Following are a few general remarks about the weather conditions that prevailed when this study was being made. During the late summer of 1953 and continuing into the fall until late November, abnormal drought and warmth were recorded in much of the country. Throughout eastern United States and into the Midwest the early part of spring in 1954 was particularly warm, followed by abnormally cold and wet weather for a good part of May. Then the summer was hot and dry, followed by an autumn that featured three hurricanes in the northeastern part of the country. The last storm in mid-October swept through the Appalachian region. Otherwise the weather in the Pittsburgh district was favorable, with no heavy snowfalls or unusual cold spells. The fall of 1954 in southern Michigan was generally mild, with a high rainfall recorded in October. The winter of 1954-55 in the Pittsburgh area was quite cold, with fairly heavy snow on the ground for much of January and a part of February. In contrast, the winter in the Great Lakes region was relatively warm and open.

In 1955 and 1956 the weather pattern for western Pennsylvania and southern Michigan was quite similar. March of 1955 was cold while April and May were marked by periods of warm, dry weather. The summer which followed was extremely dry and hot. According to the East Lansing Weather Bureau, July and August were the hottest on record with precipitation much below normal. The summer heat extended into September. Cold weather reached Pittsburgh and East Lansing in mid-November. In Pittsburgh there was a temperature deficit of approximately 100 degrees and a precipitation surplus of about seven inches for the first five months of 1956 (Brooks,

1956b:332). Likewise the spring was cold in Michigan. Cool and wet weather was widespread during the summer while the fall was warm and dry. In East Lansing September and October were the driest since 1864, and October the warmest since 1920. In 1957 cold weather prevailed until mid-April, and summer presented contrasting weather conditions in western Pennsylvania and southern Michigan. Drought conditions were prevalent in the eastern part of the country while much rain fell in southern Michigan. East Lansing reported the third wettest July in history.

Flora

The streets within the study areas were quite unlike from the standpoint of shade trees. None were present along the one street in Area 1; the buildings were adjacent to the sidewalk in most cases (Plate 1). In Area 2 there were no shade trees along the streets, but a number of evergreens and a few deciduous trees were on the front lawns (Plate 3-A). In contrast to this, the streets in Area 3 were lined with large American elms (Ulmus americana L.), Norway maples (Acer platanoides L.) and silver maples (Acer saccharinum L.) (Plate 4).

Only one portion of Area 1 had an appreciable number of shrubs and trees, as is evident in Figure 1 and in Plate 1-B. Spruces (Picea spp.), pines (Pinus spp.), and a great variety of deciduous trees and shrubs were present. In the gully and along the stream, crack willow (Salix fragilis L.) was the commonest species. Lombardy poplars (Populus nigra, var. italica Muenchh.), apple trees (Pyrus malus L.) and sour cherry trees (Prunus cerasus L.) were present in backyards. Plate 2-A shows one backyard near the northern boundary of the area. Other than the poplars and willows, there were only two large trees, a sycamore (Plantanus occidentalis L.) and a silver maple, both well over 60 feet in height. Trash was de-

posited constantly in the stream and gully. A hillside on which there was one small grove of trees composed primarily of black cherry (Prunus serotina Ehrh.) rose from a portion of the gully to a busy highway above. Much trash littered the hillside as well.

In contrast to the situation in Area 1, Area 2 was composed primarily of well kept lawns. A great variety of trees and shrubs were present, among which were spruces, weeping willow (Salix babylonica L.), lombardy poplar, American elm, American mountain ash (Pyrus americana DC.), white ash (Fraxinus americana L.), and a variety of ornamentals and fruit-bearing types. The hillside marking the southern boundary was planted with Japanese honeysuckle (Lonicera japonica Thunb.), and a row of flowering crab-apple trees (Malus atrosanguinea (Spaeth) Schneid.) stood at the base of the hill (Plate 2-B). Hedges and shrubs often marked the property lines (Plate 3-B). As shown in Figure 2, there were two small woodlots, composed primarily of black cherry. The grounds surrounding one house gave the appearance of a park-like woods.

As in Area 2, the lawns of Area 3 were well kept. In addition to the large elms and maples lining the streets, many backyards contained shade trees well over 60 feet in height. Spruces, arborvitae (Thuja occidentalis L.), and many fruiting trees and shrubs were also present (Plate 5-A). Trees were so common in some spots that a park-like appearance resulted. The woodlots of this area were composed mainly of Norway spruce (Picea abies (L.) Karst.). Austrian pine (Pinus nigra Arnold) and black locust (Robinia pseudoacacia L.) were common in the small woods on Cedar Street. In the wooded section near the river there were some oaks (Quercus spp.) and American elms. In the only field (Plate 5-B) the most numerous herbaceous plants were timothy (Phleum pratense L.), white melilot (Melilotus alba Desr.), Queen Anne's lace (Daucus carota L.), fleabane

(Erigeron sp.) and common ragweed (Ambrosia artemisiifolia L.).

Fauna

In addition to the food provided by trees and shrubs, feeding stations were maintained by some residents. One was operated in Area 1 and several in Areas 2 and 3. Birds and mammals identified in the study areas are listed in Tables 1 and 2 respectively. Transient birds are not included. In Area 1 most of the species were found in about one acre where the feeding station was located and where cover was present. The owner of the property reported that one morning in winter approximately 50 cardinals (Richmondena cardinalis) were in his yard. Since Area 3 was the largest of the study plots and also offered a variety of cover, it was not surprising to find more species of birds here than in the other areas.

Frequently robins ignored other species of birds, even when they approached the nest site. On July 5 a hairy woodpecker (Dendrocopus villosus) feeding about 10 feet from nest 54-45 was ignored. On at least one occasion robins retreated before the eastern kingbird (Tyrannus tyrannus), blue jay (Cyanocitta cristata), brown creeper (Certhia familiaris), starling (Sturnus vulgaris), house sparrow (Passer domesticus), red-eyed vireo (Vireo olivaceus), Baltimore oriole (Icterus galbula) and common grackle (Quiscalus quiscula). It seems that when one bird dominates another, much depends upon which individual acts first. On February 27, 1955, Bernard Van Cleve observed a brown creeper on a tree trunk which was in the path of roost-bound robins. The creeper charged a robin and the latter retreated. On June 14, 1954, I watched a red-eyed vireo pursuing and diving at a male robin, forcing him to the ground.

On the other hand, I observed robins driving the rock dove (Columba

livia), eastern phoebe (Sayornis phoebe), blue jay, catbird (Dumetella carolinensis), starling, house sparrow, common grackle, brown-headed cowbird (Molothrus ater), rufous-sided towhee (Pipilo erythrophthalmus), as well as the eastern chipmunk (Tamias striatus) and the eastern fox squirrel (Sciurus niger). The house sparrow and common grackle were driven more frequently than any of the others, and seldom were they tolerated near robin nests. Likewise, Common (1947) saw grackles chased by a pair of robins on several occasions. Common, however, and Schantz (1939:168) found that house sparrows were ignored. On the other hand, Arnold (1907:84), Brooks (1939:19), Jensen (1925:591) and Pershing (1930:55) record house sparrows snatching earthworms and/or insects from robins. Richardson (1945:40) and Rohrback (1913:246) found that these weaver finches caused the desertion of two robin nests. While nest 54-6 was under construction, house sparrows removed materials from the nest, even once when the female robin was present. It would seem that both of these species are recognized as predators by most robins, and accordingly they are attacked, as is true of some rodents. Edwin Graff reported that a fox squirrel once climbed to nest 55-23 and just as it reached the nest, one adult robin pounced on it and drove it away. A few days later I observed F3 chasing a fox squirrel vigorously, even though the rodent was some distance from the nest.

DISTRIBUTION AND MIGRATION

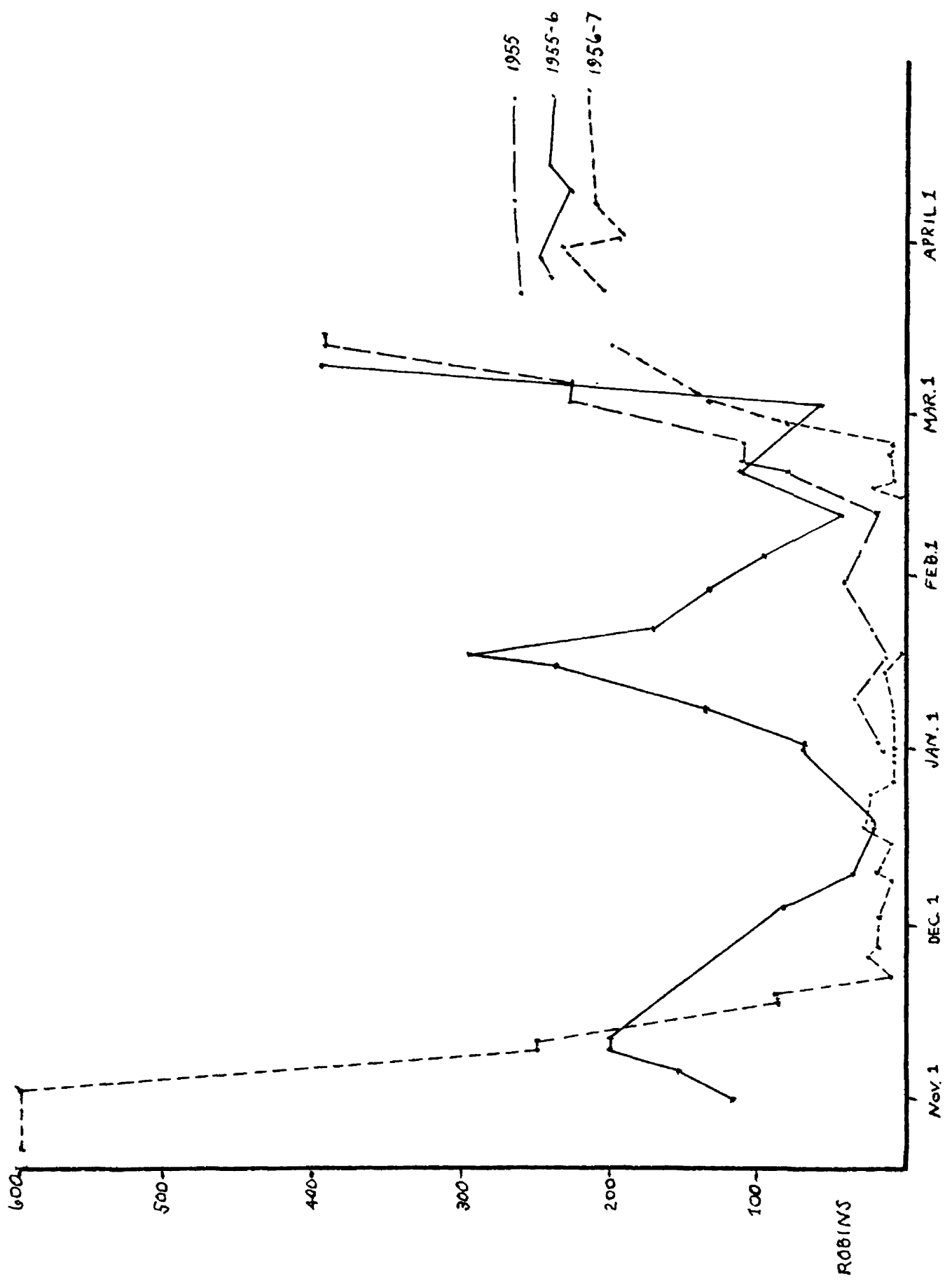
Seasonal Distribution

It is a well known fact that the robin is migratory. In neither Michigan nor Pennsylvania is it usually found in appreciable numbers during the winter months. Todd (1940:437) states that this thrush occurs regularly in western Pennsylvania in the winter. In Michigan small numbers are observed every winter in the southern part of the state (Wood, 1951:332).

A better concept of the seasonal distribution of this species can be realized if regular visits are made to an area which is utilized as a night roost during the entire year. Such an area occurred in Highland Park, in the eastern part of Pittsburgh, where counts of the robin population were made regularly by Bernard Van Cleve and irregularly by myself from the winter of 1955 to the spring of 1957. These data are presented in Figure 4. It is evident that few robins were found in the winter of 1956-57, and that no appreciable numbers were observed in January, 1955.

But the winter season of 1955-56 presented an entirely different story, with a large influx of robins in January. This condition was not peculiar to the roost in Highland Park, nor to the Pittsburgh district as a whole. Robbins (1956:233) commented on the unusual numbers of robins reported in the northeastern United States during the winter of 1955-56. Brooks (1956a:250) mentioned a roost near Huntington, West Virginia, that contained an estimated 5000 robins, and cited a flock of 2300 near State College, Pennsylvania. He also pointed out that an exceptionally heavy crop of wild grapes and of fruits of the flowering dogwood (Cornus florida L.), among others, resulted in a large number of wintering robins.

Figure 4. Robins observed at a roost in Highland Park, Pittsburgh, during the winter months from 1955 to 1957. Dots represent dates of observation.


1955
1955-6
1956-7
ROBINS
600
500
400
300
200
100
Nov. 1
DEC. 1
JAN. 1
FEB. 1
MAR. 1
APRIL 1

Cooke (1884:105) writes that the distribution of this species during the winter depends entirely upon the food supply.

From Figure 4 it can be seen that many robins left the area by late January in 1956. No correlation between temperature and numbers of robins was evident. However, by this time the food supply may have been generally depleted over the Pittsburgh area. On January 27, 1956, I found a flock of some 50 robins in Area 2, but within three to four days the supply of mountain ash fruits was exhausted, and I recorded few robins thereafter until March. On March 16 there was a particularly heavy snowfall, which accumulated to approximately nine inches by the end of the day. When the snow was beginning to fall in the early morning, I counted 38 robins in one backyard where food had been provided. On March 17 and 18 about 10 were found here by the Townsends, and on March 19 I found only 4 in the entire study area. Food was available in at least two backyards, and if the robins had remained in the vicinity, it seems likely that they would have visited the food supplies. Speirs (1956:24) points out that severe frost or snow may make soft fruits and soft-bodied invertebrates inaccessible, and that as a result robins move to parts where other suitable food items are available.

From data gathered during the 1938, 1939 and 1940 Christmas Bird Censuses and from a study of 405 banded robins, Speirs (1953:176) found that the area of greatest winter concentration lies between the latitudes of 30° and 35° N., with extensions northward into eastern North Carolina and central Tennessee and southward into the peninsula of Florida and into the wooded regions of southeastern Texas. It is interesting to note that during the winter of 1955-56, when robins were common in the northeast, there was a scarcity of these birds in the Carolinas (Robbins, 1956:233).

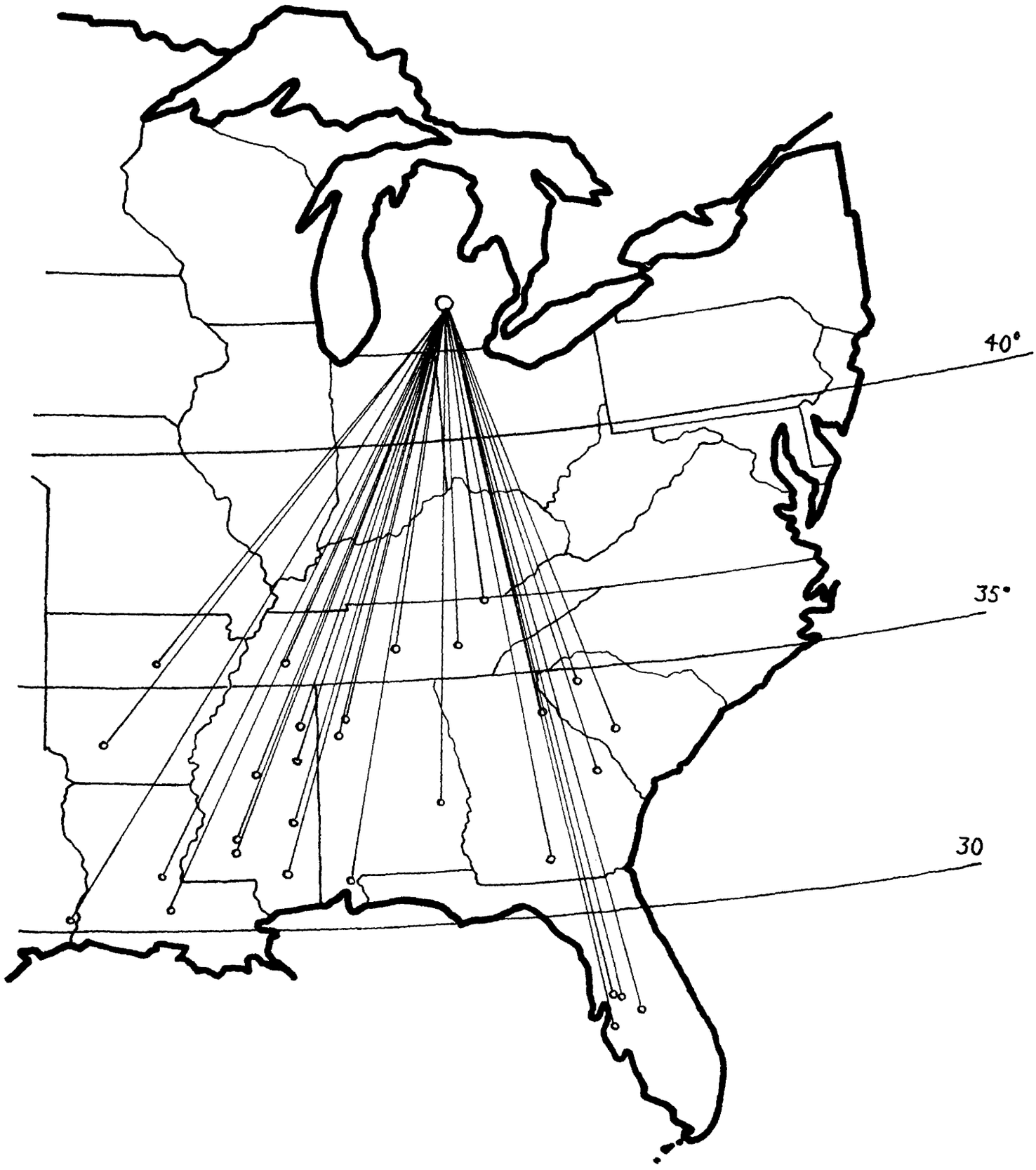
Speirs' conclusions are verified by 30 foreign recoveries of robins (Figure 5, Table 3) banded at East Lansing from 1925 through 1942. With one exception all of them were between November and March. Of the 29 recoveries during the late fall and winter, 20 (69 per cent) were between the latitudes of 30° and 35° N.. These records show a rather wide spread, but a number of them are almost directly south of East Lansing.

Migration

For the Pittsburgh area, Todd (1947:235) gives the average arrival date for spring migrants as February 22. The first robins recorded in my study areas in Pittsburgh from 1954 through 1957 were on February 21, February 14, March 3 and February 18 (1957 record by Edwin Graff) respectively, with February 21 as the average. The data from the roost in Highland Park show a gradual increase in robins after February 13 in 1955, March 3 in 1956 and February 26 in 1957. These dates coincide well with the dates of arrival in the study areas. All of the first robins in the study areas were males. A similar tendency for males to arrive on the territory earlier than the females was observed by Speirs (1946:38) at Urbana, Illinois, in 1941, and by Young (1951:9) at Madison, Wisconsin, from 1947 through 1949. Nice (1933:157) records a male which arrived at Columbus, Ohio, in 1932 and in 1933 on February 10 and January 25 respectively; his mate did not appear until March, however.

In southern Michigan the first spring migrants are often noted in early March. Wallace (1946:163) writes that in 1946 there was a flood of migrants during the first days of March. In 1947, however, there were only scattered individuals present during that part of the month; otherwise the robin was not found until March 19-20 or later (Black and Wallace, 1947:171). In 1945 it was first recorded at East Lansing on March 5 (Wallace, 1945:117),

Figure 5. Foreign recoveries of robins banded in East Lansing, 1925-1942.


40°
35°
30

and in 1952, on March 7 (Wickstrom, 1952:87). On March 8, 1955, Ruth Durkee observed the first robin in Area 3. In other years the earliest migrants may arrive in late February. On February 25, 1957, I observed a male and a female in a residential area of Lansing.

When robins first return in March and April, they are likely to be found feeding together on large expanses of lawns, in city parks and on golf courses. On March 31, 1955, no robins were found in the backyards of Area 2 when I walked through it between 10:15 and 10:30 A.M., but at 10:35 over 10 individuals were seen feeding in the nearby park. On April 7, I saw over 20 feeding in the same park, and in a number of cases a male and a female were near each other. In the spring of 1957, I made similar observations in a Lansing city park.

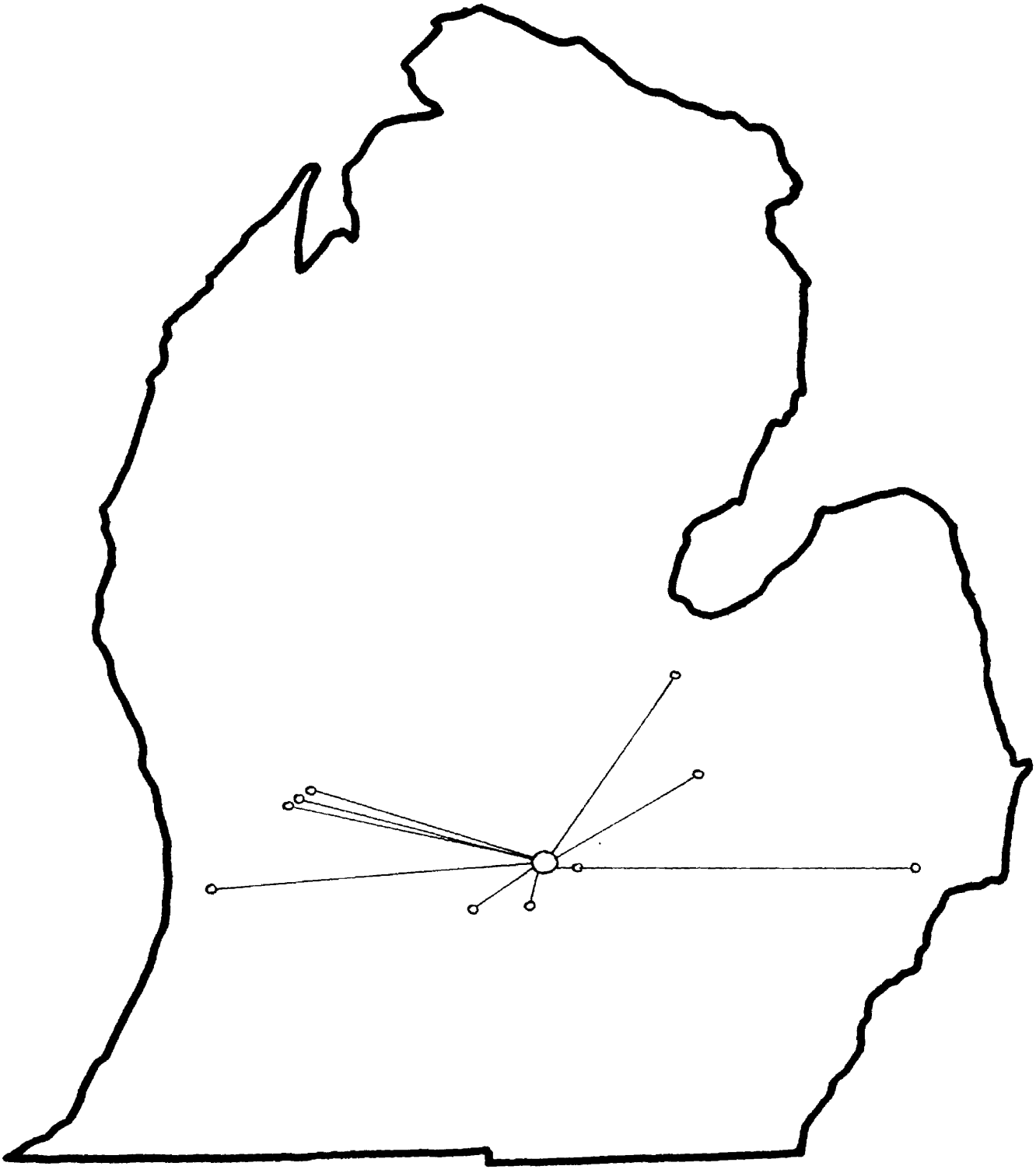
In the fall most robins leave western Pennsylvania during October, the last by November 10 or November 15 (Todd, 1940:437). The data gathered at the roost in Highland Park in 1955 show a gradual decrease from November 14 until December 17 after which the phenomenal influx of robins occurred. Bernard Van Cleve reported that the winter population in 1953 seemed more or less stabilized by November 21, and in 1956 by November 22. Wood (1951: 331) writes that for the most part the robin leaves the Lower Peninsula of Michigan in October. On October 16, 1954, I visited a wooded area in East Lansing, which had been used by robins as a feeding ground in the summer months. During a two-hour period five were found.

It is interesting to note that among the foreign recoveries listed in Table 3 there are some from late February and March when the first robins are appearing in the Lansing area. Return records of robins to Madison, Wisconsin, indicated a variation in the arrival dates of individuals (Young, 1951:9). This was true of two robins that returned to the Pittsburgh study

areas for two successive years after banding. In 1955, I first saw F3 on April 8, and in 1956 on April 7. In 1956, I recorded M5 on March 3, and in 1957 Grace Townsend observed him for the first time on February 25.

Post-breeding movements preceding the autumn migration have been noted by Farner (1952) and by Speirs (1956). In his account of the avifauna in Crater Lake National Park, Farner (1952:104) writes of the fairly pronounced movements of robins into higher altitudes after the breeding season. In the majority of cases, post-breeding shifts take robins in a northerly direction where wild fruits, water, and cool temperatures prevail (Speirs, 1956:24). Food supply undoubtedly plays a major role in determining the post-breeding movements. In both the Pittsburgh and Lansing areas, woodlots proved especially attractive in the post-nesting season. Some of the banding recoveries in Michigan (Figure 6, Table 4) may well represent such movements.

Figure 6. Michigan recoveries of robins banded in East Lansing, 1928-1942.



HOSTILE BEHAVIOR

As the breeding season progresses robins spend more and more time within a restricted area, known as a territory, and an intolerance toward other robins is often exhibited. Young (1951:11-13) lists six threat postures and displays that are used by both males and females to intimidate other individuals: "tail lift", "crouch", "attack run", "normal posture", "attack flight", and "pushing". Others to be considered here are tail flicking, gaping, bill snapping, and upward posture. Sometimes these displays are effective against intruders; at other times actual combats ensue. Fighting consists largely of the participants flying at each other as they move vertically into the air. Young (1951:14) writes that the birds strike each other mainly with the bill. In some instances it appears as if the feet are used also. Sometimes combats may be very vigorous. On April 8, 1955, during a fight between F3 and an intruding female, I saw one bird forced on her back briefly, after which both flew at each other again.

In the early spring, when territories are being established, it is a common sight to see two robins hopping over the ground, now almost side by side, then apart, then side by side again. This behavior is "pushing". On March 10, 1955, two males were engaged in such a display near Area 2. At intervals the bird that lagged behind a few inches rushed ahead, and the participants then flew at each other, rising above the ground. After the combat, they moved away in opposite directions, only to come back together again. This display appeared quite formalized, like a dance. Whether there is any significance in the locations of the birds is not known. On April 8, 1955, I observed three "pushing" displays between F3 and an intruding female,

each of which ended in the former's favor. In moving over the ground, F3 was usually behind.

It is interesting to note the "pushing" reactions of the male of nest 57-13 toward a dummy. On June 7, 1957, the dummy had been in the territory, approximately 40 feet from the nest, for about 40 minutes before the male came upon it, quite by accident. He walked around the dummy several times, attacking it from behind twice, even removing a tuft of feathers from the rump. After five minutes he flew to a nearby tree. Tape recordings of call notes were played, and at once the male flew back and landed about one foot behind the dummy. He moved to the front and then back again to the rear of the stuffed bird, as if "pushing" were to begin. But no movement appeared on the part of his "opponent", and the male left within two minutes.

Of the 24 "pushing" displays recorded in my field notes, 19 resulted in actual combat. Fifteen of these were timed, and they varied from 2 to 20 minutes, with an average of 7.7 minutes. In five displays between two males, one or two non-participating females were nearby; in another case when a male and a female were "pushing", a second female was in the background; and on one occasion when two females were the participants, two males were within a few feet. Following this behavior in two instances, birds picked nervously at pieces of grass, and another time at bits of sunflower seed. Such incomplete feeding movements during territorial disputes are called "substitute feeding" by Tinbergen (1939b:223).

On April 27, 1957, in a small woodlot in Lansing, I observed "pushing" in the trees. The birds moved from one limb to another in much the same pattern as has been described for the behavior on the ground. A similar arboreal version was noted in Area 1 on April 14, 1956. An unbanded male flew to a large sycamore and sang; at once M4 flew to the tree, perching

about two feet from the intruder. The two then proceeded to move over the branches, the unmarked bird running almost the entire length of some. Lack and Light (1941:50) record a hopping and running display by the blackbird (Turdus merula), which may take place either on the ground or in the trees.

Young (1951:12) writes that during the "attack run" a robin, often with lowered head, dashes suddenly toward another individual. On March 16, 1956, the day of the heavy snowfall mentioned previously, I found this behavior to be the commonest threat display. At times it culminated in combat and in short aerial pursuits. Robins may gape during the "attack run". At two bird baths in Areas 1 and 3, a robin on the rim or in the bath sometimes rushed with open bill at other birds, causing them to retreat. On August 6, 1954, in a wooded area near East Lansing, a young of the year perched on top of a trap and challenged other robins by rushing at them with open bill. In Area 3 on July 14, 1955, a young robin attempted to drive house sparrows from a similar trap by charging the smaller birds with lowered head and open beak.

When dashing at another bird, the robin may snap its bill as well. In Area 1 during the period of heavy snow in March, 1956, a female more or less dominated a small porch outside of my apartment where food had been placed. When other robins (including a male which later may have been her mate) or house sparrows flew to the landing, she ran at the intruders, snapping her bill. I recorded similar behavior on the part of the young robin at the trap in Area 3 on July 14, 1955. In an attempt to drive away the house sparrows it not only rushed at them, but repeatedly jumped from the trap to the ground, snapping its beak.

Bill snapping was directed against me several times. On May 3, 1955, when F1 was flushed from a nest containing young, she flew about six feet from the nest and snapped her bill for about one-half minute. This was the

usual behavior by the adults of nest 55-9 when it contained young, as well as later when the nest had been damaged and the young had disappeared. Lack and Light (1941:50) regard the bright color of the bill and of the inside of the mouth in the blackbird as threat colors. It would seem that this would be true of the robin as well, as both the outside of the bill and the inside of the mouth are bright yellow.

Young (1951:12) noted labored "attack flights", which precede aggressive action and are rather indistinctive at times. I recorded this display on several occasions, but I also had innumerable observations of robins flying rapidly toward others, many resulting in chases and combats.

I have two records of the "tail lift". Young (1951:11) writes that during the "tail lift" the head is depressed, the rump elevated and the tail held stiffly upward at about a 45-degree angle. While displaying in front of an intruding male on May 28, the male of nest 57-13 lifted his tail, which was spread out somewhat, and turned in half circles, always coming back to face the other robin. The displaying bird also gaped when it was face to face with the other, and call notes were given. This behavior lasted about one minute and ended with the birds flying in different directions.

Flicking the tail up and down may be used in conjunction with other threat displays or by itself. Frequently wing flicking accompanies this hostile form of behavior. On April 11, 1956, in a "pushing" display between F1 and an unmarked female, there was much tail flicking, especially by F1. Later another unmarked female, also flipping her tail, flew near F1, which moved quickly to another part of the lawn.

Young (1951:11) writes that a robin often crouches when approached by a strange individual. I made four observations of this. On April 26 the male of nest 57-3 moved to a tree and perched about 15 feet above the ground

where the female of nest 57-6, accompanied by her mate, was gathering nesting material. The 57-6 male then assumed a crouching position for approximately three minutes until the 57-3 male left the area. This behavior was noted on March 16, 1956, in Area 2 when one male approached another which was feeding on a piece of bread; at this point the latter crouched on the ground, extended his head forward and snapped his bill. On April 13, when I was examining the eggs in nest 55-1, the female crouched nearby for about three minutes, immobile and with neck outstretched.

I saw one example of upward posture in connection with aggressive behavior. On March 11, 1956, after a combat between M2 and M3, M2 flew to a shrub and briefly pointed his bill into the air, the head and the beak more or less in line with the dorsal surface of his body.

As has been noted in some of the preceding examples, threat displays are not restricted to the period of establishment and maintenance of the territory, but may be used in other situations. In communal feeding areas robins are somewhat scattered, but if one comes too close to another, combat and chase may result. On March 16, 1956, in a backyard where 38 robins were feeding, it appeared that one would not tolerate another closer than one foot on any side. From observations made on flocks of migrant robins feeding on the campus of the University of California, Childs (1949:102) concluded that they spaced themselves evenly, reaching a maximum density of about .07 birds per square yard.

This intolerance was observed on July 15, 1955, on the Michigan State University campus, when four adult robins were spaced on the edge of a roof at intervals of about five feet. One individual moved between two others, and immediately a combat resulted. On August 29, 1955, at the Highland Park roost in Pittsburgh, 20 robins were perched on a wire; the distance

between any two birds was at least one foot. Emlen (1952:189) observed that cliff swallows (Petrochelidon pyrrhonata), when perched in linear arrangement on wires, were dispersed so that there was a space of at least four inches between individuals. He postulates that the space between birds may be related to the distance a bird can strike without shifting its feet.

From his study of the genera Catharus and Hylocichla, Dilger (1956) describes displays similar or identical to the ones found in Turdus migratorius: tail flicking, wing flicking, gaping, bill snapping, upward posture, "horizontal stretch", and "horizontal fluff". The attitude assumed by the robin during the "attack run" appears to be identical to the "horizontal stretch", and the "crouch" identical to the "horizontal fluff". A careful comparison of the hostile forms of behavior found in Turdus with those found in other genera of Turdidae would make an interesting study.

MATING

Pair Formation

At first the members of a pair engage in activities which serve to attract and stimulate each other. Some species engage in courtship feeding. The male usually feeds the female, which adopts an attitude and gives calls that are almost identical with those of a young one begging for food. Lack (1940a:169) states that courtship feeding seems to be absent in the genus Turdus. Young (1955:330) reports that observations on courtship feeding in the robin are inconclusive.

I made observations that suggest the existence of some relatively undeveloped form of courtship feeding in the robin. On May 7, 1957, in Area 3, two birds were perched about eight feet apart, the female slightly below the male; she gave call notes very similar to the begging calls of the young. The female moved toward the male, which retreated a few inches. At this point she flew from the tree with the male following her. On April 18, after an unsuccessful attempt at copulation on nest 54-6, the female, followed by the male, flew to the ground where she squatted and gaped as a young bird begging for food. On April 3, 1957, in Lansing, I saw a male squatting about four feet in front of a female. Three or four times he moved toward her and each time that he stopped, he crouched and gaped. He then flew to a fence post, still gaping, but there was no reaction on the part of the female. On April 22, in the same area, I observed a male gaping in front of a female gathering nesting material. The female rushed at the male, but he continued the begging behavior and did not retreat. Both then left the yard.

Lack (1940a:170) writes that in many species in which courtship feed-

ing occurs, the male also feeds the female on or near the nest during incubation. I observed this at nest 54-6. On May 3, at 6:54 P.M., the male arrived with food; the female turned around in the nest and raised herself in order to take the food. The male left at once, only to return at 7:04 when he fed her again. Common (1947:240), Howell (1942:566, citing McClanahan, unpublished manuscript) and Samson (1923:106) report similar behavior. Brackbill (1944:139) also reports it, but he did not see any food pass between the pair.

On July 14 the male was sitting on nest 56-24 when the female returned. He extended an open bill and she placed her beak in his, after which he moved to the nest rim, then to a nearby shrub. Brackbill (1944:139) noted a similar display during the second brood of the pair mentioned above. In this case the female made no response until the male pecked at her closed, empty bill. When the female placed her beak in his, the male drew his mandible down over hers a number of times. Lack (1940a:170) observed a captive male English robin begging for food from a captive female. The conclusion that he draws is that behavior normally found in one sex is latent in the opposite sex.

On April 15, when the female was making one of many trips to the 54-6 nest site with materials, the male flew at her and chased her into a clump of shrubs. Two minutes later she reappeared and began collecting nesting materials again. It would seem that such behavior is best classified as a courtship chase.

In the spring I observed chases at communal feeding grounds but whether these were courtship chases or due to infringement upon another's feeding site was not determined. On April 1, 1954, on a golf course near Area 1, one robin chased another from the ground to an oak tree. This caused much excitement in a group of 19 robins feeding at this end of the

course, and about six of them flew into the tree and clustered around the two. There was much commotion among the robins on the ground as well.

Howell (1942:537) and Young (1955:333) found that members of a pair tend to remain together during the entire nesting season. This was also true in the present study, but an interesting exception was provided by M1 and F1 in 1956, which had been mates during the nesting season of 1954. After they abandoned nest 56-6, M1 paired with an unbanded female, and Grace Townsend reported F1 about 200 feet northeast of nest 56-6.

Since robins are known from banding to return to the same general area each year, it is possible for the same birds to pair in successive years. There is no evidence of any bond existing between the sexes after the nesting season, however, and it seems to be purely a matter of chance whether the same male and the same female will remate in consecutive years. Young (1955:334) found one pair of robins remating in two successive years, and Nice (1944:3) observed a pair remating in three succeeding years.

Before and during nesting the members of a pair frequently feed together. On March 31, 1956, M4 and his unmarked female fed together for one hour and 15 minutes over approximately one acre of land. From observations made at communal feeding grounds in the early spring, it would seem that pairs may move together to these areas at intervals throughout the day.

Copulation

I made few observations on copulation. However, I saw several unsuccessful attempts at and away from nests.

On July 1, 1956, a pair feeding on the ground in the Michigan State University Horticultural Gardens moved to a nearby tree, and while the male perched on a limb below the female, he gave a soft whisper song. On four occasions he attempted to mount her, but each time she flew to another limb

of the same tree, uttering plaintive call notes. The male left but soon returned to the female. Three times he approached her, gave a whisper song, and three times he copulated with her successfully. During coition the male fanned his wings vigorously. Young (1955:333) records the same wing-fanning behavior. After each mounting the female called slowly. The three copulations took place over a span of about two minutes. The female remained quietly in the tree for about three minutes, and the male made several short flights with labored wing beats. When the female left the tree, the male followed her.

On April 26, 1957, in Area 3, after an attempted coition, the male flew to a perch and sang. It is interesting to note that no display preceded this or the other unsuccessful attempts at copulation.

Unusual copulatory behavior was noted on July 21, 1956, in a woodlot of Area 3. An adult male feeding in the leaf litter came to a piece of wood about five inches long and approximately one-half inch in diameter. First he squatted down on one end of the stick with much wing fanning; then he made the same copulatory movements at the other end of the stick. This behavior was repeated 12 times in about three minutes. Before the male finished fanning his wings he usually touched the opposite end of the stick or the ground with his bill. Atypical sexual behavior has also been reported by Brackbill (1947b:116) and Young (1949b:94; 1955:332).

THE SONG CYCLE

Description of Songs

Two types of song are given by the robin: a subdued whisper song, and a loud carolling which is heard much more frequently than the soft song. Following is a description of the carolling song.

> The song is long-continued. It consists of loud, clear, whistled phrases of two or three notes each, with short pauses between the phrases. The phrases are put together in groups of three to eight (usually four or five), with slightly longer pauses between these groups. Rather rarely a bird may repeat a single phrase over and over, eight or ten times in succession. Usually there are only two or three different phrases in one group, a single phrase being frequently repeated two or three times; but other phrases appear in subsequent groups, so that the number of phrases used by one individual may be eight or ten. The phrases are likely to be different in another individual, and study of the characteristics of each individual Robin will enable a student to recognize that individual and follow its movements from day to day, and often to mark its return to the locality in subsequent years. (From: A GUIDE TO BIRD SONGS by Aretas Saunders. Copyright 1935, 1951 by Aretas A. Saunders, reprinted by permission of Doubleday and Company, Inc.)

During the course of this study I found three males with unusual phrases in their songs. In the spring of 1954 a male in Area 1 had a distinctive phrase that can best be described as "chi-chi-bu". On a brief visit to East Lansing in July, 1955, I heard the male of nest 55-21 repeating "co-rup-bu" over and over, each part of the phrase a bit higher in pitch than the preceding one. During the spring and summer of 1957 a male in a suburban part of Lansing gave "he-ba-he-ba-he-ba-he-ba" many times in the course of his singing, each part a bit lower in pitch than the preceding one.

In 1932, in Allegany State Park, New York, Saunders (1938:81) recorded a very distinctive phrase in a robin's song that sounded like "heeoway". Baerg (1951:121) writes that at times a male is able to mimic another

species quite well; he cited an instance when a robin was heard crowing like a bantam rooster.

Similar in form to the carolling song, the whisper song is not as loud, and it is higher pitched. Frequently the bill is closed when this song is given.

Song in Relation to the Breeding Cycle

The whisper song is heard frequently in the early spring when territories are being established and pairing bonds are being formed, but it is given late in the nesting season as well. Howell (1942:540) believes that it plays an important part in courtship as well as serving as a threat in territorial disputes. Young (1951:15) states that this song serves primarily as a threat, but that there is a possibility that it is an indicator of excitement and would be heard during both courtship and combat. A record of a male robin singing the whisper song before copulation has been given earlier. On April 16, when nest 54-7 was under construction, I heard the male giving the whisper song when only the female was nearby. It was given by males near nests 54-45 and 57-22 on July 5 and June 15, respectively, while the female was incubating. Thus it would seem that this song definitely has a dual purpose: functioning in the establishment and maintenance of the pairing bond as well as serving as a threat.

On the other hand, the role of the carolling song is difficult to evaluate. Young (1955:331) suggests that it may serve as an advertisement for a mate. An observation that I made on May 31, 1955, indicates that carolling may serve as a declaration of territory. Before and immediately after a successful encounter with F3, the male of nest 55-7 sang loudly. In the spring it is heard shortly after the first male arrives. In 1956, I recorded the first male in the Pittsburgh study areas on March 3, and the

first song on March 6. Over a three-year period at Madison, Wisconsin, Young (1951:9) noted that the interval between the arrival of the first males and the first song varied from 3 to 13 days.

In my field notes I have records of 126 songs which can be related to three stages of the nesting cycle, as shown below.

Stage of Nesting Cycle	Number of Songs
Incubation	85
Feeding young in the nest	28
Feeding young out of the nest	13

From the above data it is obvious that song decreases after the eggs have hatched. Saunders (1938:78) writes that male robins in full song do not appear to be nesting, and that after nests are established and incubation begins, the song is not given as frequently. Howell (1942:542) noticed no marked decrease in the singing until the young hatched. Young (1955:331) heard the song at all stages of the breeding cycle, but he found a decrease after pair formation.

When the female was incubating, the singing male was often perched near the nest. I heard five different males singing a total of 30 songs, either when they were perched on the nest rim or when they were actually sitting on the eggs. Most of these songs were incomplete. On May 31 the male of nest 57-13 gave 10 short songs from the nest rim during one and a half hours, for a total of 35 seconds of song. In the same period, nine songs were given near the nest, for a total of two and a half minutes. Later in the afternoon of the same day during a 45-minute interval, this same male sang four times from the nest rim, for a total of 13 seconds. Two songs were given when the male was away from the nest.

Songs were recorded from parent birds after their young left the nest. On June 1, in the vicinity of nest 57-2, the male fed a young that was al-

most independent, then perched beside the offspring and sang, even though the young robin gaped and begged for food.

Songs are often given at communal feeding grounds. On April 12, 1954, in a woods adjacent to a golf course, I heard four males within 50 feet of each other in full song at different times. Five minutes later another male sang in this area, and as he was singing a second male flew to the top of the same tree, displacing the first male and singing in his place. On April 19, 1954, one robin was in song on the golf course, with five other robins feeding closeby. Stoner and Stoner (1952:146) state that early on cool April mornings the robins congregated in Washington Park, Albany, New York, produce a bedlam of song. In such examples, song is probably a response to the social stimulation of the flock.

A tape recording of the loud carolling, which lasted for about two minutes, was played in the territories of the 57-13 and the 57-16 pairs so that I could make observations on their responses. Thirteen tests without a dummy robin and eight with a dummy were carried out in late May and early June when the two nests contained eggs and young respectively. No reaction was evident except on three occasions in the 57-13 territory in late May when the male sang for a few seconds after the recording had been played. Again, if a purpose is to be assigned to the song given under these conditions, declaration of territory seems to be the only possible choice.

When I examined nests containing eggs or young, the adults almost invariably gave alarm notes, some of which were tape-recorded. These call notes were played back eight times in the territories of the 57-13 and the 57-16 pairs. Three times when a dummy was present in the territory, the male of nest 57-13 broke into song after the recording. This is probably best classified as singing under stress. Tinbergen (1939a:79) writes that birds which have just escaped a predator or are alarmed will give a

song of great intensity. Another probable example of song under stress was observed on June 12 at nest 57-19. I was near the nest when the male appeared with food; he gave a series of call notes, then flew to a roof and sang.

Daily Cycle of Song

The awakening of birds in the early morning has received the attention of several workers. In the case of the robin, call notes may be the first signs of awakening; at other times it is the carolling, which gradually swells into a dawn chorus. In East Lansing, Fisler (1956:47) found that the mean awakening time for the robin from March 7 through April 30 was 61.6 minutes before sunrise; from May 1 through July 30, it was 63.5 minutes before sunrise; and from August 1 through November 30, it was 25.9 minutes before sunrise.

From some observations in the White Mountains in New Hampshire, Wright (1912:314) states that the dawn chorus continues for 45 to 50 minutes. Howell (1942:541) writes that it lasts 30 to 45 minutes. This is true during the height of the nesting season, but as nesting activity declines, the dawn chorus also declines. After the dawn chorus few songs are heard for about an hour. The following records are from my field notes.

Date of Observation	Place	Beginning of Chorus	Ending of Chorus	Duration of Chorus in Minutes
June 6, 1957	Lansing	3:45 A.M.	4:35 A.M.	50
June 21, 1957	Lansing	4:00	4:35	35
July 5, 1954	Lansing	4:30	4:50	20
July 8, 1955	Pittsburgh	4:20	4:35	15
July 9, 1955	Pittsburgh	4:20	4:35	15
July 24, 1954	Lansing	4:40	4:45	5

At sunset there is another general song period. In their study of the evening song of the robin and the mockingbird (Mimus polyglottos) from February 1 to May 7, 1929, Shaver and Walker (1931:14) found very high positive correlations between the time of sunset and the time of the ending of evening song. I noted that on the same date in different years, song activity ceased at about the same time when skies were clear. On the other hand, I found that cloudy skies resulted in an earlier cessation of song, as shown by the following observations.

Date of Observation	Place	Sunset	Time of Last Song	Sky Cover
April 2, 1954	Pittsburgh	6:45	6:56	cloudy
April 2, 1956	Pittsburgh	6:45	7:08	clear
July 7, 1954	Lansing	8:11	8:30	cloudy
July 7, 1957	Lansing	8:11	8:43	clear
July 17, 1954	Lansing	8:06	8:30	clear
July 17, 1957	Lansing	8:06	8:33	clear

Night singing has seldom been reported in the robin. Speirs (1946:80) reports robins singing about 2 A.M. on moonlight nights in April, 1941, in Urbana, Illinois. Mr. H. E. McClelland of Pittsburgh reported that on April 5, 1952, at 12:30 A.M. a robin sat on a wire under a street light and sang for several minutes. Thereafter, every morning for 10 days, rain or otherwise, he observed a robin singing on this same perch from 4:00 to 4:10 A.M.. However, Allard (1930:459) writes that lights of city streets appear to have little effect upon the activities of birds.

Song Perches

I have heard robins singing on perches ranging from the ground level (4 records) to a height of 60 feet. On June 7, 1957, I noted a robin sing-

ing a few phrases in flight approximately 20 feet above the ground. The only other record of a flight song was made by Brackbill (Bent, 1949:34).

In his territory a male uses a variety of song perches. Sometimes one tree or structure is used more frequently than other ones. On May 31, during a period of 135 minutes, I heard the male of nest 57-13 sing from four different trees on 24 occasions and once from a mound of soil. The four trees were used 14, 5, 3 and 2 times respectively. The nesting tree was used most frequently, and all of the nest-tree songs were given from the rim of the nest, which was 13.5 feet above the ground. The other perches ranged in height from 10 inches to 15 feet.

During a 60-minute period on June 1, the male of nest 55-7 sang once from each of three perches and four times from another. The range in height of these perches was from 15 to 40 feet. From July 24 through August 3, the male of nest 55-22 sang 10 times from six different trees and other structures. Two were used three times, while the other four were used once. The perches showed a wide variation in height, with the lowest 10 feet above the ground and the highest about 60 feet.

Song Cessation

As the nesting season approaches an end, and the robins start the postnuptial molt, the song ceases gradually. The first marked decline in the number of daily songs is the beginning of cessation; general cessation marks the end of singing for the species as a whole, even though a few individuals may sing after this date. In the summers of 1955 and 1956, I studied this phase of the song cycle in Pittsburgh and East Lansing respectively by counting the number of songs as I walked over a definite route. In Pittsburgh the observations were made between 5:30 and 6:30 A.M. in Area 1, as well as in a suburban area and a cemetery southwest of the study

area; in East Lansing the observations were made between 6:30 and 7:30 A.M. in Area 3 and an adjoining portion of the Michigan State University campus. The length of the dawn chorus could be used to advantage in a study of this sort.

The data are shown in Figures 7 and 8. Both studies present a similar pattern. Little correlation with temperature fluctuations can be seen, except possibly at the beginning and the end of the study in 1955, and at the beginning of the study in 1956. Despite the differences in temperature in 1955 and in 1956, a definite trend in cessation of song was evident in both years during the first part of July.

Song activity was much more pronounced during the day in July, 1956, when the temperatures were low, than in July, 1955, when the temperatures were very high. Bicknell (1884:127), Fry (1916:30), Hillstead (1944:17), Nice (1943:112) and Vaurie (1946:165) agree that climatic extremes --e.g., heavy rain, drought -- have a depressing effect upon song. On the morning of May 19, 1957, however, when rain was falling heavily, I heard one robin in song while it was foraging in a garden.

In Table 5 the data collected in 1955 and in 1956 are compared with those collected by other workers. The dates for the beginning of song cessation in this study are earlier than those in other localities. Fry (1916:32) noticed a scarcely perceptible decline on July 7. This is in contrast to the obvious one that I recorded. But by the first of July nesting activity is past its peak, and it is not surprising to find a decline in the song, regardless of climatic factors. The times of the last song do not differ widely. Time was spent in the field after August 7 in both 1955 and 1956, and no songs from adults were heard for the remainder of the month. In 1953 and 1954 few data were collected in East Lansing, and no trend of song cessation can be shown. In these years I

Figure 7. Song cessation of the robin at Pittsburgh in 1955.

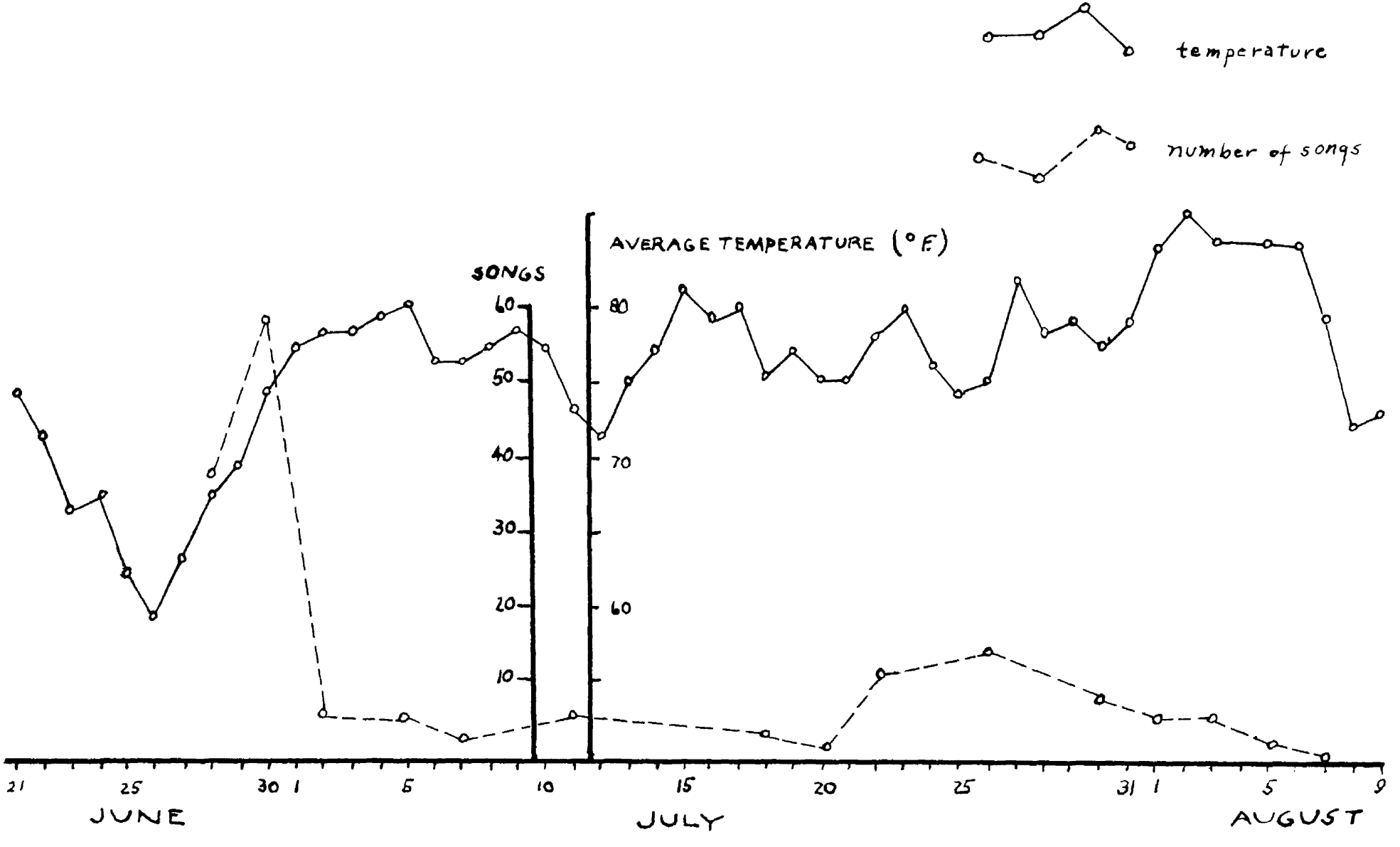
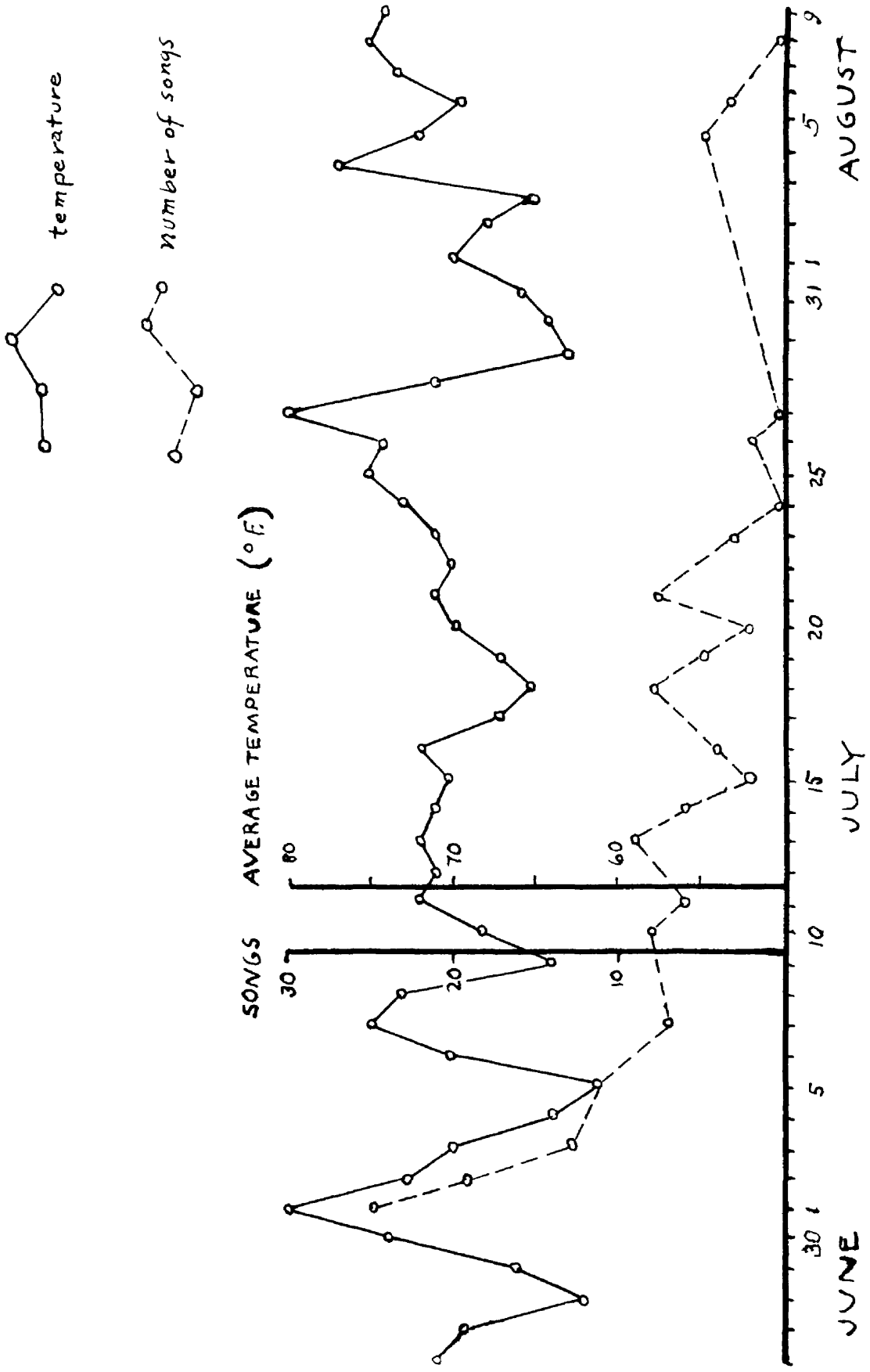

temperature
number of songs
AVERAGE TEMPERATURE (°F.)
SONGS
60
50
40
30
20
10
80
70
60
21
25
30
1
5
10
15
20
25
31
1
5
9
JUNE
JULY
AUGUST

Figure 8. Song cessation of the robin at East Lansing in 1956.


temperature
number of songs
SONGS
AVERAGE TEMPERATURE (°F)
30
20
10
80
70
60
JUNE
30
1
5
10
15
JULY
20
25
31
1
5
9
AUGUST

heard the last song of the summer on August 7 and August 11 respectively. These last songs are incomplete, brief and feeble in comparison to the songs given during the nesting season.

The period of song cessation coincides with the beginning of the post-nuptial molt. In 1955, in Pittsburgh, I saw the earliest molting robins on June 26 and 28 when at least one tail feather was missing on both individuals. By mid-July molting robins were quite common. On July 14, I observed several with missing rectrices in East Lansing, and on July 24, I noted that the rectrices of F4 in Area 1 were very worn, with at least two missing. In August I found molting individuals every day.

Resumption of Song in the Autumn

After the cessation of song in the summer, singing is often resumed in the fall. Bicknell (1884:127) noticed a secondary song period in the last days of September or in October. In two years he heard no robin in song later than November 8. From data collected over a period of 30 years, chiefly in southern Connecticut, Saunders (1948b:376) writes that he heard this species singing in the fall in 19 different years. The average dates of this secondary song period were from September 28 to October 17; the earliest was on September 13, 1930, and the latest on November 6, 1946. Stover (1912:171) observed that the singing of robins of the year began early in September, reaching its height in the fall.

My earliest record of an immature robin in song was on August 19, 1955, at the roost in Highland Park in Pittsburgh, and the earliest record of an adult renewing song was on September 3, 1955, also in Pittsburgh. Another early one was on September 7, 1953, when one song was given in a woodlot near Area 1. From September 15 through October 8, 1957, robins sang practically every morning at approximately 6:30 A.M.. Many of these

vocal efforts were incomplete and feeble. Following is a listing of the earliest and last songs recorded in the Pittsburgh area. In 1956 no fall singing was noted in East Lansing.

Year	Earliest Fall Song	Last Fall Song
1953	September 7	November 10 (E. H. McClelland)
1954	October 14	October 14
1955	September 3	October 9
1957	September 15	October 8

Another late song was heard by Dorothy Auerswald on November 12, 1953, near Ligonier, Pennsylvania. With some resumption of song in September and October, it is not surprising to find that the molt is largely completed by this time. All robins observed on October 1, 1955, had apparently finished the molt.

Songs have also been recorded during the winter months by other workers. Black (1932:16) writes that there was considerable singing at a winter roost in Arkansas, which he had under study from October 22 to December 16, 1928. On several occasions Wright (1902:198) heard songs given by robins in a flock on January 7 and 8, 1902, near Cambridge, Massachusetts.

CALL NOTES

The common call notes of the robin are listed in Table 6 with the conditions under which they were recorded. However, one call note may vary in volume, in pitch, and in rate during a time interval, depending upon the stimulus which prompted the call. If call notes are to be described, words and syllables must be used, and it is not surprising to find different interpretations for the same call note in the literature. In considering the call notes I have listed first the term which I think best represents the call.

I recorded the "yeep" call (Saunders, 1951:136) more frequently than any other. This is the "chirp" of Howell (1942:544) and the "pleent" or "plint" of Bent (1949:36). Howell writes that when this call is given loudly, it functions as an alarm note. I observed this many times, but it may be given under a great variety of conditions. When young were taken from nests for banding and/or weighing, this call was always given by the adults. Once at nest 56-4 and several times at nest 54-44 it was noted that the "yeeps" stopped for a few minutes after I left the nesting territory with the young. When I reappeared, the calls were resumed, and when the young robins were removed from a container for transfer back to the nest, the call notes increased in volume as well as becoming higher in pitch. The 55-23 nestlings responded to "yeep" calls given by the parent birds by crouching into the nest. In another case a young robin that had left the nest became motionless when the calls were given.

A count of the "yeeps" was made at nest 57-16 on June 7 when I alarmed the female by examining the young. During one minute 69 call notes were

given, and 58 in another. Howell (1942:545) counted "yeep" calls given by a female which had young out of the nest. In five one-minute counts the number of call notes ranged from 49 to 56. These are in contrast to a count that I made on a robin feeding with a flock in a wooded area on August 5, 1953, when 21 calls were given in one minute.

While sitting on nest 57-13 the male gave no reaction to a tape recording of "yeep" calls. However, when the female returned, he left, giving loud "yeep" calls.

At dusk the robin frequently gives "yeep" calls interspersed with songs and other call notes, among which is the laughing call. It has been described as "ha-ha-he-hi-hi-ha-ha" by Saunders (1951:136), "he-he-he-he-he" by Bent (1949:36), and as "chir" or "chee" repeated from 5 to 10 times by Howell (1942:545), who adds that the call is given under a number of conditions but that it may be associated with sociability or a sense of well-being.

The laughing call may be given when danger is near or when one robin intrudes into another's territory. In one instance parent birds gave this call when I approached the nest, and immediately the young crouched low, responding in the same manner as they had to "yeep" calls. During two territorial disputes the resident bird gave the laughing call when it first noted the intruder, which answered with the same call. However, the "yeep" notes were more commonly used as an alarm call. On March 28, 1954, the laughing call and the "skeet-urp" call were given antiphonally between two robins for a three-minute interval on the edge of a golf course. Perhaps these calls indicated sociability or a sense of well-being.

In the spring some laughing calls were much reduced in volume and soft in tone. I heard this version of the call when a pair was searching for a

nest site, from the male when the female was incubating nearby, and when members of a pair separated from or joined each other. It appeared to serve as a threat also, since it was given on two occasions by the resident bird when an intruder appeared, and once by a female when she found a dummy robin at a bird bath.

The "huh" or "tut" of Bent (1949:36) was also given under a variety of conditions. When a robin was alarmed, the call was similar to sobbing. Two times the 55-23 young crouched in the nest when the parents gave this call. A combination of this call note and the "yeep" note was often given, resulting in "yeep, huh-huh-huh". On the evening of September 9, 1953, a robin gave this call as it flew from a tree on the edge of a communal feeding area in the direction of a night roost. Four others then left with this individual. That evening the call was heard several times in the surrounding trees as robins flew to the roost.

"Skeet, skeet" is another call listed by Bent (1949:36). This is the one which I interpret as "skeet-urp", a very shrill call which seems to be given at times of intense activity.

In addition to the call notes in Table 6 a few others were heard. Saunders (1951:136) lists a "eeeee" call similar to that of the cedar waxwing (Bombycilla cedrorum). I recorded this call five times, in every case from robins in flight. I heard a call not unlike the bubbling song of the brown-headed cowbird on five occasions, all at dusk, when robins were flying or were about to leave for a night roost. Perhaps this is indicative of the ability of the robin to mimic the song of another species.

Howell (1942:545) writes of a female robin giving a hysterical squeal when she was captured on the nest. I heard similar calls from a young robin when it was taken from a trap for banding, and from a parent when a

fledgling was caught for banding. On September 30, 1954, in a wooded part of Area 2, a robin gave an almost hysterical scream when it was forced to the ground during a chase.

POPULATIONS

In Wooded Areas

From the data on robin populations in Table 7, it is evident that few robins are found in forested areas. Hering (1948:54) covered 75 acres of the Black Forest in central Colorado, which was composed of a nearly pure stand of western yellow pine (Pinus ponderosa Laws.); of the nine nests found, five were on the edge of an open area. In a census of two 20-acre tracts in Latah County, Idaho, where the dominant species of the climax forest is Douglas fir (Pseudotsuga taxifolia (Poir.) Britt.), Johnston (1949:142) found no robins in the tract that had been selectively lumbered five years before and only 2.5 pairs per 100 acres in a comparatively open tract that had been logged quite heavily in the two years preceding the census.

From studies in forested areas, Kendeigh (1944:96) listed the robin as a forest-edge species that may nest in the woods if open sites are nearby. In another study Kendeigh (1948) found the robin as a breeding species in several forest communities of northern Lower Michigan. In July, 1952, when I was a student at the University of Michigan Biological Station, I made a census of the birds in a 50-acre aspen-oak-pine forest located in the same area where Kendeigh conducted his Michigan studies (Mehner, 1952). Some red maple (Acer rubrum L.) and paper-birch (Betula papyrifera Marsh.) were also present. The breeding population consisted of six pairs, of which four maintained territories on the forest edge.

In his studies of the avifauna in Crater Lake National Park, Farner (1952:104) found the robin associated with all kinds of forests. He noted,

however, that soft, moist soil must be accessible for feeding, as well as a supply of mud for nest-building.

From mid-April to mid-May in 1954, I made five censuses of a 10-acre woodlot adjoining the Mount Lebanon Municipal Golf Course in Pittsburgh. Crataegus and black cherry were the commonest species of trees, and there were a few oaks and maples. Six active nests were found, and two other pairs were present, making a total of eight pairs. Much of the feeding was apparently done on the golf course.

In Open Areas

Soft-bodied insects and earthworms are important items in the diet of the robin; hence, moist soil and open areas seem to be prime requirements. Storer (1926:265) writes that the former range of the robin in California included only those parts where damp, short-grass meadows persisted during the summer months. Formerly none was present in the Golden Gate Park, but after moisture was brought to the area by man, the robin appeared.

It is not surprising to find a high density of robins in parks, cemeteries, and suburban areas. Young (1949a:1955) found very high populations (12-19 pairs) in a 5.2-acre tract in the University of Wisconsin Arboretum where Thuja furnished nesting cover. Weeks (1935:137) located 11 pairs in a 4.5-acre residential area that was somewhat similar to Area 3 of this study in that the streets of both areas were lined with elms and maples. He made an effort to attract robins by erecting shallow, box-like platforms covered with two-pitched roofs. Of the 11 nests, 5 were in these shelters.

The populations that I found in Study Areas 1, 2 and 3 are listed in Table 7; some are shown in Figures 9-13. In some small sectors of Areas 1

Figure 9. The breeding population (five pairs) of Area 1 in April and May, 1956. Nest 56-2 is outside of the boundaries of Area 1.

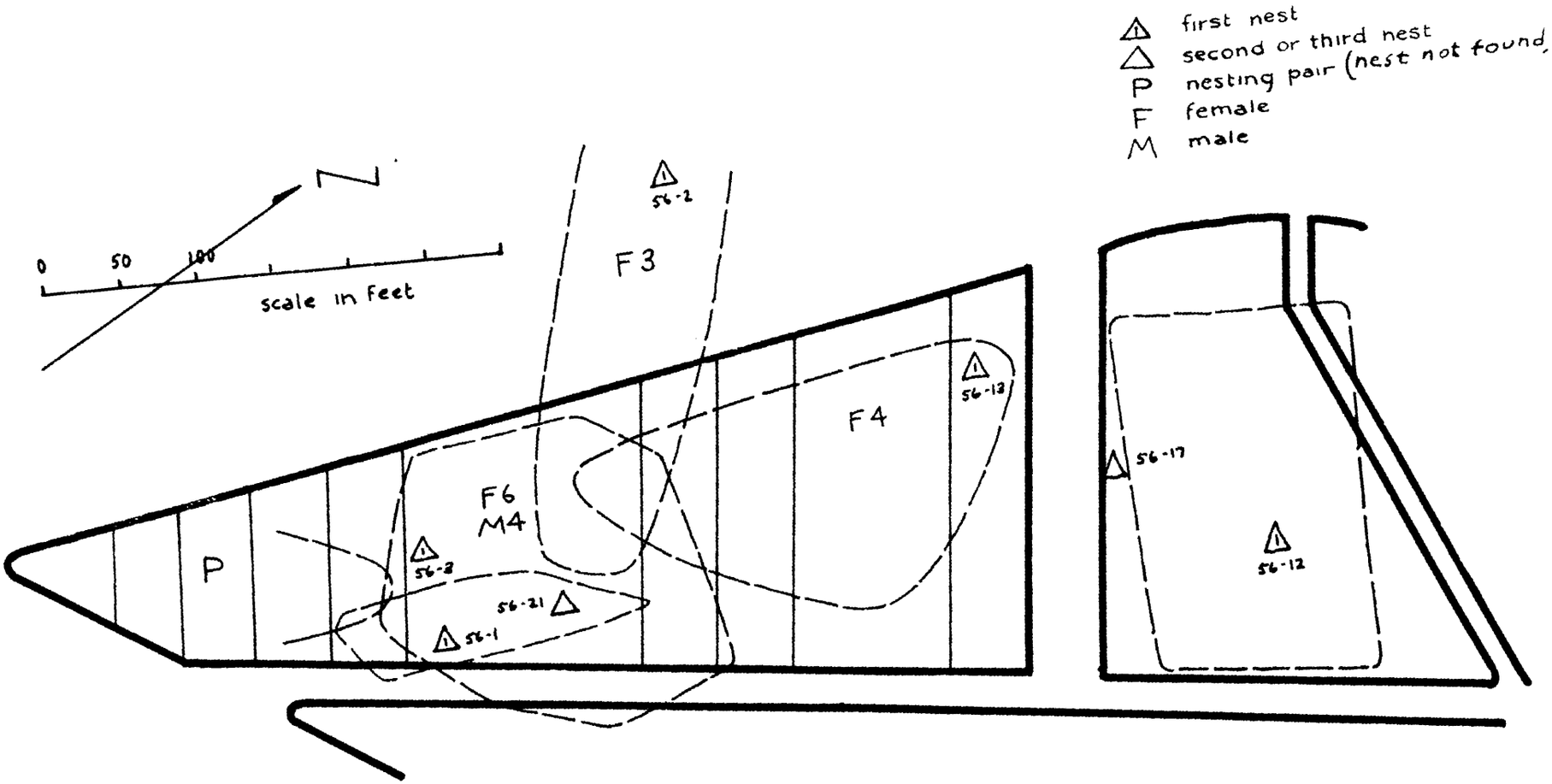
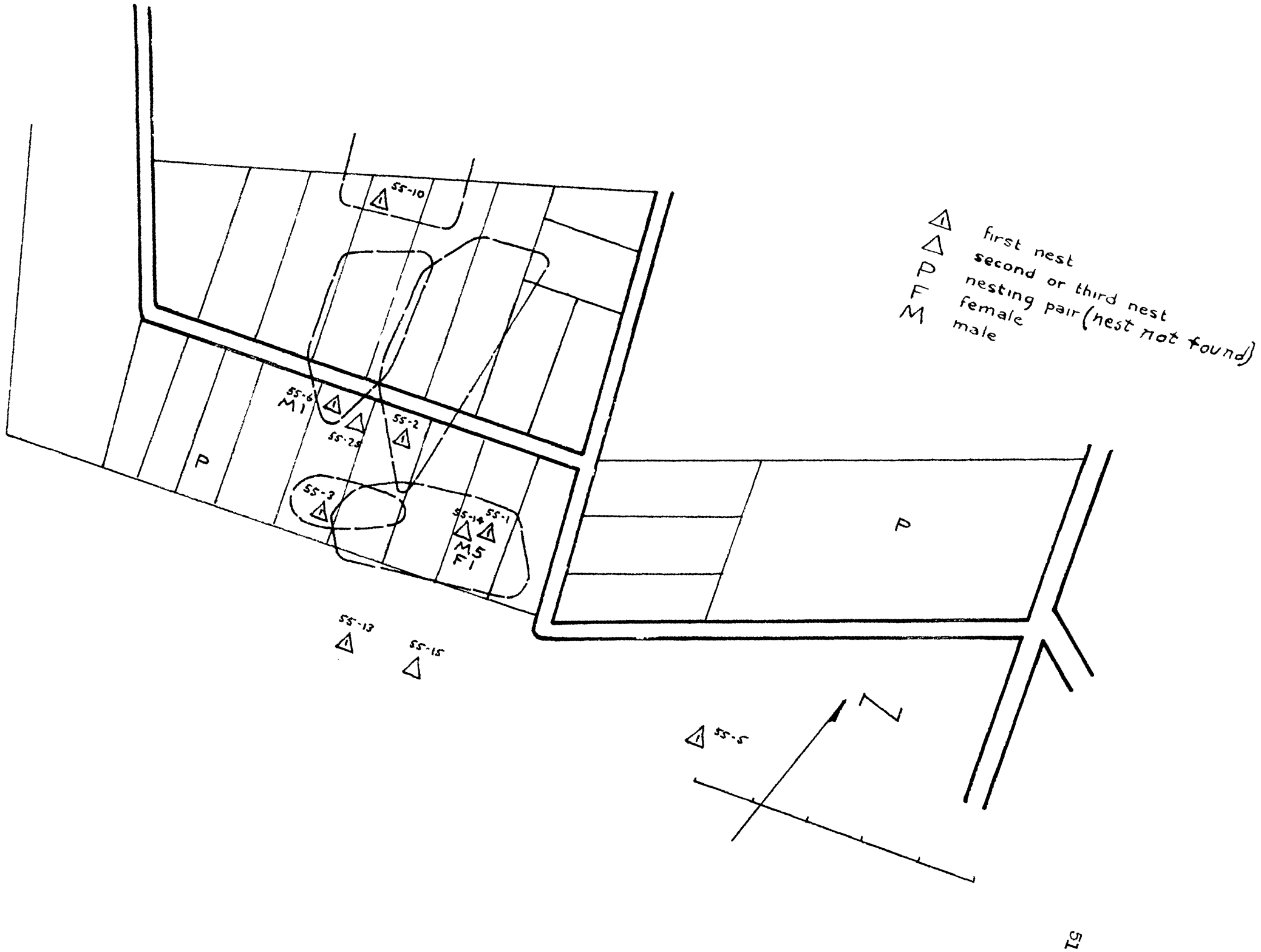

first nest
second or third nest
P nesting pair (nest not found)
F female
M male
N
0 50 100
scale in Feet
F3
56-2
F4
56-13
F6
M4
P
56-2
56-21
56-1
56-17
56-12

Figure 10. The breeding population (nine pairs) of Area 2 in April and May, 1955.



△ first nest
△ second or third nest
P nesting pair (nest not found)
F female
M male

Figure 11. The breeding population (five pairs) of Area 3 in July, 1956.

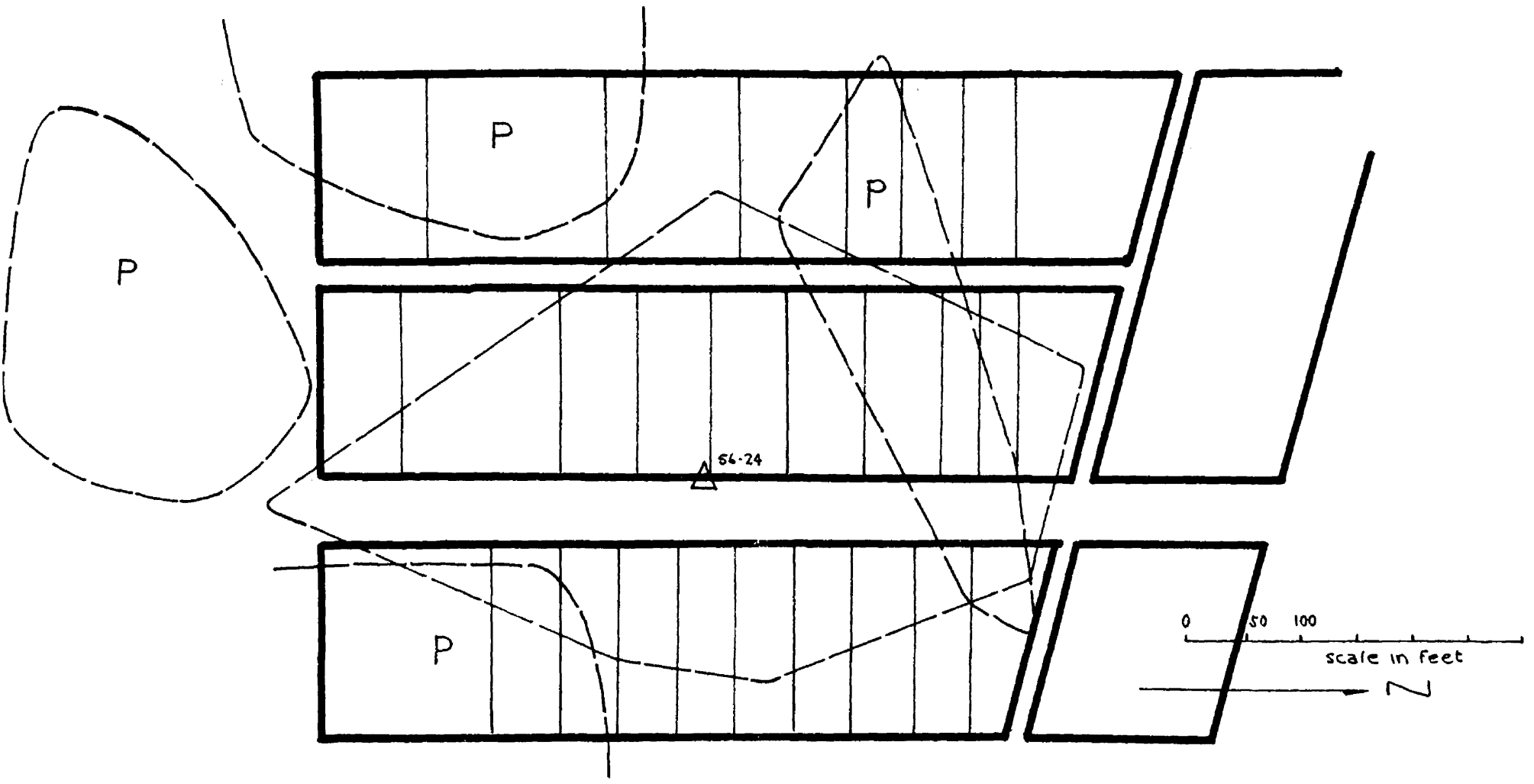

first nest
second or third nest
P nesting pair (nest not found
F female
M male
P
P
P
P
54-24
0
50
100
scale in feet
N

Figure 12. The breeding population (seven pairs) of Area 3 in April and the first part of May, 1957.

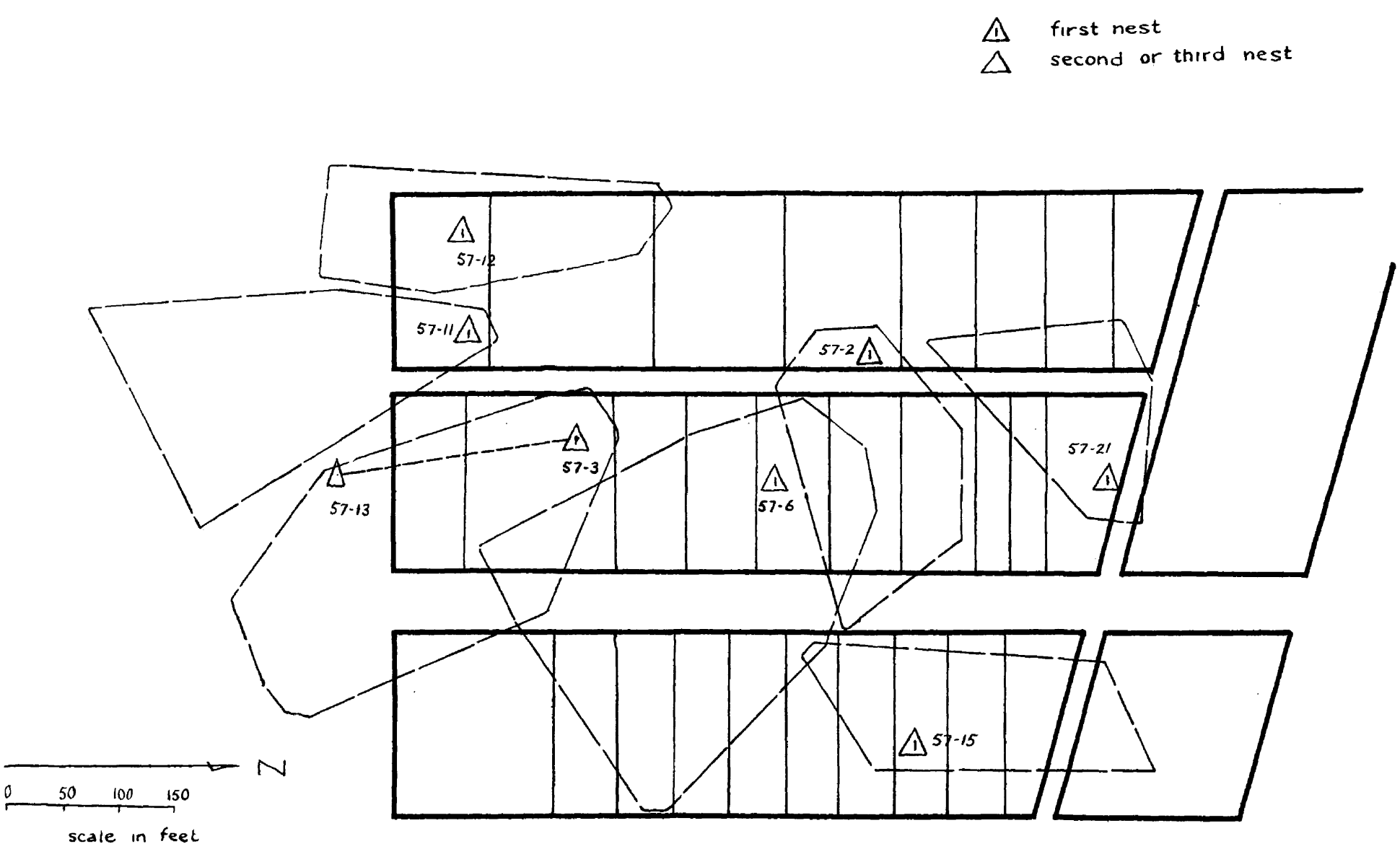
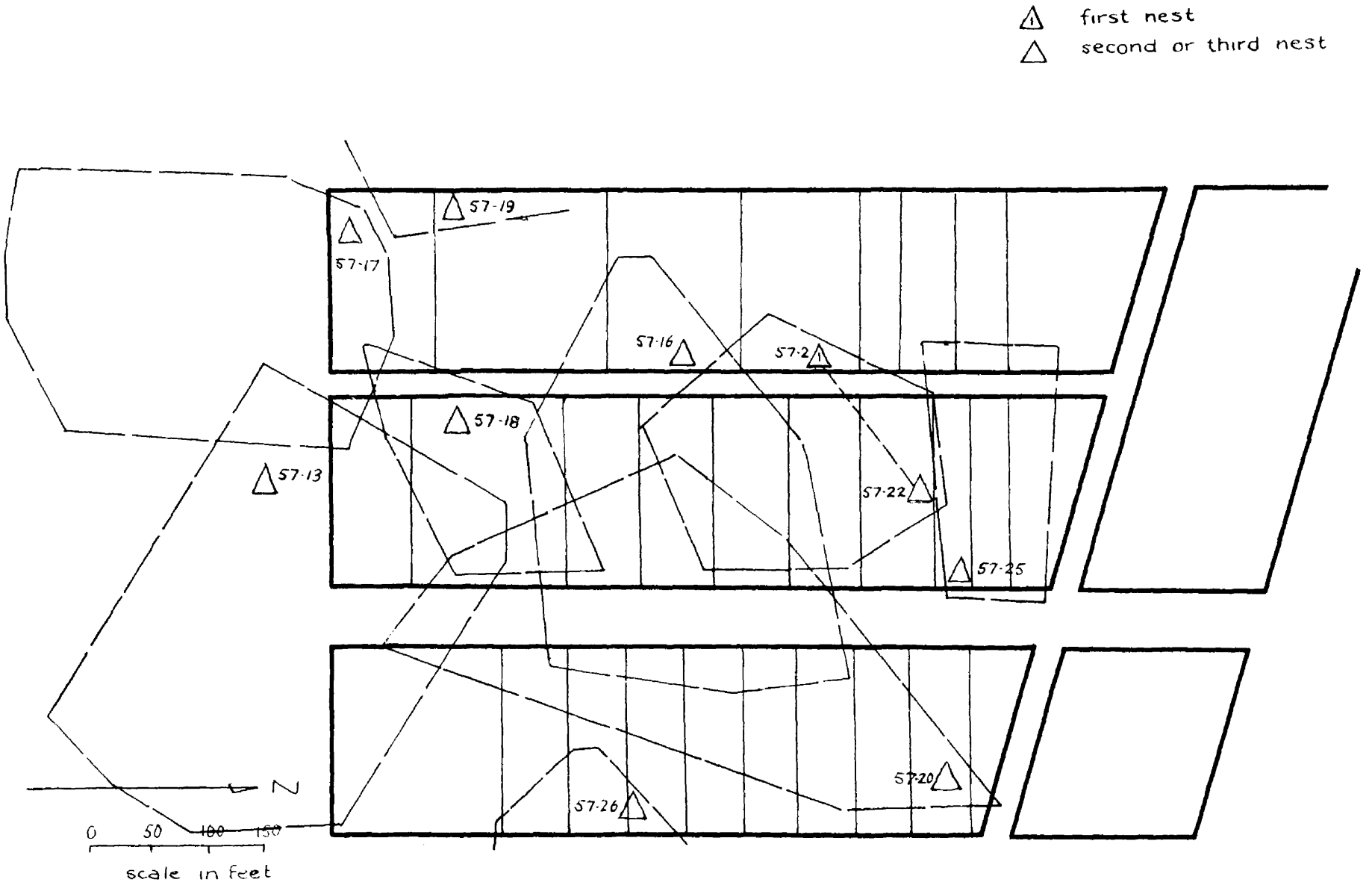

first nest
second or third nest
57-12
57-11
57-2
57-3
57-13
57-6
57-21
57-15
N
0 50 100 150
scale in feet

Figure 13. The breeding population (nine pairs) of Area 3 from mid-May through June, 1957.


first nest
second or third nest
57-19
57-17
57-16
57-2
57-18
57-13
57-22
57-25
57-20
57-26
N
0 50 100 150
scale in feet

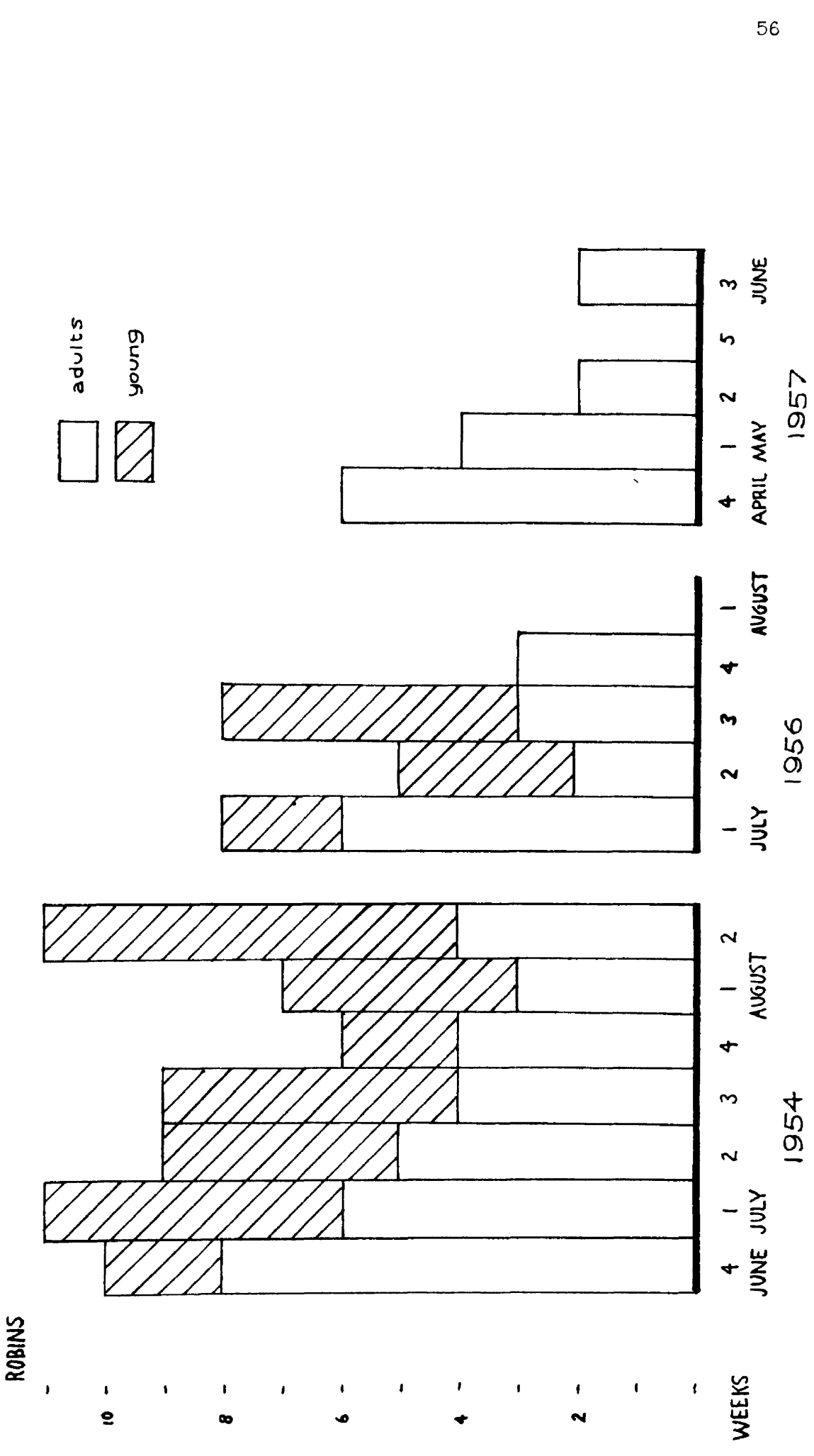
and 2, dogs, children, and residents unsympathetic toward the study did not make intensive observations feasible so that some nests were not found. In Area 3 some nests, probably in tall shade trees, were not located. Territorial boundaries are not shown for several pairs since no records were kept of the movements of some unbanded adults. Because only a small fraction of the adult robins was banded, it is not known in many cases whether a pair remained to nest a second or third time. Some of the adults could be identified with certainty because of certain peculiarities of plumage.

The populations given for Areas 1, 2 and 3 in Table 7 represent the highest number of pairs known to be nesting at one time. Even though Area 3 had many shade trees and cover equal to or exceeding that in Areas 1 and 2, it supported a comparatively small population. It is unlikely that the difference in geographical location could account for this dissimilarity.

In the summers of 1954 and 1956, and in the spring of 1957, almost daily observations were made in the Horticultural Gardens (Plate 6-A) on the Michigan State University campus. Thickets and rows of Thuja, Syringa and Lonicera, and a few tall shade trees furnished excellent cover. In 1954 five pairs nested successfully on approximately 5.5 acres, three of them in the southern border of flowering crab-apple trees (Malus purpurea (Barbier) Rehd.). Since 1954 no nests have been built in this border. Only two nests were found in the Gardens in 1956, of which one was successful. In 1957 two nests were located there, but neither produced any young. The decline of the population is also evident in the weekly counts that I made of robins utilizing the gardens for nesting and feeding (Figure 14).

Obviously some factor has been affecting the robin population in East Lansing adversely. In the summers of 1955 and 1956 aerial sprays contain-

Figure 14. Counts of robins in the Horticultural Gardens, Michigan State University.


ROBINS
WEEKS
10
8
6
4
2
adults
young
4 1 2 3 4 1 2
JUNE JULY AUGUST
1954
1 2 3 4 1
JULY AUGUST
1956
4 1 2 5 3
APRIL MAY JUNE
1957

ing DDT were used in mosquito control. Insecticides were also used on the campus to control, among other things, the bark beetles (Scolytus multistriatus (Marsh.) and Hylurgopinus rufipes (Eichh.)), which carry the causative fungus (Ceratostomella ulmi Buism.) of the Dutch elm disease.

When small numbers of adults and no young were found in 1957, a count on the north campus from Bogue Street west to Harrison Road was taken on June 21, 22 and 24, a period when a large number of young would be expected. In the 185-acre tract censused, 15 adults and one young were counted, about 4 pairs per 100 acres, less than what has been found in some forested areas. From April to July, 1957, an effort was made to find as many nests as possible. Of the six that were located, five produced no young and the fate of the other nest was not determined. There was also a very marked decline in the number of robins using the campus for feeding before flying to night roosts. On several evenings in the summer of 1957, I saw only two or three robins on the lawn in front of the new museum building, which, in 1954, attracted at least 50.

I found one robin showing symptoms of DDT poisoning on the campus within a few feet of Area 3 on May 3, 1957. It fluttered its wings and flicked its tail up and down constantly; its tarsi were flat against the ground, and the bird appeared to have no control over its leg movements. Before it died about one hour later, it underwent periods of violent spasms, with the bill open much of the time. Later in May I found two dead robins in the same part of the campus, but other factors may have been responsible. The condition of one was quite unusual. All of the primary feathers on the left wing as well as half of the first secondary and a narrow edge from the next two secondaries had been sheared off. Perhaps a power lawn mower was responsible, as birds poisoned with DDT can move only

with difficulty, and it would be possible for a dying bird to be caught by a mower.

On May 22, 1957, in Area 3, Dr. George J. Wallace and I saw a robin which was unable to fly well. Eventually it blundered into a shrub and was caught. Its behavior was similar to that described above. Four hours after it was found, the bird was dead. Within recent years robins showing symptoms of DDT poisoning have been brought to the Poultry Pathology Department and the Zoology Department on the campus, and many other dead robins have been reported.

Other studies of bird populations have been made in areas where DDT was used. In 1949 Benton (1951) censused a 20-acre study plot in Princeton, New Jersey, before and after the elms were sprayed for Dutch elm disease. He also made a census in a similar plot where insecticides were not used. After the spraying he found 11 dead birds in the test area, but he noted that the number of robins remained high throughout the post-spraying period. In 1950 Blagbrough (1952) continued the observations in Princeton. A survey following the application of a 2 per cent DDT spray in the spring showed that the robin and myrtle warbler (Dendroica coronata) suffered the highest mortality. Over a four-year period Robbins et al. (1951:215) found a gradual decrease of some species of birds in a study area located in the Patuxent Research Refuge in Maryland, which was sprayed with an aerial application of DDT in oil at the rate of two pounds per acre, a relatively low concentration compared to some current applications. It seems that the effects of DDT may be cumulative. Rudd and Genelly (1956:18) write that chronic poisoning from DDT does occur in birds and that there are adverse effects due to denial of food supply.

Thus, the number of dead and dying robins, the decline in populations and the failure to produce young strongly indicate that DDT and other in-

secticides are responsible for this situation. Studies of other species of birds on the campus and in nearby areas should be undertaken in the immediate future to determine their status. Further studies of the robin would also be of great interest so that the trend of the population could be seen.

TERRITORY

Territorial Behavior

Following Nice's (1941) classification, Young (1951:22) places the robin's territory into Type A (Mating, Nesting and Feeding Ground for Young). Young concludes that the males establish the territories, but that the mated females play an important role in helping to maintain them. He found that, for the most part, robins are able to rout the intruders that they attack, even though many territorial intrusions are tolerated.

Young robins of the year were often chased by adults from a nesting territory, but often the chase was not as vigorous as when adults were attacked. On July 8 the male of nest 54-40 was driven from the tree containing nest 54-47; the 54-40 young also ventured into the same tree, but they were not pursued with as much vigor. On May 31 both adults and young of nest 57-2 ventured into the territory which contained nest 57-13. The adults left in face of an "attack run" by the 57-13 male, but when the latter ran at one young, it opened its mouth and begged for food. The male jumped back, thus avoiding the young one instead of attacking it. Within 10 minutes the 57-2 male returned to feed the young, and immediately the 57-13 male flew from the nesting tree and chased the intruder again. In some cases I noted that an adult reacted quickly toward a young one. On August 2 a young robin, able to fly, perched about 10 feet below nest 56-24, and the female chased it from the tree at once.

Young (1951:21) noted a strong tendency, especially among males, to return to practically the same territory in succeeding years. This study supports his conclusion. M1 returned to the same territory for three suc-

cessive years, M5 and F3 for two consecutive years, and F1 in two alternate years. In 1955 M2 and M3 occupied adjacent territories, and on March 11, 1956, they returned to them. After a day of threat displays and combats, M3 disappeared. M2 remained for 17 days after which he also disappeared, and his territory was taken over by M4.

In 1955 F1 and F3 were in residence for 143 and 96 days respectively. Of 10 banded individuals, Young (1955:343) recorded 141 days as the longest period of residence for a male, and 133 days for a female; the shortest periods for a male and a female were 113 and 101 days respectively.

Young (1951:11) writes of the contraction of territorial boundaries from the time the males first establish themselves until nesting is underway. This was true of M4 and F6 in 1956 (Figure 15). From March 29 through April 14, they occupied an area of .70 acres, from April 20 through May 7, .60 acres, and from May 19 through June 9, .44 acres. Since only 22 observations were made in late May and early June, it is likely that the area was somewhat larger than shown in Figure 15. However, the territory may be larger during the second nesting. This was illustrated by M2 and F3 in 1955 (Figure 16). The extent of the territory at the first nesting was .48 acres, and at the second it was .60 acres. In this study area the population was reduced by one pair when the second nest was active.

As can be seen in Figures 9-13, the territories of robins may overlap, and two or three pairs may utilize the same parts of an area. Young (1951:19) also found this true in his study.

Size of Territories

The size of 15 robin territories is listed in Table 8. The fact that the extent of a territory is given does not mean that it is rigid or inflex-

Figure 15. Successive territories of M4 and F6 in Area 1 during two nestings in the spring of 1956.

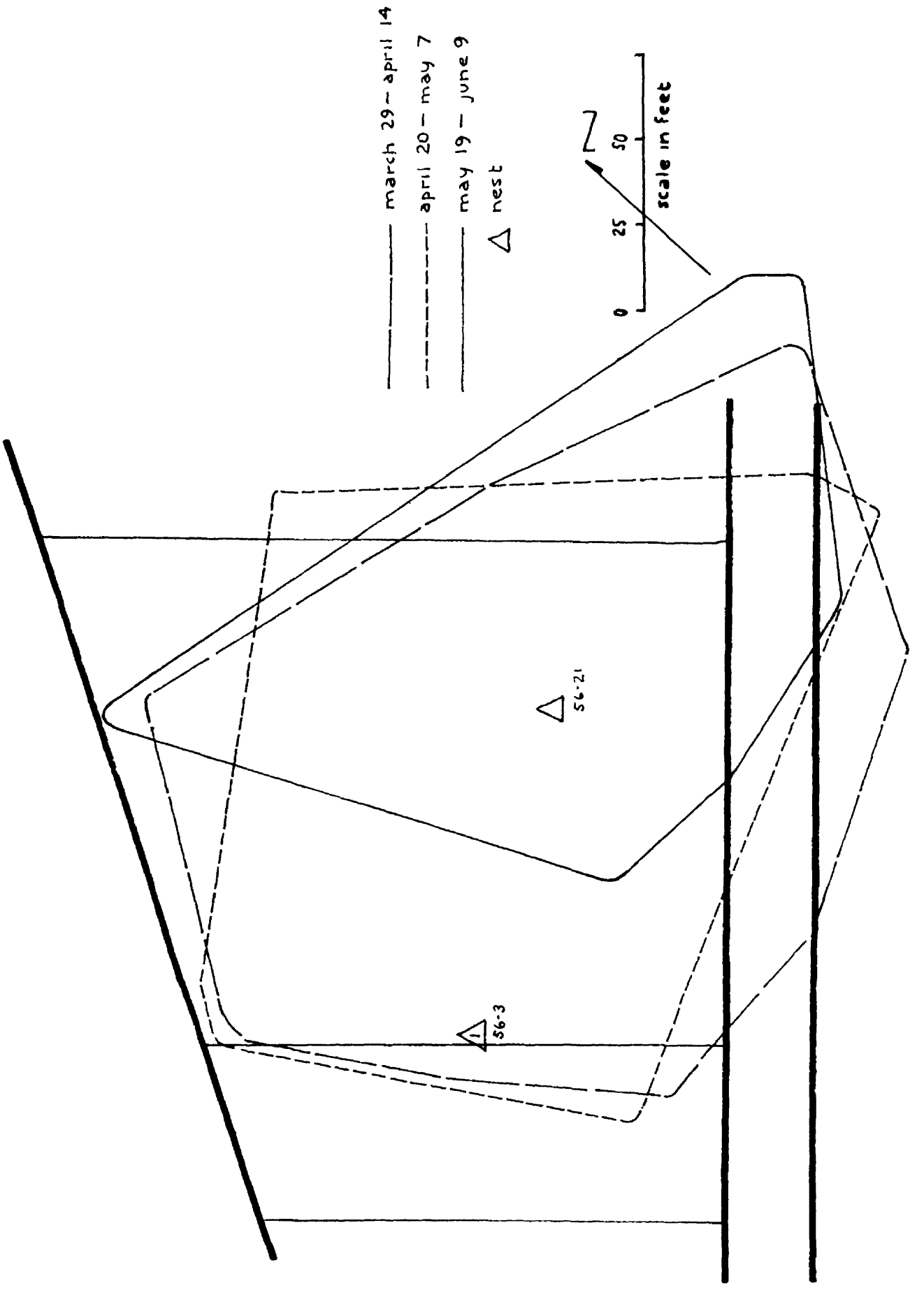
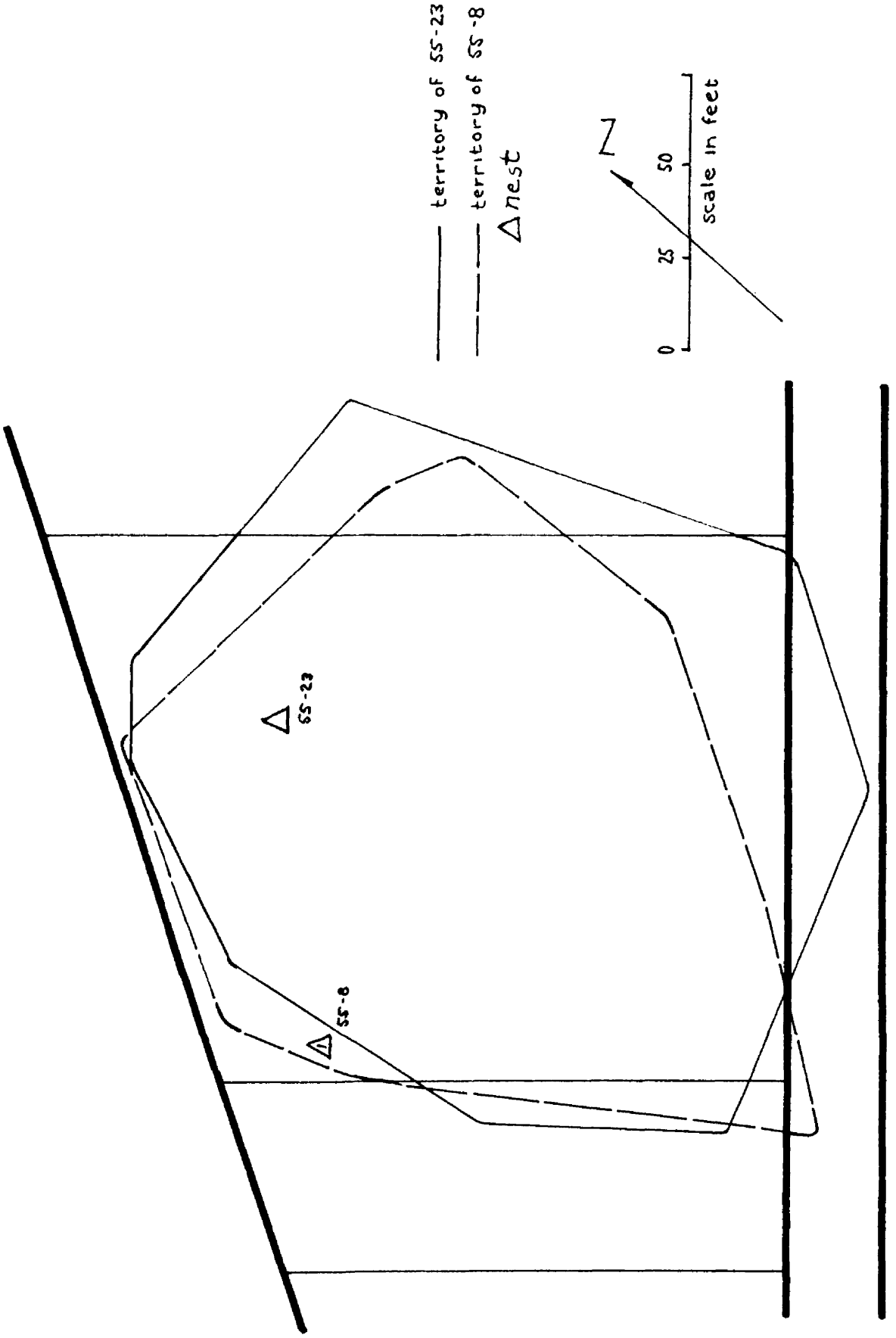

march 29 – april 14
april 20 – may 7
may 19 – june 9
nest
0
25
50
scale in feet
56-21
56-3

Figure 16. Successive nesting territories of M2 and F3 in Area 1 during two nestings in 1955.


territory of SS-23
territory of SS-8
Δ nest
N
0
25
50
scale in feet
SS-23
SS-8

ible in size or shape. Nevertheless, it is useful to have some idea of the area over which a bird carries out its daily activities.

Odum and Kuenzler (1955:129) distinguish between maximum and utilized territory. The former includes the area over which the bird ranges while the latter is only that portion that contains the singing perches, the nesting site and feeding sites. In three cases I was able to determine maximum territory. The members of a pair, especially the male, were observed continuously from three to five hours, and their locations were plotted at approximately five-minute intervals on a map. After every 10 observations the outermost points were connected with straight lines so as to include all of the other plotted points, and the areas were measured with a planimeter. In the case of the 56-24 pair when the young were being fed (Figure 18), and of the 57-13 pair (Figure 19) during incubation, it is evident that a point was reached when there was little or no increase in area. Insufficient observations were made at nest 56-24 during incubation (Figure 17), and hence there was no levelling-off point when the numbers of observations and the resulting areas were plotted. Odum and Kuenzler (1955:133) found that from 25 to 90 observations, or two to eight hours in the field, depending upon the species, were necessary to reach a point beyond which each 10 observations would result in less than a 10 per cent increase in territory size.

The above technique was not followed in determining the size of the other territories listed in Table 8 in that the positions of pairs or members of a pair were not plotted at regularly spaced intervals. Again the outermost points were connected by straight lines. When less than 20 records were taken for a male or a pair, I did not measure the area. All territories, whether measured or not, are shown in Figures 9-13 so that the

Figure 17. Territory of the 56-24 pair in Area 3 during incubation. The numerals represent the increase of area after a series of 10 observations.

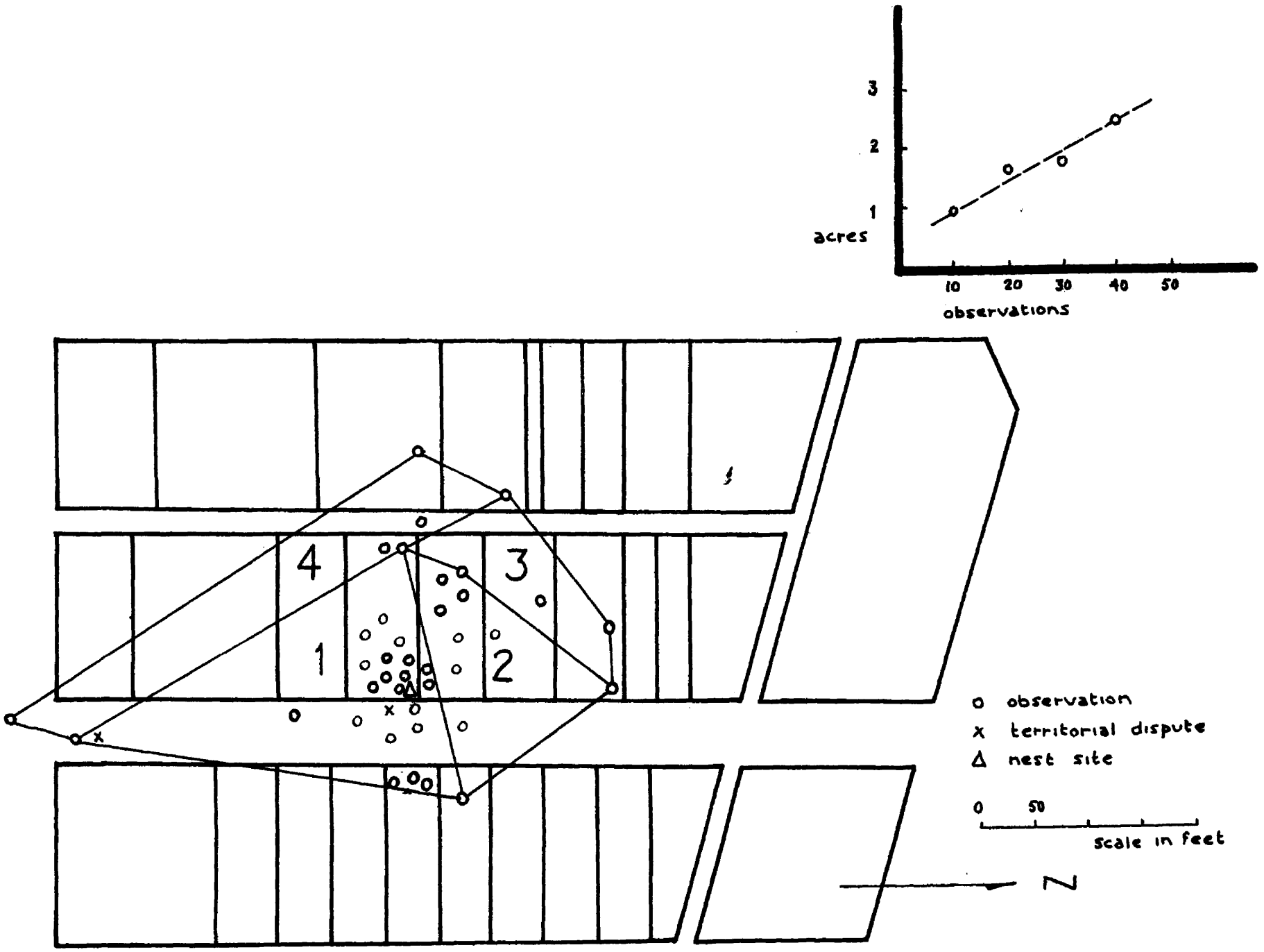
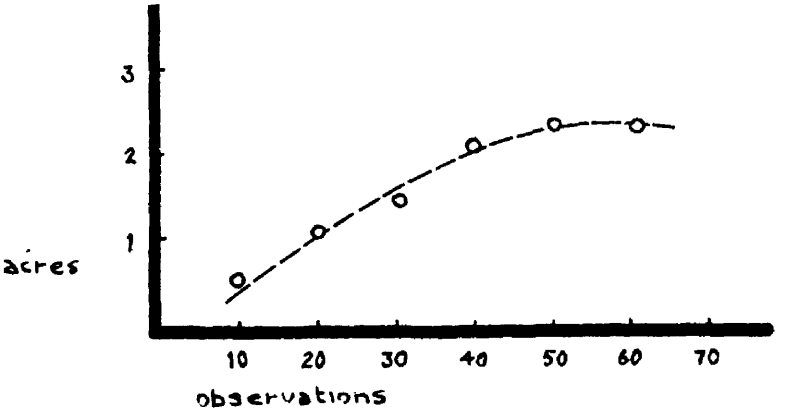

3
2
1
acres
10
20
30
40
50
observations
4
3
1
2
o observation
x territorial dispute
Δ nest site
0
50
scale in feet
N

Figure 18. Territory of the 56-24 pair in Area 3 during the period when young were being fed in the nest. The numerals represent the increase of area after each series of 10 observations.


3
2
1
acres
10
20
30
40
50
60
70
observations

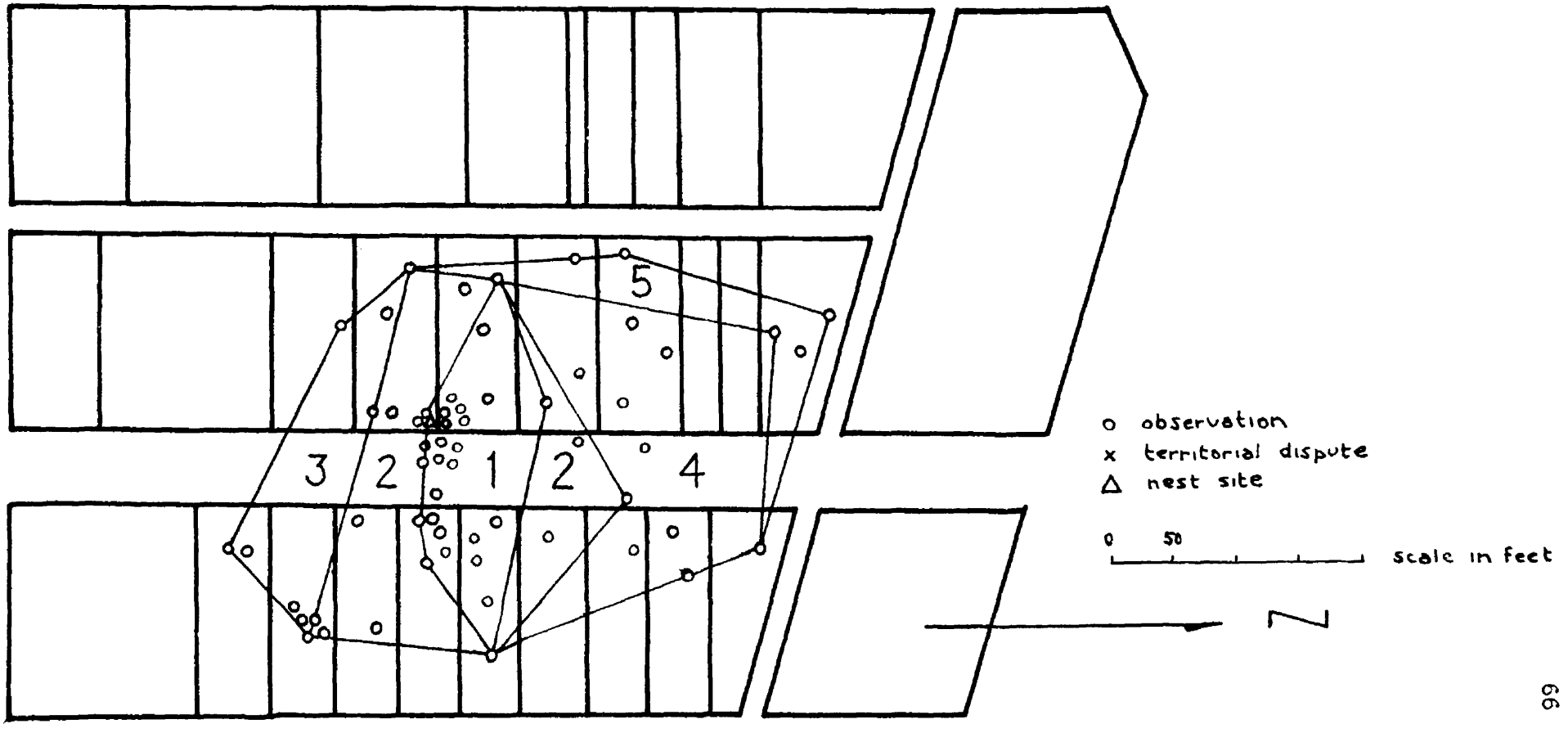
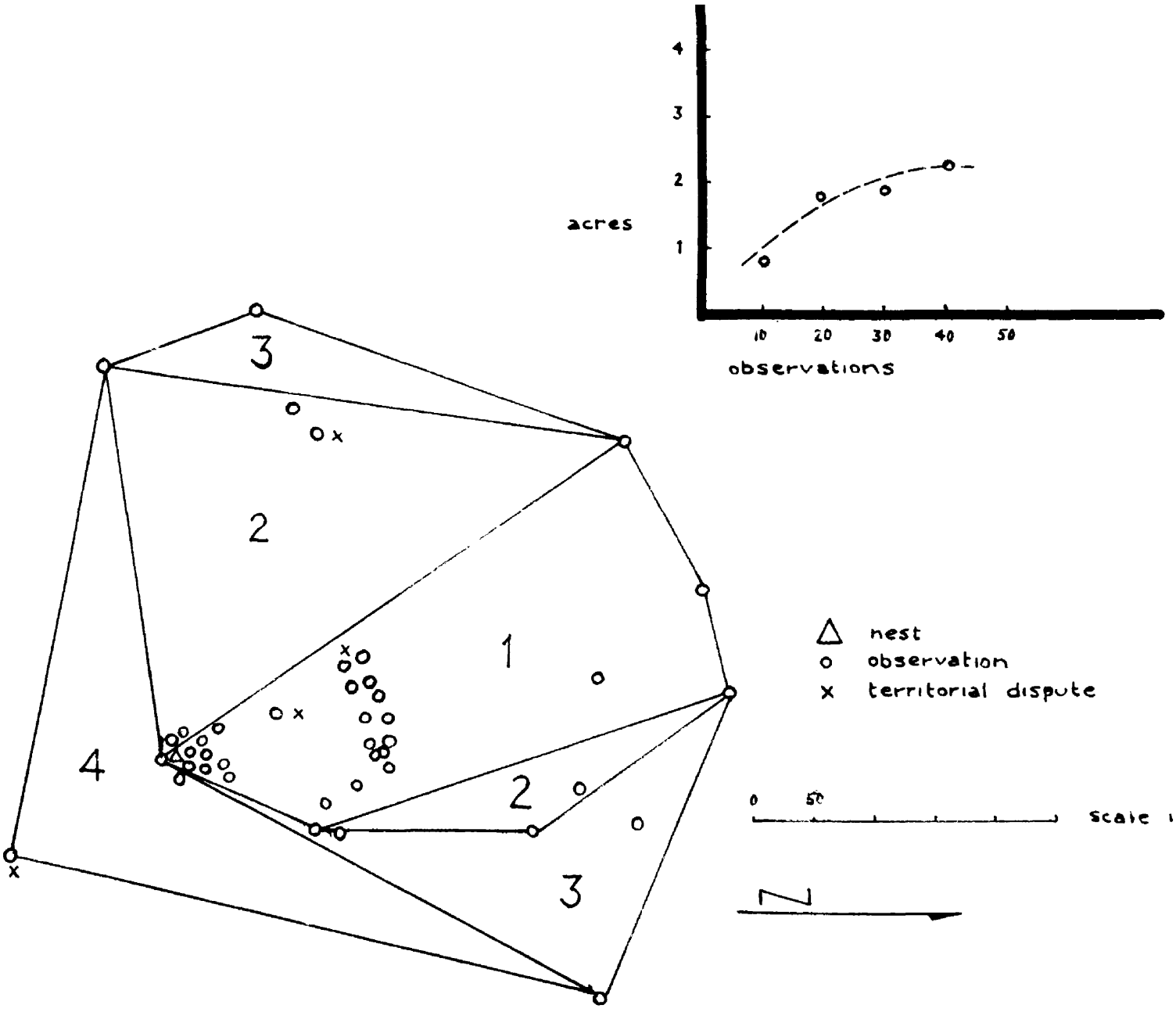

5
3
2
1
2
4
o observation
x territorial dispute
△ nest site
0
50
scale in feet

Figure 19. Territory of the 57-13 pair in Area 3 during incubation. The numerals represent the increase of area after each series of 10 observations.


4
3
2
1
acres
10
20
30
40
50
observations
3
2
1
4
2
3
nest
observation
territorial dispute
0
50
scale in feet

populations of nesting pairs and overlapping can be seen.

Other data are available from the literature on the size of robin territories. In Ithaca, New York, Butts (1927:347) observed that the members of a pair obtained most of their food within an area of about .50 acres. In a study of a pair raising three broods, Shantz (1939:167) determined the extent of the territory at approximately .80 acres. Young (1951:20) found the average size in the University of Wisconsin Arboretum to be .30 acres, with a minimum of .11 acres and a maximum of about .60 acres. Weeks (1935:137) writes that the average extent in a residential area at Sanbornton, New Hampshire, was .40 acres. Howell (1942:531) gives .28 acres as the average extent in an area where the robin population was high, and .51 acres where it was low. Both Howell and Weeks determined the average size by dividing the area of the plot by the number of nesting pairs. This method leaves much to be desired in view of the fact that territories do vary in size and that many overlap.

The largest territories that I measured, about 2.5 acres, were in Area 3, which had the lowest populations. These are maximum territories; perhaps the smaller ones that I determined in Areas 1 and 2 were utilized territories. Seven of these were in areas where the density was 100 pairs per 100 acres. The range was from .44 to .70 acres, with an average of .60 acres. When the density was 120 pairs per 100 acres, the range of five was from .24 to .87 acres, with an average of .50 acres. The smallest territories were recorded by Young (1951:20), and his study area contained the heaviest populations of robins. This strongly suggests a relationship between density and extent of territory.

NESTS AND NEST BUILDING

Span of Nesting Season

Howell (1942:545-547) summarizes data on nesting dates from various localities in North America. Wood (1951:330) writes that in Michigan nesting occurs chiefly in May, June and early July. Burleigh (1923:147) gives the earliest record for Allegheny County, Pennsylvania, as April 14, 1912, when a nest with four slightly incubated eggs was found. An earlier recent record is April 11, 1956, when a nest with two freshly deposited eggs was collected by a high school student near Area 1.

From 1954 through 1956, in Areas 1 and 2, a peak of nesting activity was found in late April and early May (Figures 20, 21). In 1957 two peaks of activity, one in late April and early May and another in late May and early June, were noted in Area 3 (Figure 22). With the exception of 1955, my absences from Pittsburgh in late spring and summer prevented gathering data on late nesting there. The populations given for the study areas are higher than the nest count because all of the nests were not found.

Burleigh's (1929:120) latest record is August 18, 1927, when three half-grown young were found near Harmarville, Pennsylvania. The latest nesting that I observed in Pittsburgh was on August 7, when food was still being carried to the young of nest 55-22. Nickell (1957:95) reports three 13-day-old young in a nest on August 5, 1955, in Oakland County, Michigan. On August 3, 1954, I found three dead young, about five days old, on a sidewalk in East Lansing. The two young of nest 56-24 in Area 3 left on August 3. On September 1 and 2, 1956, I observed a fledgling being fed by parent birds in Lansing. Forbush (1929:413) gives a still later record at

Figure 20. Robin nesting cycle in Area 1.

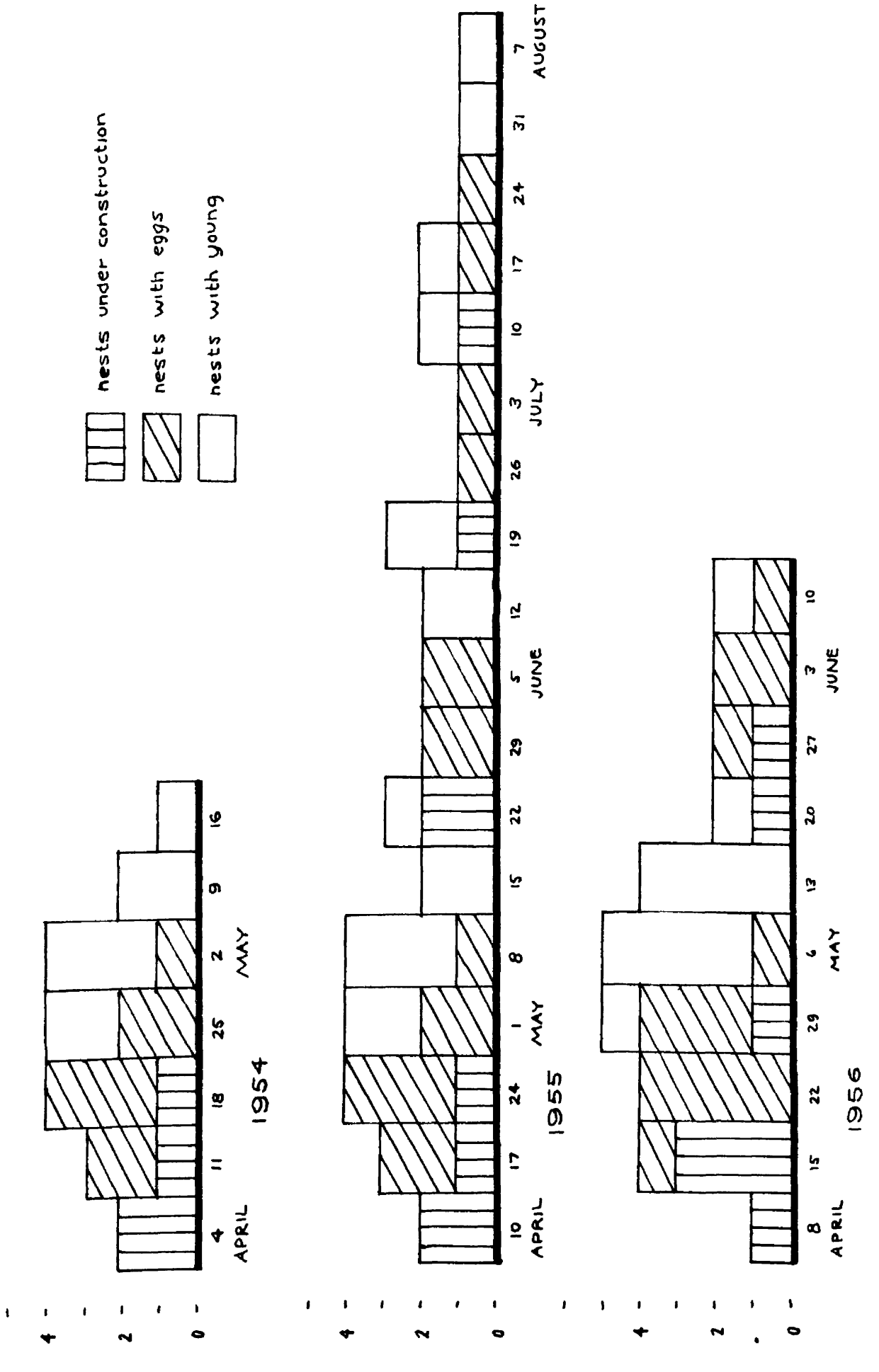

nests under construction
nests with eggs
nests with young
4
2
0
APRIL
4
11
18
25
MAY
2
9
16
1954
10
17
24
1
MAY
8
15
22
29
JUNE
5
12
19
26
JULY
3
10
17
24
31
AUGUST
1955
8
15
22
29
MAY
6
13
20
27
JUNE
3
10
1956

Figure 21. Robin nesting cycle in Area 2.

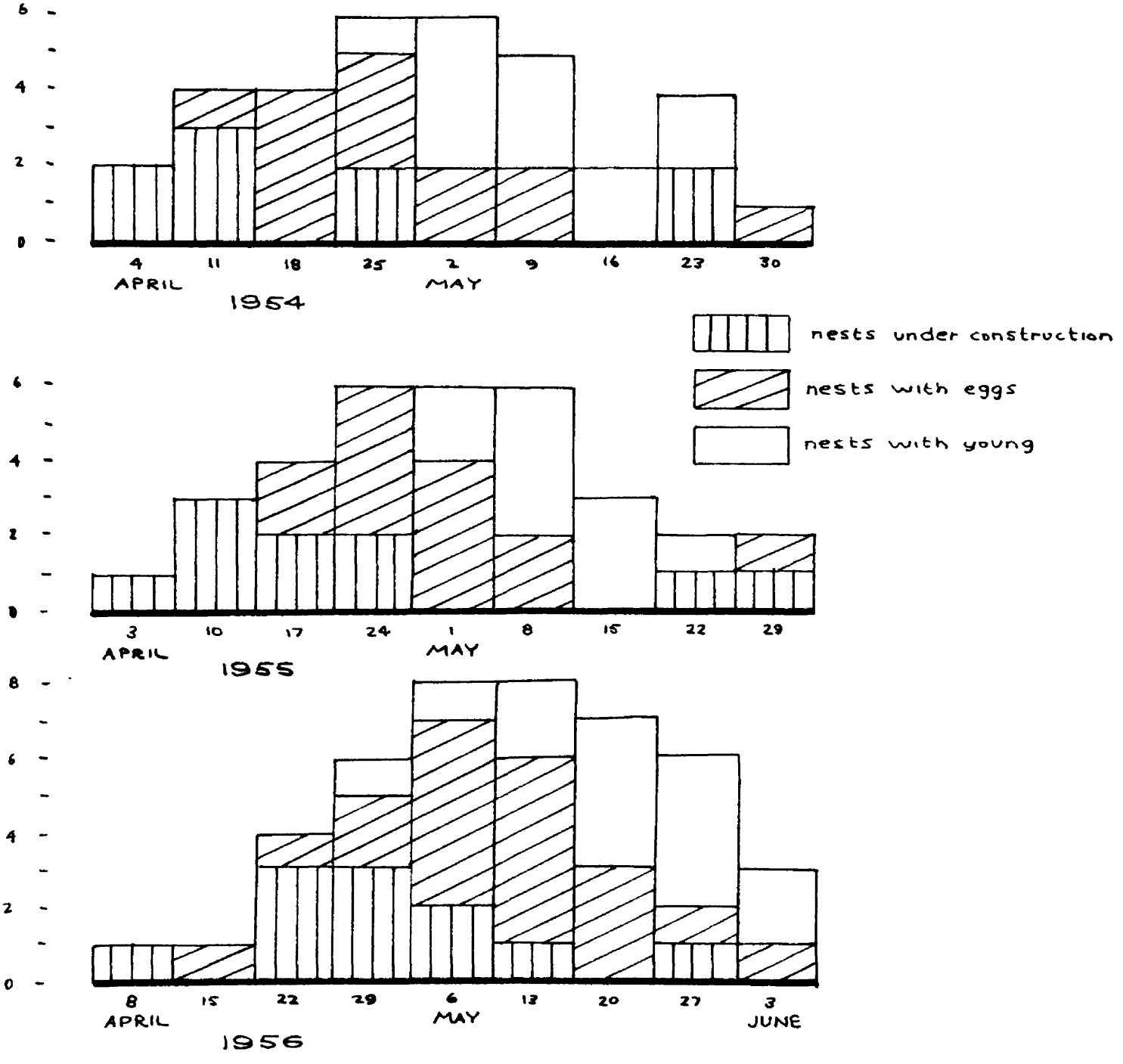
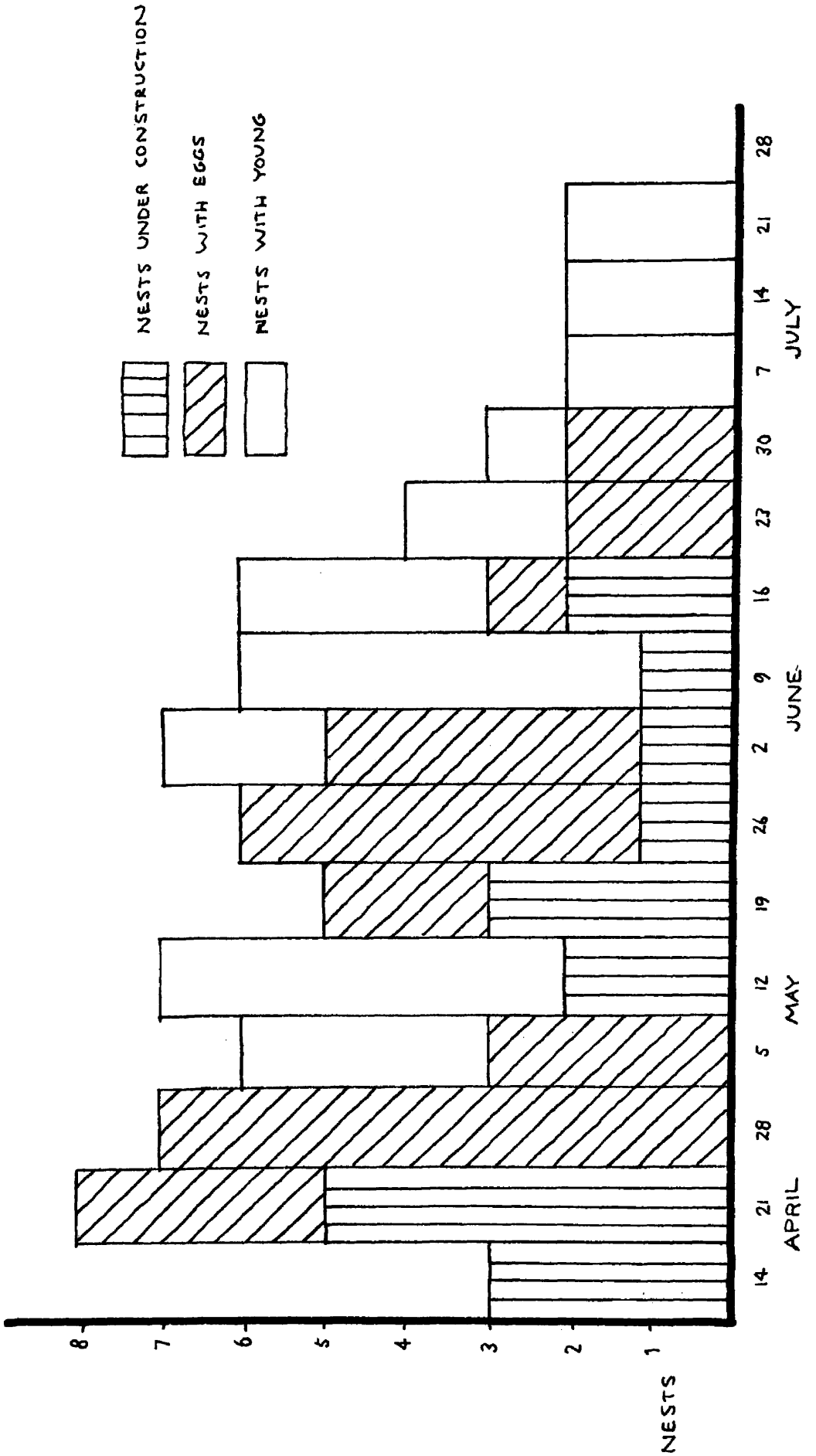

6
4
2
0
4
APRIL
11
18
25
2
MAY
9
16
23
30
1954
nests under construction
nests with eggs
nests with young
6
4
2
0
3
APRIL
10
17
24
1
MAY
8
15
22
29
1955
8
6
4
2
0
8
APRIL
15
22
29
6
MAY
13
20
27
3
JUNE
1956

Figure 22. Robin nesting cycle in Area 3 in 1957.


NESTS UNDER CONSTRUCTION
NESTS WITH EGGS
NESTS WITH YOUNG
NESTS
8
7
6
5
4
3
2
1
14
21
28
5
12
19
26
2
9
16
23
30
7
14
21
28
APRIL
MAY
JUNE
JULY

Hopkinton, Massachusetts, of a brood occupying the nest until September 13. Todd (1940:439) gives the most unusual late record: the discovery by H. C. Kirkpatrick on December 9, 1889, of a female at a nest with two eggs near Meadville in northwestern Pennsylvania.

Selecting the Nest Site

Several times I have seen the female or a pair in the process of selecting a nest site. On April 10, 1954, the female of nest 54-6 was walking on the limbs of a large maple in Area 1. She began on a limb close to the ground and settled down at several points, as if testing the sites. This behavior continued as she worked her way up to the top branches. The same procedure was repeated on April 11, and a few days later, after another site was selected and then abandoned, the female returned to the maple to build a nest. Meuli (1935:296) compares the movements at the potential nest site to the shifting and turning that occur during the actual nest building. On April 23, 1957, in Area 3, a female attempted to crouch into a crotch that was not quite wide enough for her body. Immediately she moved on to another crotch, then retraced her steps, testing the same spots again. On April 4, 1956, in Area 1, a female which was testing possible nest sites in a spruce fell to a branch below as she attempted to settle on a crotch.

In some instances the male appears to help in selecting the nest site. On April 19, 1955, I heard M1 giving various call notes as he flew, followed by his mate, to a pine tree where nest 55-6 was constructed a few days later. It would seem that M1 also influenced his mate in the selection of a nesting site in 1956, since they used the same nest that he and an unbanded female had used for a second brood in 1955. Common (1947:238) observed both members of a pair examining potential nest sites.

On May 13 in Area 3, before the female built nest 57-13, she moved over the branches of an apple tree. The male which was on the ground nearby, then flew to a nearby tree and hopped from one branch to another. After he picked up a flower petal and gave a whisper song, the female flew to him. He then moved to the ground and took a piece of leaf, but dropped it and picked up another flower petal. The female approached the male, but he returned to a tree and began walking over the branches. Unfortunately, the pair was disturbed by noise at this point and left the area.

The first choice of a nesting site may be abandoned in favor of another. On April 19, 1954, in Area 1, a female carried nesting material to a precarious site in a pine, but it all fell to the ground. On April 20, she and her mate investigated a birch tree, but finally selected a crotch in a sycamore and completed a nest by April 29. Weeks (1923:254) and Schantz (1939:157) write of females carrying material to two or three sites before concentrating on one.

Nest Site

It is a well known fact that robins use a variety of nesting substrates. The sites of 150 nests, including ones in the study areas and others found in Pittsburgh, Lansing and East Lansing from 1954 through 1957, are listed in Table 9. Nests built before May 15 are considered as first nests, the others as later nests. In Pittsburgh, I found 25 out of 85 (29.4 per cent) first nests in evergreens, and in the Lansing area, 4 out of 19 (21.0 per cent). These numbers were appreciably higher than the 3 out of 18 (16.7 per cent), and 2 out of 28 (7.1 per cent) later nests in the same area. Out of 59 first nests in Ithaca, New York, Howell (1942:550) found 34 (57.6 per cent) in evergreens. In Table 10 Howell's data are compared with mine. Klimstra and Stieglitz (1957:335) found only 8 out of

173 nests (4.6 per cent) in coniferous species, but conifers are not abundant in Iowa and Illinois where their observations were made. In a cemetery at Madison, Wisconsin, Koehler and Koehler (1945:17) found 56 out of 92 (60.9 per cent) nests in young spruces. Nickell (1944:51) noted some preference for evergreens and other protected places in the early spring. Even though many deciduous trees do not offer much cover at this time of the year, it is not unusual to find first nests in them. Nest 54-7 was in a sycamore, and nests 55-11, 55-12 and 57-8 were in oaks. Since these trees do not leaf out until late spring, they afford little concealment or protection from the sun and rain.

Only 1 nest out of 47 (2.1 per cent) in the Lansing area was placed on an artificial site while 30 out of 103 (29.1 per cent) nests in Pittsburgh were on such substrates. Sixteen out of the 30 nests in Pittsburgh were 10 feet or more above the ground. Perhaps the lack of tall shade trees forced robins to make use of window ledges and platforms that offered adequate height.

In the Lansing area, I found 9 (19.2 per cent) nests in American elms and 12 (25.5 per cent) in maples. Klimstra and Stieglitz (1957:335) found 57 (32.9 per cent) and 28 (16.1 per cent) nests in American elms and box elders (Acer negundo L.) respectively. In East Lansing, I found 8 (17.0 per cent) nests in apple trees. Weeks (1935:137) also found apple trees a preferred nesting site.

Nickell (1944:51) writes that certain species -- e.g., black cherry, quaking aspen (Populus tremuloides Michx.)-- do not furnish safe foundations because their branches are too smooth and/or are lacking in horizontal crotches. Seldom have I found nests of any bird in poplar; the one listed in Table 9 was recorded by another observer. Of 103 nests in Pitts-

burgh, however, I noted 7 (6.8 per cent) in black cherry, and 2 were successful in producing young.

The nest may be placed near the center of the territory or close to the territorial boundaries. In the latter case, two active nests may be within a short distance of each other. Nests 54-8 and 54-9 were 55 feet apart. Other similar examples can be noted in Figures 9-13. Hoyt (1948: 190) recorded two active nests 20 feet apart. Weeks (1935:137) found two 18 feet apart.

I have records of nest sites used by F1 (Figure 23) and F3 (Figure 24) from 1954 through 1957, and by F4 in 1956, and by F6 in 1955 and 1956 (Figure 25). All of them were in relatively small areas. Following are distances separating nests built in the same year by known females.

Female	Nests	Distance Apart in Feet
F1	54-2, 54-30	30
F1	55-1, 55-14	25
F3	55-8, 55-23	100
F4	56-3, 56-21	85
F9	57-11, 57-17	100
F10	57-3, 57-13	230
F11	57-2, 57-22	150

In the early stages of nest building, some robins do not exhibit a strong attachment to the nest site. On April 23, 1957, quite by accident, I came upon a female depositing nesting material in a juniper (Juniperus sp.); she was startled and did not return to this site again. Jordan (1901:108) observed a male with nesting material fly against a branch of the nesting crotch, with the result that no more material was carried to the site.

Figure 23. Nesting sites of F1 in Area 2 from 1954 through 1956.

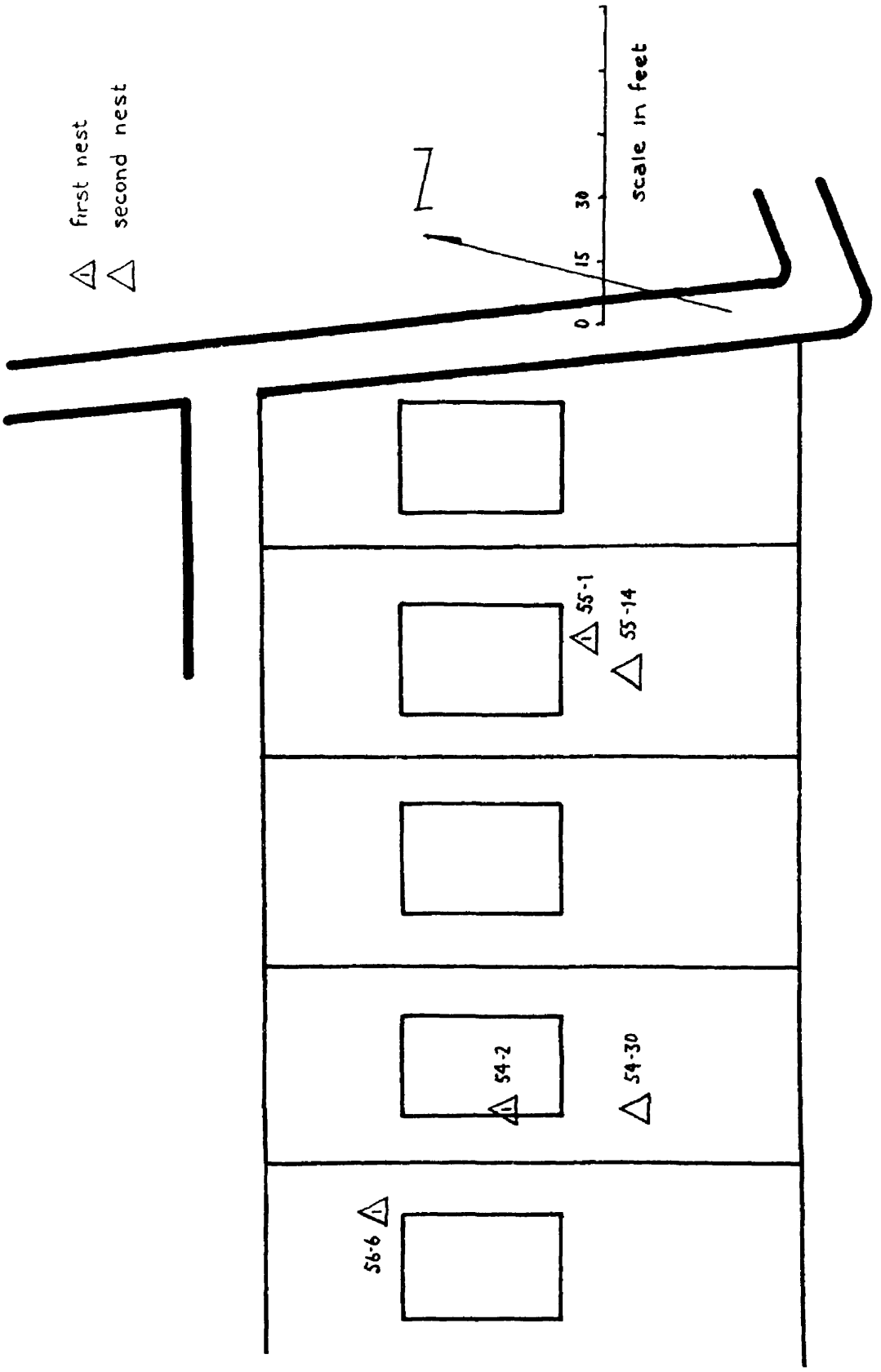

first nest
second nest
N
0
15
30
scale in feet
55-1
55-14
54-2
54-30
56-6

Figure 24. Nesting sites of F3 in Area 1 from 1954 through 1956.

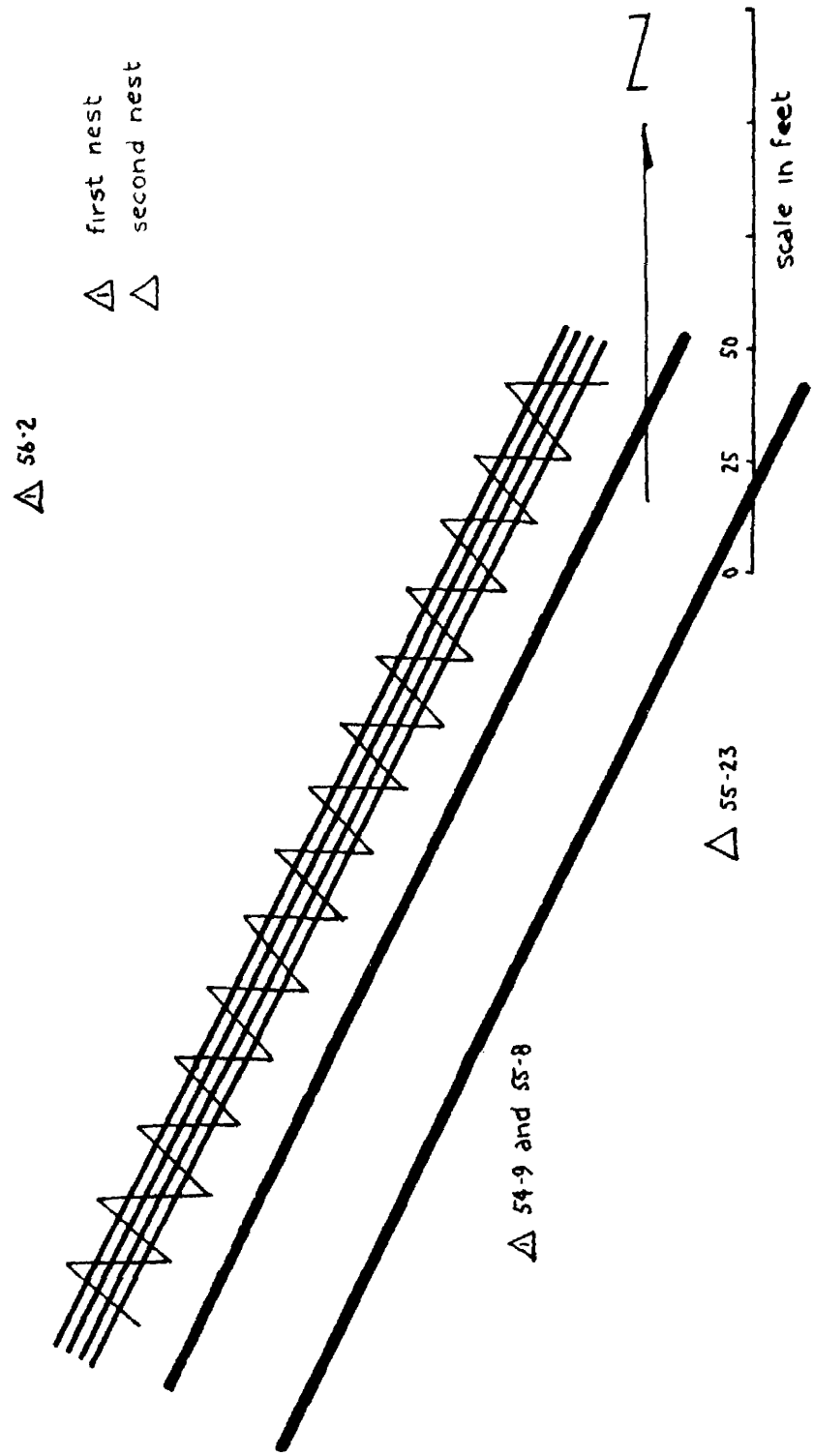
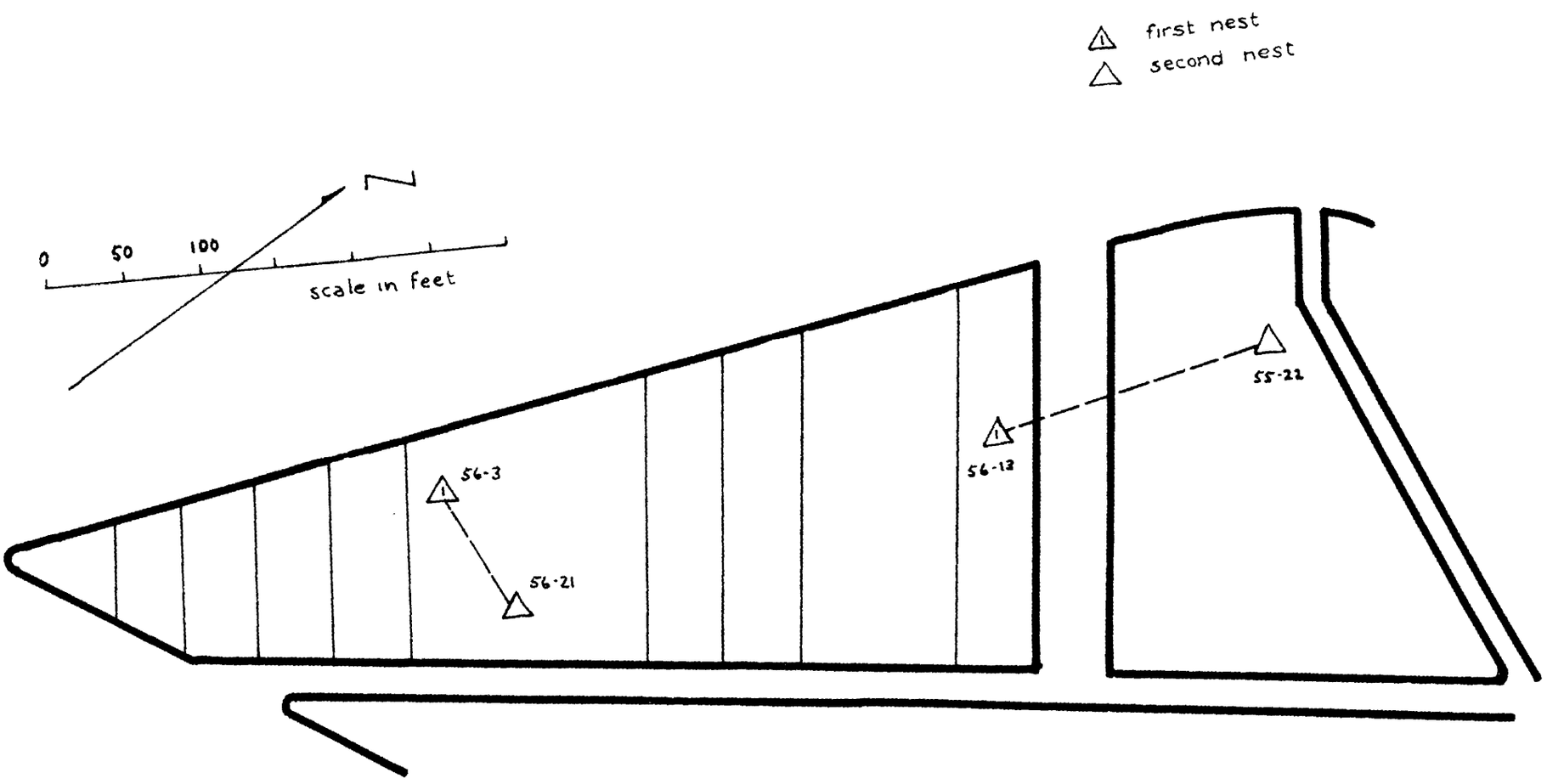

first nest
second nest
56-2
54-9 and 55-8
55-23
N
0
25
50
Scale in feet

Figure 25. Nesting sites of F4 (nests 56-3 and 56-21) and F6 (55-22 and 56-13) in Area 1 in 1955 and 1956.


first nest
second nest
N
0
50
100
scale in feet
56-3
56-21
56-12
55-22

Later in the nesting cycle, the attachment to the site is quite strong. Julian Myers of Pittsburgh reported that an occupant in an apartment building pushed a nest from a window ledge. The female then laid two eggs on the ledge. When the nest was replaced on the ledge and the eggs introduced into it, the female resumed incubation.

On May 3 nest 55-2 with eggs was transferred from one second-floor window ledge to another, about 15 feet distant, because the house was being painted. However, the female returned to the freshly painted ledge and squatted in the paint even though she had been present when the nest was moved. It was then placed in a metal pan and returned to the first ledge, but not to the original spot. The female still returned to the original site and did not incubate the eggs until the nest was placed there. I moved nest 54-2 with young about six feet to a trap to capture the adults. The female flew to the nest site, however, and assumed an incubating posture. On May 21 the one young was taken from nest 56-4 for banding, after which the female returned to the empty nest and sat on it. Charles (1909: 30) and Scott (1902:70) noted robins sitting in empty nests.

The nest site may continue to exert a strong influence on the adults after the young leave. On May 10 the young of nest 54-8 were frightened from the nest while the adults were nearby. I collected the nest, and after I left the vicinity, the adults went directly to the spot where the nest had been located even though they had seen the young leave. Common (1933:413) observed a female going to a nest after the young had left. Wallace (1939:356) made a similar observation at a Bicknell's thrush (Hylocichla minima bicknelli) nest.

Nesting Height

Nests may range from ground level to a height of 60 feet or more.

Several observers report ground nests. Howell (1942:549), at the other extreme, recorded one that was 65 feet in height.

I measured or estimated the height of 131 nests (Table 11). The average height of 83 in Pittsburgh was 14.5 feet, with extremes of 5 inches and 50 feet; the average of 48 in Lansing and East Lansing was 20.3 feet, with extremes of 4.2 feet and 50 feet. For 20 nests in Area 1 the average height was 21.2 feet. The average of 29 in Area 2 was 12.5 feet, and that of 23 in Area 3 was 23.5 feet. Klimstra and Stieglitz (1957:334) found 10.7 feet as the average height in residential and rural areas in Iowa, and 15.4 feet within the city limits of Carbondale, Illinois. Young (1955: 336) found that the average height was 7.4 feet in Madison, with many of the nests in the University of Wisconsin Arboretum.

From a study of 185 robin nests on his undisturbed laboratory grounds near Butler, Pennsylvania, Preston (1946:90) found 7.3 feet to be the average nesting height. Preston and Norris (1947:262) postulate that low-nesting species have been more or less eliminated from suburban areas because of "attrition-pressure" which operates rigorously at the ground level but which declines with height. They further postulate that within a species different individuals have preferred nesting heights. Thus, by "attrition-pressure", certain clans comprising the species have been selected for survival in accordance with their nesting behavior. It is evident that the average nesting height that I found in suburban areas and which Klimstra and Stieglitz found in Carbondale is much greater than that found in relatively undisturbed habitats.

The nesting heights of known females are given in Table 12. Since their mates may have been influential in selecting the site, the male, if known, is also listed. With the exception of F3 in 1955, the second nest

was placed higher than the first. In 1954 F7 and F8 started nests at 7 feet. F7 then constructed another nest (54-6) 25 feet above the ground and F8 built her nest (54-7) at 40 feet. From my data no favorite nesting height for a given female is apparent. Brackbill (1947c:116) found no preferred nesting height for two females, but a third one built three nests 8.5 feet above the ground.

Nest Construction

In the early spring, before nest construction is underway, female robins pick up grasses and other materials, and then drop them. Temperature undoubtedly influences the start of nest building. The number of nests in their first day of construction in and around the study areas, together with the average temperature, is shown in Figures 26, 27 and 28 for 1954, 1956 and 1957 respectively. In all three years, the very first nests were started after a rise in temperature. The stimulating effect of high temperatures and the depressing effect of low ones are evident in 1956.

Construction is done mainly by the female. First a bulky foundation is built; next a mud cup is added and then the lining. Herrick (1911) describes the behavior of the nest-building female in some detail. Of 56 excursions to gather nesting material that I recorded in my field notes, the male accompanied the female 17 times. At other times the male was usually nearby, on a perch or feeding on a lawn.

Herrick (1911:347-348), Jordan (1901:108), Kelly (1913:310) and Samson (1923:106) write of males bringing material to the nesting site. Once while nest 54-6 was under construction I observed the male crouched in the nest, turning about as if shaping the cavity, an action also described by Shantz (1939:158).

A variety of materials was used in nest construction. Analyses of

Figure 26. Nests in their first day of construction in and around Areas 1 and 2 in 1954.

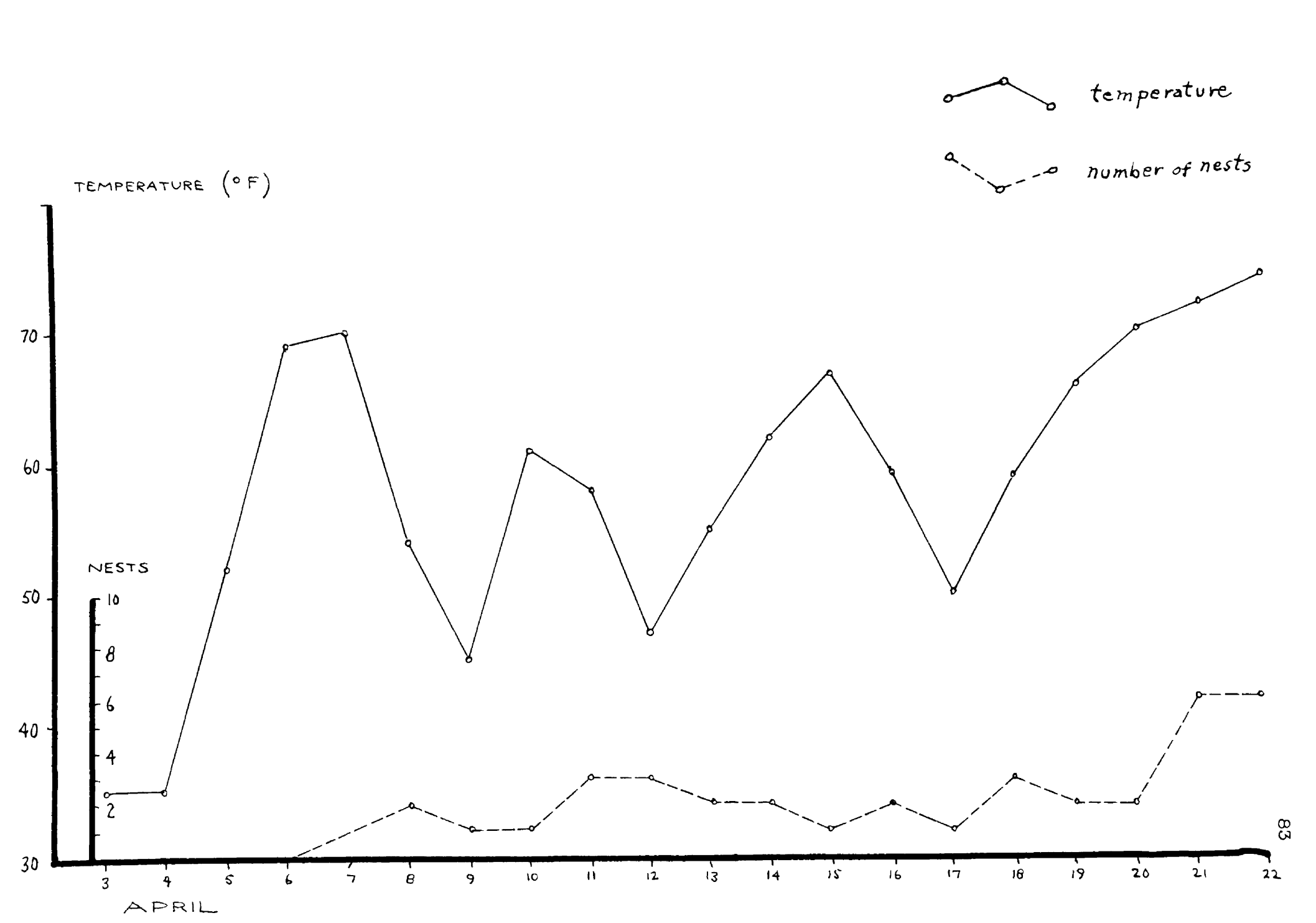

temperature
number of nests
TEMPERATURE (°F)
70
60
50
40
30
NESTS
10
8
6
4
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
APRIL
83

Figure 27. Nests in their first day of construction in and around Areas 1 and 2 in 1956.

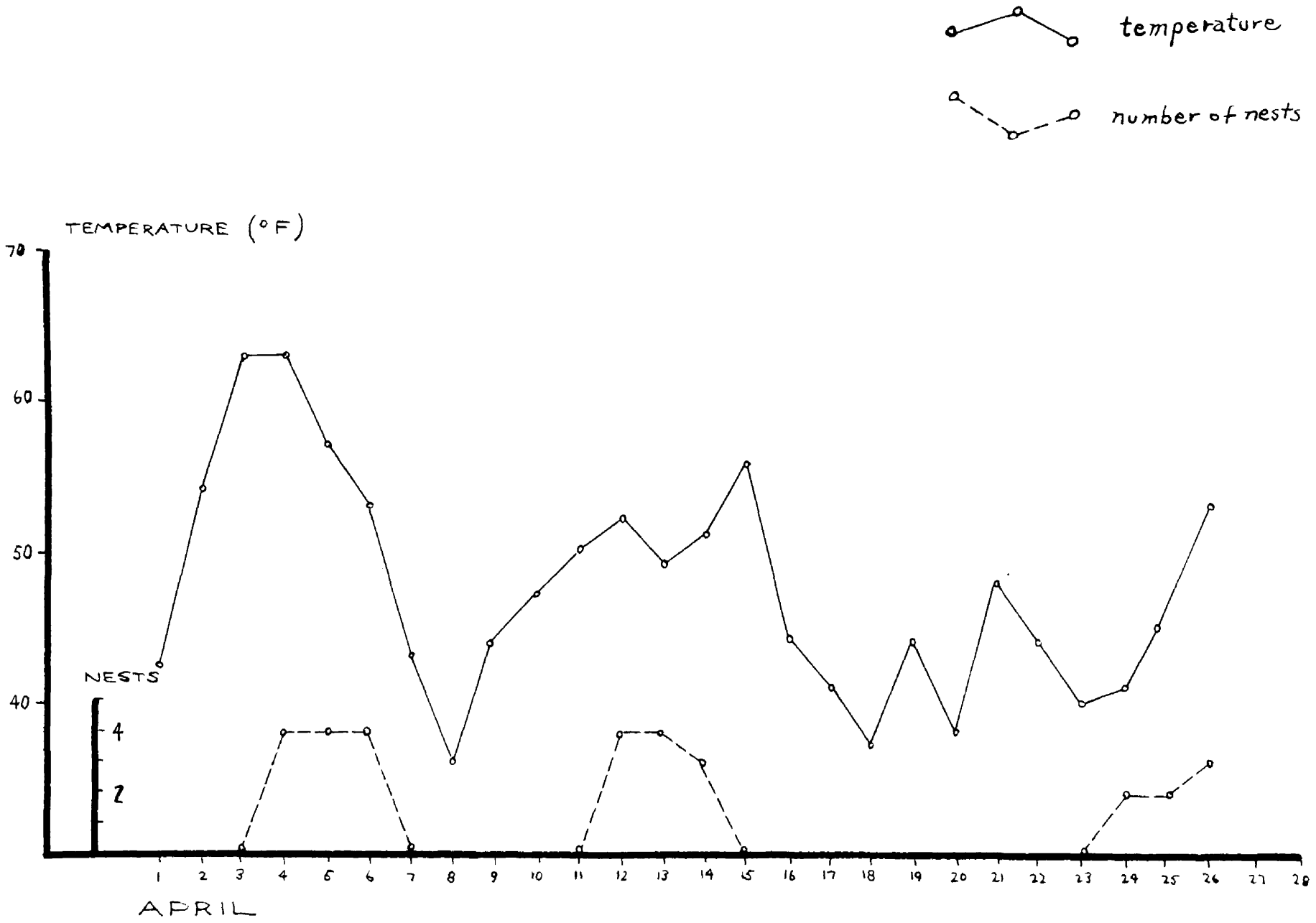
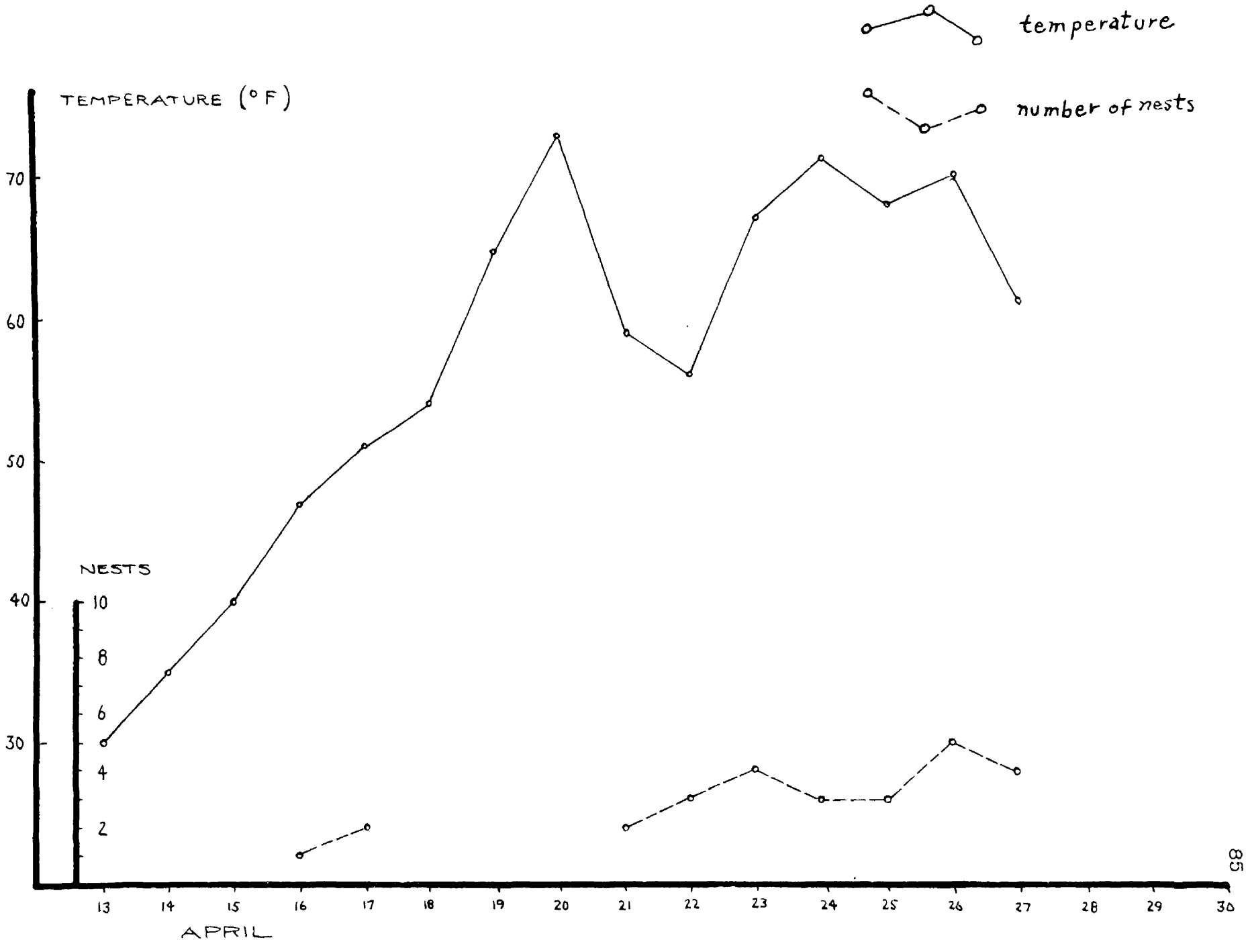

temperature
number of nests
TEMPERATURE (°F)
70
60
50
40
NESTS
4
2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
APRIL

Figure 28. Nests in their first day of construction in and around Area 3 in 1957.


temperature
number of nests
TEMPERATURE (°F)
70
60
50
40
30
NESTS
10
8
6
4
2
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
APRIL

nests collected in Pittsburgh and East Lansing are given in Table 13. Grass was found in all of them. Of the 12 nest linings examined, 6 were composed entirely of grass. Roots were found in 2 linings and in 14 out of 17 foundations. Several times when I was observing robins gathering grass, I noted that they pulled up the roots as well.

Seven of the eight foundations with bark had pieces of grapevine bark. I saw one female collecting this in Area 1. Once she grasped a loose piece in her bill, then fluttered into the air, pulling at it. After three attempts she got a small piece. Another time she tried unsuccessfully to get bark by pulling at loose pieces from a perch below. I found numerous twigs in the nests analyzed; the longest, about one foot in length, was from an American larch (Larix laricina (DuRoi) K. Koch). Pearson (1910: 207) reports a nest containing 63 slender Abies twigs, some of which were one foot in length. I watched the unsuccessful attempts of the above mentioned female trying to collect twigs from a silver maple. She grasped a twig with her beak, then pulled at it as she walked along a branch below. However, she was able to break off twigs from a grapevine.

Paper, cloth and cord are commonly found in robin nests. Of 17 nests examined, 9 had white or brown cord, the pieces ranging in length from 3 to 36 inches. While gathering material for nest 55-14, F1 succeeded in removing some stakes and string marking rows where seeds had been planted, but evidently she found the material too bulky to incorporate into the nest. Frequently paper and/or pieces of cloth are deposited first in the crotch. Hanging from the base of nest 55-24 was a piece of cloth about two feet long and two inches wide. Another nest contained a piece about six feet in length and one-third inch in width. Seven nests that I analyzed contained paper, the largest a cleansing tissue.

Materials other than mud may be used for the cup that is added to the

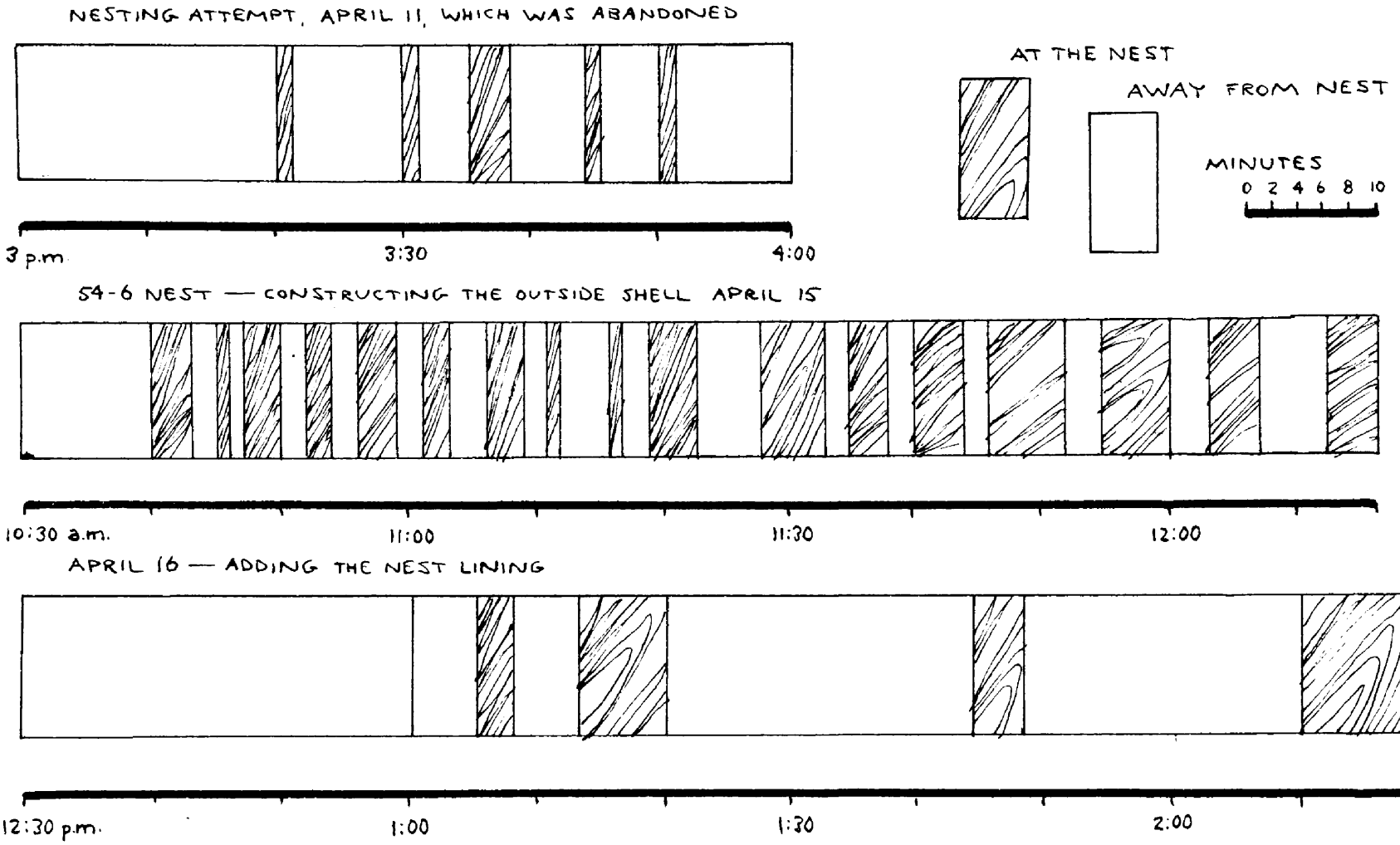
foundation. When F11 was gathering material for the cup of nest 57-22, she took muck and decayed vegetation from a bird bath. Forbush (1929:411) writes that the nest sometimes lacks a cup.

Nests show some variation in size and weight. The nesting crotch or site influences the size of the nest, and the amount and type of materials determine the weight. Nickell (1944:54) found that nests with a clay cup showed a greater average weight than those with a cup of sandy muck and that nests with muck weighed least. Linear measurements based upon 17 collected nests, and dry weights based upon 19 nests, are given in Table 14. Nests were oval in shape, and I measured the long diameter or long axis as well as the short diameter or short axis.

I studied one female while she was constructing the outside shell of nest 54-6 on April 15 and when she was adding lining to it on April 16, as well as during an unsuccessful nesting attempt on April 11 (Figure 29). The average time she spent at the site on April 11 was 1.4 minutes while the average interval away from the nest was 6.0 minutes; on April 15 it was 2.8 and 3.3 minutes, and on April 16 it was 5.6 and 15.0 minutes. During the observations on April 11 there was a drizzle of rain, and on April 16 there was a hard shower. These conditions may have cut down the activity. However, a female carried material to nest 57-16 on May 18 during a very heavy rain. In the case of nest 54-6, the intervals at the nest and away from it were longer when the lining was being added than earlier in the construction. Even though the nest appeared complete on April 16, she carried grass to it on April 19. Herrick (1911:347) noted that a female remained at her nest for longer and longer intervals during the third day.

Kelly (1913:310) observed a nest that was completed in one day; Shantz (1944:118) reported one whose construction extended over 18 days.

Figure 29. Nest-building activities of the 54-6 female in Area 1.


NESTING ATTEMPT, APRIL 11, WHICH WAS ABANDONED
AT THE NEST
AWAY FROM NEST
MINUTES
0 2 4 6 8 10
3 p.m.
3:30
4:00
54-6 NEST — CONSTRUCTING THE OUTSIDE SHELL APRIL 15
10:30 a.m.
11:00
11:30
12:00
APRIL 16 — ADDING THE NEST LINING
12:30 p.m.
1:00
1:30
2:00
2:30

Howe (1898:164) writes that the variation in time is caused by weather conditions and by whether or not the female is ready to lay her eggs. He found that the average time needed for seven nests was six days. Young (1949a:40) found it to be seven days. In my study the average time for 12 nests was four and one-half days. Nine of them were first nests, and the average time was four days, with extremes of two and eight days. Two of these nests, 57-1 and 57-3, were built in two days, following a very pronounced change from cold to warm weather. The average time for the three later nests was 5.7 days, with extremes of two and eight days.

Four of the 12 were constructed by F1. Her first nests, 54-2 and 55-1, required four and one-half, and five days respectively, and her second nests, 54-30 and 55-14, eight and seven days respectively. In both years these second nests were constructed in late May and early June when she was helping care for the first broods that were out of the nest. However, Howell (1942:589) found that the time for building second nests averaged about four days while that for first nests averaged about six days.

Multiple nests, either of the storied type or side by side on a horizontal surface, have been found by several observers. Many authors record a robin nest being used for more than one brood. F3 used the same nest for her first broods in 1954 and 1955. F1's first nest in 1956 was constructed in 1955 by an unmarked female.

Arthropod Fauna of Robin Nests

In 1954 I found a number of blow-fly larvae in three nests. These specimens, and later others, were sent to the Insect Identification and Parasite Introduction Section of the United States Department of Agriculture, where Dr. C. W. Sabrosky, in collaboration with Dr. G. Bennett,

placed them in a new species of Protocalliphora, which will be published in the near future (personal communication).

Johnson (1925:53; 1927:2; 1929:29; 1932:26), Mason (1936:113), and Plath (1919c:375-376) report the occurrence of the blow-flies, Calliphoridae, in robin nests. Johnson (1925:53) writes that the larvae usually hide in the nest during the day and that at night they emerge to suck blood from the nestlings. Plath (1919a:193) introduced larvae of Protocalliphora azurea (Fallen) into a cage containing lesser goldfinch (Spinus psaltria) nestlings. Later larvae were found on the feet and lower parts of the body of each nestling. Thomas (1936:46) postulates that the larvae normally leave the nest at maturity and pupate in the ground unless a mud cup or a nesting cavity prevents them.

In the Puget Sound region, Plath (1919c:374) found 18 out of 25 (72 per cent) robin nests infested with Protocalliphora azurea. He found the number of larvae ranging from 7 to 138 per nest. I found Protocalliphora in 8 out of 20 (40 per cent) nests taken in Pittsburgh (Table 15), but none in the six nests collected in East Lansing. All were of an undescribed species, with the exception of three P. metallica Tns. in nest 56-1. More adults than puparia are listed for nests 54-8 and 56-8. Evidently some of the pupal cases were lost when the nests were taken from gallon jars in which they were stored. In the other six nests more puparia than adults were found. It is possible that some of the pupae were parasitized and thus did not complete their metamorphosis. Mason (1936:113) and Whitehead (1933:293) found chalcid-flies, Chalcidoidea, parasitizing Protocalliphora.

Two of the nests listed in Table 15 were collected by students who did not record the height, but the others were low. Plath (1919c:375) believes that the height of the nest may be a factor in parasitism by

Protocalliphora.

George and Mitchell (1948:550), Mason (1936:113), Neff (1945:75) and Plath (1919a:199; 1919b:38) attribute deaths of nestling birds to blow-fly larvae. Of the eight nests listed in Table 15, five were known to be successful in producing apparently healthy young. Johnson (1927:1; 1932:28), Thomas (1936:46) and Sargent (1938:83) likewise observed no ill effects upon several species of nestling birds.

I found the following specimens of arthropods in robin nests.

	Number	Nest
Crustacea		
sow-bug, Porcellio laevis Koch	2	54-40
	32	54-43
	2	56-1
Insecta		
Phalaenidae (puparium)	1	54-50
Anthomyia pluvialis (L.)	16	54-40
Fannia sp.	1	56-8
Bradysia sp.	27	54-43
Arachnida		
Ornithonyssus sylviarum (C. & F.)	-	54-43

Of these, the northern fowl mite (Ornithonyssus sylviarum) is the only parasite; it breeds directly on the host (Ewing, 1929:12).

Peters (1936:21) lists the following ectoparasites of the robin: several species of bird lice (Mallophaga), two species of louse-flies (Hippoboscidae), as well as several mites and ticks.

EGGS

Description

The eggs of the robin are greenish-blue in color. In Pittsburgh the average size of 17 eggs in millimeters was 29.2 x 20.3 and in East Lansing 7 eggs averaged 29.2 x 21.5. The maximum length in Pittsburgh and East Lansing was 31.0 (two records, x 19.9 and x 20.1) and 30.9 (x 21.2) respectively, and the minimum length was 27.1 (x 20.0) and 27.1 (x 21.3). The maximum width was 22.0 (x 29.5) and 22.0 (x 30.0), and the minimum width was 19.5 (two records, x 28.9 and x 29.0) and 21.2 (two records, x 28.9 and x 30.9). For 30 eggs in the Ithaca region Howell (1942:562-563) found that the average length was 28.4 and the average width 20.7. He determined the average weight of 60 eggs as 6.26 grams. Hamilton's (1935: 109) observations indicate that during incubation there is a loss of more than 25 per cent of the original weight.

Oviposition

For seven nests, six in Pittsburgh and one in East Lansing, I found that the average time between the completion of the nest and the appearance of the first egg was four days, with extremes of two and seven days. Young (1955:336) observed that oviposition usually began three or four days after the nest was completed, but that there may be no interval or as much as 15 days elapsing before the first egg is laid.

Eggs are usually deposited at the rate of one per day until the clutch is complete, although Young (1955:337) found it common for the female to skip a day.

Clutch Size

Young (1955:337) calculated the mean clutch size for 273 nests as 3.4 ± .05. The mean clutch size for 42 nests in Pittsburgh was 3.4 ± .11; for 13 nests in East Lansing it was 3.5 ± .18 (Table 16). Sets of five eggs or more are uncommon. Howell (1942:536-537, 561) discusses large clutches, citing examples of six, seven and eight, some of which are known to represent the laying of two females.

Using the Maryland data on file at the Patuxent Research Refuge and data gathered by Howell at Ithaca, New York, Davis (1955:21) calculated the mean monthly clutch size, and these data are compared with mine in Table 17. In all cases there is a drop in clutch size in June, but no trend is evident in the early spring.

Incubation

The female robin may begin to sit on the eggs before the clutch is complete. However, the presence of a bird on the nest does not imply that full heat is being applied to the eggs.

I found the female of nest 57-18 on the nest in the afternoon of the first day of egg laying. On the second day of oviposition, the female of nest 55-23 was incubating in the evening while the females of nests 57-7 and 57-9 were incubating earlier in the day. The female of nest 54-45 was not attentive to her eggs until the third day.

In the case of two nests Kendeigh (1952:127) noted that the female was on the nest the night after the first egg was deposited. Herrick (1911:349) observed that incubation began at one nest on the second day of oviposition, and for three nests Schantz (1939:159) found that incubation began on the evening of the second day. In the studies of single nests, Charles (1909:27) and Murray (1930:428) found the start of incubation to

be the third day while Saunders (1938:81) did not observe the female incubating until the day after the third egg was laid.

I determined the incubation period for 12 nests, 10 in Pittsburgh and 2 in East Lansing, by recording the day the last egg was laid and the day it hatched. Seven clutches were incubated for 12 days, four for 13 days and one for 14 days, with a mean period of 12.5 ± .19 days. This is in agreement with Kendeigh's data (1952:127) which indicated a mean interval of 12.4 days for 13 nests and with Young's (1955:337) which gave the mean length of incubation as 12.5 ± .14 for 57 eggs. Koehler and Koehler (1945: 17) record a female which sat on three eggs for 19 days, then abandoned them.

Periods of attentiveness and inattentiveness have been studied at two nests by Schantz (1939), who used an electrical apparatus to announce and/ or record the arrivals of the parent birds, and at four nests by Kendeigh (1952), who obtained data with thermocouple and potentiometer. Forty attentive periods taken at random by Schantz (1939:160) during the incubation of a second clutch after the first two days averaged 44.2 minutes, alternating with inattentive periods of 11.3 minutes. Thus approximately 80 per cent of the daytime was spent on the nest. At a later nest Schantz (1944: 118) recorded 32 attentive periods that averaged 20.6 minutes and inattentive ones that averaged 5.6 minutes. Kendeigh (1952:128) found that early in the spring the percentage of daytime spent on the eggs was between 78.7 and 76.2, while in June and July it was between 67.0 and 68.6, with the decrease attributed to rising air temperature.

I determined several periods of attentive and inattentive behavior at eight nests (Table 18). Twenty-one periods of attentiveness averaged 36.4 minutes, while 23 intervals of inattentiveness averaged 6.3 minutes. While

I was watching nest 54-45 on July 3, there were periods of hard rain when the female remained on the eggs. On May 2 the female incubated nest 54-6 during a thunderstorm in the late afternoon. During a light drizzle of rain on May 3 she was huddled in the nest with her bill almost flush with the rim.

For 13 attentive periods, I noted that the incubating bird changed her position on the average of once every 14.4 minutes. However, Herrick (1911:350) observed an incubating female which maintained one position with little deviation. In the course of 14 hours, Schantz (1944:118) found that a female changed position 70 times. Sometimes when the female changed her position she probed the nest with her bill, with an average of once every 18.9 minutes for eight attentive periods. I was unable to see what she was doing, but it is quite possible that she was turning the eggs. Schantz (1944:118) writes that the above mentioned female turned the eggs 22 times in 14 hours.

In nest 57-7, a cracked egg was retained throughout incubation even though it was reduced to a mere shell. In other instances such eggs disappeared from the nest, evidently removed by one of the adults, or else the nest was deserted.

Frequently I found the male perched near the incubating female, and on several occasions I saw the male at the nest. Eighteen observations were made at eight nests of one adult relieving another. Six times call notes were given by one of the adults, but in the other cases no notes were used. I noted that some males perched on the nest rim while the female was away. Schantz (1944:118) writes that the male spent 68 minutes at the nest that he studied for 14 hours.

I made 11 observations of six males sitting on the eggs while the fe-

male was away. For three intervals of 8, 10 and 22 minutes, the male crouched in nest 57-13 like an incubating female. The other attentive periods by the male were brief, ranging from one to three minutes. Brackbill (1944:139) and Samson (1923:107) record males sitting on the eggs during adverse weather conditions. This behavior cannot be considered true incubation, however, as the male lacks an incubation patch (Bailey, 1952: 127).

Hatching

Robin eggs hatch within a period of about 24 hours (Howell, 1942:568), and a clutch tends to hatch over a period of two or three days (Kendeigh, 1952:127).

Following hatching, the shells are usually carried from the nest. Shell-carrying is quite general among the Turdidae (Nethersole-Thompson, 1942:191). The remains of an egg from each of two nests, and of two eggs from another nest were carried to points 100, 55 and 75 feet away. In the case of 55-7, however, I collected shell fragments directly under the nest. One half of a shell from nest 54-2 was tucked inside of the other part. This is commonly observed in the song thrush (Turdus ericetorum) (Nethersole-Thompson, 1942:214).

The female may eat the shells. Charles Reinbolt reported that the female of nest 54-22 did this. Howell (1942:568) cites a similar observation.

Infertile eggs may be retained in the nest. In nest 57-7 one egg that had been cracked remained in the nest throughout incubation even though it was reduced to a mere shell. The movements of the birds may grind the pieces into the lining, and this may account for some of the shell fragments

found in nests. In other instances such fragments may be from shells that were not removed from the nest, or in cases of robbed nests, shell fragments may be left by predators after eating the eggs.

THE YOUNG

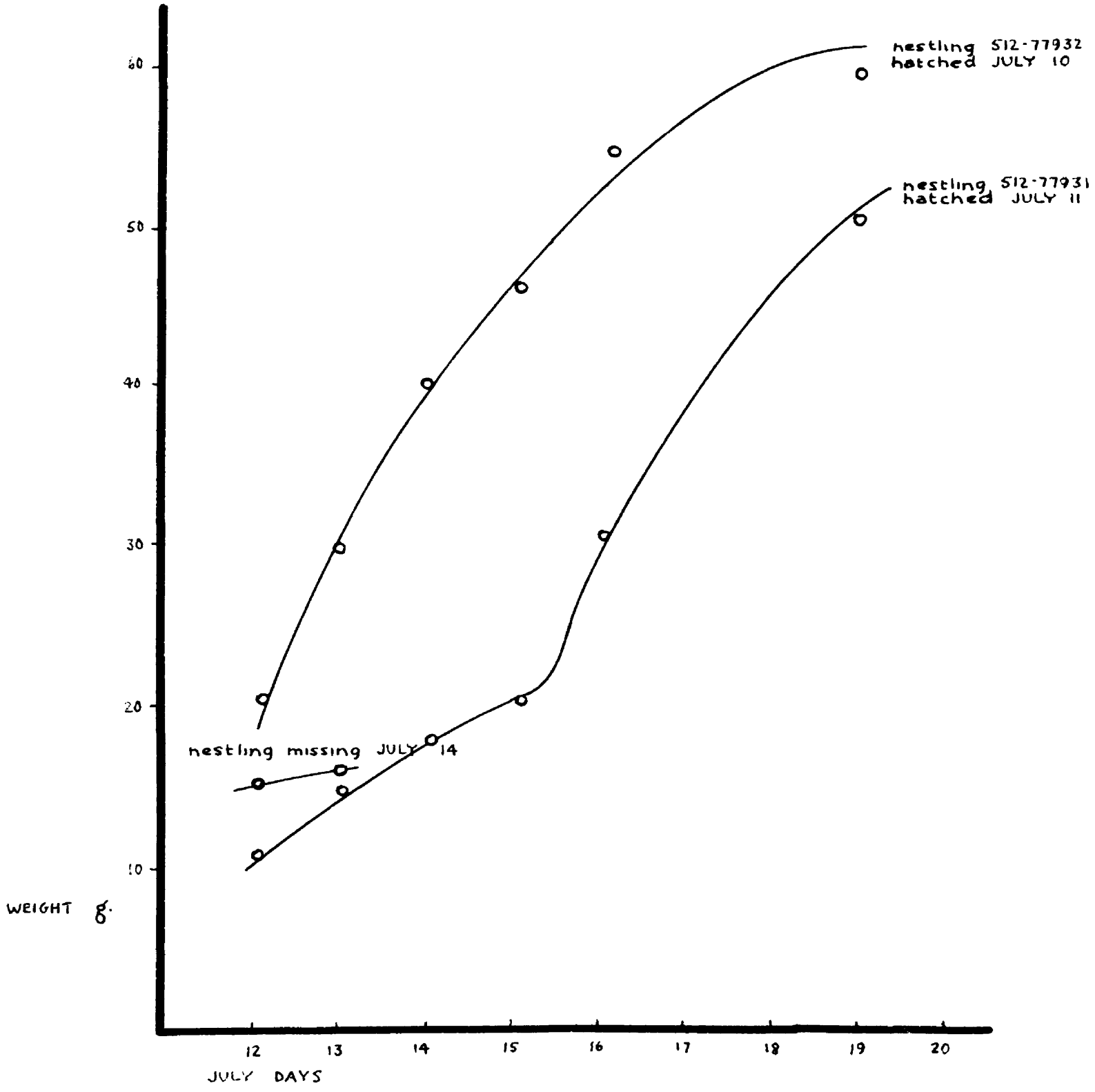
Physical Development

The development of Y79 of nest 57-16 is shown in Plates 7-9. Howell (1942:569-581) describes the growth of robin nestlings in detail, including the daily changes in weight, total body length and length of wing, tarsus and tail. I recorded the changes in weight for the young of nest 54-44 (Figure 30). The nestling that was missing on July 14 may have died and been removed by one of the adults. Judson (1915:213) writes of a male carrying off a dead nestling. Nestling 512-77931 was one day younger than its two nest mates, and its increase in weight after the fourth day, when it weighed much less than Nestling 512-77932, was very pronounced. Baldwin (1922:222) found that the weight of the youngest member of a brood of three increased similarly; by the ninth day it even surpassed one of its older nest mates. That an age difference of two days or more may be very unfavorable for the youngest member is indicated by Nickell (1957:95), who found three four-day-old young and another not more than two days old in a nest. Three days later the latter was dead.

Attentive Behavior of Adults at the Nest

Kendeigh (1952:129) writes that there is no pronounced difference in the amount of attentiveness to eggs and to young nestlings. With an itograph at a nest, he found that the time spent brooding young the second and third days after hatching averaged 36.3 minutes per hour from 8:00 A.M. to 2:00 P.M. and 43.4 minutes per hour in late afternoon. At another nest over a 10-hour period, the average time spent brooding the young was 29

Figure 30. Daily changes in weights of the robins in nest 54-44.


nestling S12-77932
hatched JULY 10
nestling S12-77931
hatched JULY 11
nestling missing JULY 14
60
50
40
30
20
10
WEIGHT g.
12
13
14
15
16
17
18
19
20
JULY DAYS

minutes per hour.

Howell (1942:583) states that the female broods her young at night until they leave the nest. On the other hand, Kendeigh (1952:134) states that the female does not sit on the young at night when they are fairly well grown. However, at nest 54-45, when the nestlings were 14 days old and filled the nest completely, I observed the female settling down on them at dusk. Her body merely rested on the nest rim. The day before, the male sat on the young for a three-minute interval. Ghiselin (1956:235) saw a male brooding five-day-old young.

From approximately 16 hours of observation at seven robin nests, I found a rather wide variation in the rate of feeding, with an average of 6.4 times per hour (Table 19). In late July, Kendeigh (1952:129) obtained records for five of the last six complete days that young were in a nest and calculated an average of 6.1 feedings per hour. Schantz (1939) gives very complete data on two broods. Over a period of 10 days, a first brood averaged 6.7 feedings per hour, a second one 6.5 feedings per hour.

At one nest, Schantz (1939:163) found intensive peaks of feeding activity from 4:00 to 7:00 A.M. and from 9:00 to 10 A.M.. On the other hand, Charles (1909:29) found that the most active feeding time at two nests was late afternoon and early evening. Both sexes feed the young. The male of nest 55-23 did not participate in feeding at the beginning or at the end of the nestling period. Likewise, the male of nest 56-24 was not active at the end, but at nest 54-45 the female was not attentive to nestlings about ready to leave the nest. Schantz (1939:164) observed that in three successive broods the male shirked feeding on the day before the young were fledged.

An egg introduced into nest 57-7 hatched two days before the others.

The adults responded by feeding the nestling. On May 4 a nestling cardinal that had fallen out of its nest was placed in nest 55-2, which contained four robins about the size of the fringillid. On the morning of May 9 it appeared to be in good health, but later in the day it was missing along with one of the robins.

By removing food with blunt forceps from three nestlings on alternate days, Hamilton (1935:110) found that approximately two grams of food were brought on each visit. At times I noted that parent birds returned to the nest without food, and evidently in an effort to appease the young placed their empty bills in the gaping mouths. From analyses of 15 stomachs taken from robins ranging in age from 3 to 35 days, Howell (1942:587) found that animal matter made up 70.2 per cent of the food, and plant material 29.8 per cent.

My earliest record of vegetable material being brought to nestlings was at nest 57-20, where fruits of the American elm were fed to young between seven and eight days of age. At nest 55-23, when the young were 11 days old, 2 out of 16 feedings consisted of Amelanchier fruits. Lonicera berries were brought to the young of nests 54-45 and 56-24 when they were 13 and 15 days old respectively. Evidently some grit is introduced with the food. Howell (1942:588) found gravel in robins three to four days old. An examination of a stomach of one of the 57-15 brood that died shortly after fledging yielded sand and grit.

After being fed, the young often raises up and passes a fecal sac into the bill of the parent, which eats the material or carries it from the nest. I noted that five fecal sacs were carried approximately 100 feet from nest sites, and another 150 feet. In the late stages of nesting, the young evacuate over the nest rim, and these excreta may also be eaten. During

approximately four and one-half hours at nests, I made observations on this behavior. These data (Table 20) indicate that waste material is removed about three times per hour, and also that robins eat fecal material in varying degrees.

At one nest, Saunders (1938:82) noted that the adults swallowed the excreta until the last two days the young were in the nest. I observed that some nests became soiled at this stage. This was particularly pronounced at nest 54-45. Even the leaves below the nest were covered with excreta. For two days preceding the departure of the young, both adults, the male in particular, probed the sides of the nest and the surrounding leaves for fecal material. Tyler (1913:397) records similar behavior on the part of a female which perched near the nest and made dives for the fecal sacs as soon as the young voided them. To a lesser extent the female of nest 55-23 exhibited such behavior on the day the young fledged. Once in the morning she took a fecal sac, flew to a nearby tree and ate it. She ate another that had been voided on the plank where the nest was placed, and once she ate excreta on the outside of the nest. Twice she probed into the nest, perhaps taking fecal material. Some was present in the nest when I examined it later in the day. This may be an important factor in nest probing observed in adults caring for young. However, Protocalliphora puparia were present, and perhaps she was eating them. Haverschmidt (1953:249) associates nest probing with removal of parasites and/or food remnants.

The concern of adults for nestlings varies somewhat from nest to nest, but it appears to increase with the development of the young. When nestlings were taken for banding, the adults frequently dived at and sometimes struck me, but they usually quieted down after I left with the young. When I re-

turned, protesting call notes were given, but not until I removed young from the small box used for transporting them did the parent birds show a marked reaction.

Extent of the Nestling Period

The listing below gives the extent of the nestling period for 37 individuals.

Days in Nest After Hatching	Number of Young		
	Pittsburgh	East Lansing	Total
12	0	2	2
13	10	2	12
14	9	2	11
15	4	6	10
16	0	2	2

The mean number of days spent in the nests was 13.9 ± .16. This is somewhat higher than the 13.4 ± .13 days calculated by Young (1955:338) for 89 nestlings. However, he included individuals that were obviously disturbed on their eleventh day in the nest. Howe (1898:167) found that the nestling stage for five broods averaged 14 days. In his study of three consecutive broods, Schantz (1939:166) noted that the second and third broods left 14 days after hatching while the first left after 15 and 16 days. The two young that I recorded for 16 days in nest 57-2 were also members of a first brood, but it is thought that cold, wet weather was an important factor in keeping them in the nest.

By the time young had been in the nest for 10 days, they became very active, particularly when the parents came to the nest. They stood up, stretched and flapped their wings. During the afternoon of their twelfth day in the nest, the 55-23 nestlings stretched their wings after each feed-

ing. One even perched on the nest rim briefly. Eleven-day-old young in nest 54-45 preened themselves, and this was observed frequently in other nests as the young developed. The earliest record of a nestling scratching itself was at 12 days. When the adults were absent, the young slept for short intervals, their heads sometimes resting on the nest rim.

On June 26, I watched nest leaving at nest 55-23 in a grape arbor. Y52 was fledged before 8 A.M., and F3 continued to feed the remaining two. After a feeding at 10 A.M., Y53 climbed out of the nest, preened its feathers, was fed again, and returned to the nest within 10 minutes. At 2:30 P.M., Y51 climbed out of the nest, only to return, and for about 20 minutes both young were very quiet. About seven hours after Y52's departure, Y53 left the nest, at which time Y51 perched on the nest rim. About 30 minutes later, immediately after a feeding, Y51 flew clumsily to the ground, landing about 25 feet from the nest. Seven minutes later, it fluttered down an embankment into a clump of shrubs, a distance of about 35 feet. In one brood that Schantz (1939:166) studied, the oldest individual flew 33 feet to a perfect landing in a tree while the younger two flew about 20 feet.

At nest 54-45 two young left the nest in the morning of July 24, one perching about two feet above the nest until mid-afternoon. A third one remained in the nest until 3 P.M., and for two hours preceding its departure no food was brought to either one. By evening both had left the nest tree. Some fledglings remain in the nest tree for a day or more, as observed in a robin from nest 54-7, and one from nest 54-44. Charles Reinbolt reported that the two young of nest 54-21 in an elm remained there the day they left the nest.

Robert Clark observed the three young leaving nest 56-61 at hourly intervals on the morning of May 26, but Schantz (1939:166) watched all

three young of a brood leave within a few minutes of each other. However, the members of a brood are not necessarily fledged on the same day. Common (1947:244) recorded one fledging about 40 hours before its two nest mates, and Ghiselin (1956:235) observed three fledging over a period of five days. Nice (1944:2) gives an unusual record of the eldest young leaving the nest four days before its three mates.

Interval Between Broods

Robins frequently raise two broods, and sometimes they are successful in producing three. The average interval between the fledging of a first brood and the completion of a second nest in five cases was 11.4 days; between the fledging of a first brood and a second one it was 41.7 days in three cases (Table 21). I noted that the female usually helps care for the first fledglings up until the second brood is started.

However, the time between broods varies considerably. Judson (1915: 213) records a female building the second nest and laying the first egg before the first brood was fledged. Schantz (1939:158) noted a female selecting her second nest site two days after the first brood left the nest. Ghiselin (1956:235) records an interval of 22 days between the fledging of a first brood and the renovation of the same nest for a second brood, with 49 to 53 days elapsing between the fledging of the two broods. Tyler (1913:395) found an interval of six days between the time the first brood left the nest and when the female began incubation in the same nest.

In Area 3, five days elapsed between the destruction of nest 57-3 and the completion of the second nest, 57-13. Mousely (1917:383) collected three successive clutches from one female and found 10 days passing before the completion of another set.

Fledgling Period

After the young were fledged, they spent the next 10 to 20 days in the vicinity of the nest site. Areas in which three broods confined their activities were determined as follows.

Location	Nest	Number of Records	Days Near Nest After Fledging	Area in Acres
Area 1	55-23	31	15	1.0
Area 3	57-2	50	19	5.8
Area 3	57-11	49	13	2.8

The day that the young of nest 55-23 left their nest, they moved a few feet into a small woodlot to which they largely confined their activity. However, some individuals moved considerable distances a few days after fledging. Following are some maximum distances at which fledglings were seen from their nests. The records marked with an asterisk are Young's (1955:339). The two that I found 4000 feet from nest 54-40 were feeding in the same woodlot.

Days After Fledging	Feet From Nest
0	190
1	225*
2	240*
3	390*
4	555
7	900
14	1275*
28	4800*
31	5400*
41	4000
45	4000

Usually the male played the more active role in caring for the young. The female at nest 55-19, a second brood, was not seen after fledging day, and M3 cared for the offspring. At nest 55-23, however, M2 carried food to Y52 for one day, after which he disappeared and was not seen again until the following spring. Sometimes the adults assume equal responsibility. Schantz (1939:166) writes that two young in a first brood were cared for by the male and the third by the female, while a later brood remained closely associated with both adults. I noted behavior similar to the latter in the first brood from nest 57-2.

The attentive behavior of males in relation to five fledglings is given in Table 22. During approximately two and one-half hours of observation, the average rate of feeding was 7.8 times per hour. The attentiveness of the male continues during periods of rain. On May 19, in a very heavy rain, the bedraggled male of nest 57-11 brought food to young which had left the nest three days previously. On May 25, I flushed Y76 from a spruce thicket during a rain, and it moved to an open perch. When the male returned, he flew at Y76, hitting it with his feet and causing it to retreat. It would seem that the male was encouraging the fledgling to take shelter.

Sometimes young robins which become separated from their parents are adopted by other adults. Y75 was the only survivor of the 57-15 brood, and several times I saw it and an unbanded fledgling being cared for by an unmarked male. Once I saw Y35 of nest 55-8 being fed by an unbanded male even though its parents were in the immediate area. Nice (1944:2), Schantz (1939:166) and Young (1955:339) report similar examples.

In the following tabulation I have divided the fledgling period into three stages; the earliest appearance of certain activities is also given.

	Stage	Days Since Fledging	Activity	Earliest Observation
1.	Hiding	0-3	location note	0
2.	Early-flying	4-6	probing in ground	4
			grasping and pulling at twigs, bark and leaves	5
			tail flicking	5
3.	Semi-dependent	7-20	obtaining food	7
			cocking head	8
			chasing another young	11
			singing attempt	14
			bathing	15

The Hiding Stage is characterized by the fledglings restricting their activity to trees and shrubs, by periods of little movement, by frequent use of the location note "seech-ook", and by their complete dependence upon the parent birds. On the day of fledging I noted that the majority of young were on the ground for short intervals until they found adequate cover. Instances of young birds remaining in the nesting tree or shrub have already been cited. However, in parts of Area 2, where residents placed bread and other food in their backyards, some fledglings came to the ground with their parents to be fed. Grace Townsend's observation near dusk on the day the young left nest 55-1 indicates that the adult birds may aid the young in finding shelter. The female giving call notes was followed by two fledglings into a spruce where they remained, after which she flew to a nearby apple tree with a third one.

Once the fledglings found adequate cover, they stood or crouched on a perch for varying periods of time. One remained, almost immobile, on a

branch for 75 minutes, and another for almost three hours. Y9 of 54-40 perched on a branch for at least 12 hours, six feet from the nest; Y22 of 54-44 remained on a branch two feet below the nest for at least 24 hours. On the day after fledging of Y61 I found it "frozen" in an upright posture for about three minutes.

Upon leaving the nest the young give the location note almost continuously. When Y43 left nest 55-19, I counted the call notes given for five consecutive one-minute intervals. The calls per minute numbered 14, 10, 7, 9 and 9, with an average of 9.8. Three days later, in four consecutive intervals, its nest mate, Y44, gave 2, 6, 6 and 1 calls, with an average of 3.8 per minute. The use of "seech-ook" decreased appreciably over the succeeding days.

During Stage 1, flying attempts were somewhat clumsy and labored. Five days after fledging, many young were maintaining level flight with ease. However, some experienced difficulty in judging the heights of perches. Seven days after a fledgling of the 55-8 brood left the nest, it attempted to reach a roof about 30 feet high by flying almost straight up when it neared the building. The young robin couldn't reach the roof and then changed its course, flying to a nearby tree. Young that had been fledged eight days or more appeared capable of sustained flight. Some maximum flights that I recorded are given below.

Days Since Fledging	Length of Flight in Feet
0	40
1	60
3	150
10	800

During Stage 2, fledglings began to move readily from one branch to another, using their wings and tails to balance themselves. They grasped and pulled at twigs, and picked at pieces of loose bark and at leaves. Young flicked their tails when they gave call notes and when they were alarmed, but the tail was not moved with the precision that adults and older young exhibit. Even though considerable time was passed under cover in Stage 2, the fledglings spent more time on the ground than formerly, and they began to probe in the soil and leaf litter.

Stage 3 is characterized by a growing independence. Y76, seven days after fledging, was probing in the leaf litter of a woodlot for undetermined items of food. I have no other observations on independent feeding until 11 days after fledging. Adults often cock their heads before probing, and this activity soon developed in fledglings. Brackbill (1947a:115) found one fledgling taking cherries effectively 10 days after it left the nest, but even 8 to 10 days later it displayed little success with animate food.

Even when the young were able to acquire food for themselves, they continued to beg and follow their parents. At times the fledglings and adults moved side by side over the lawns. On June 6, 1957, two unmarked young ran to a male each time he probed in the ground. As the offspring developed, the parents encouraged independent feeding by placing food on the ground and by moving away, thus avoiding the gaping young. Grace Townsend's observation of F1 and her 55-1 brood, 11 days after fledging, shows parental influence in teaching fledglings to feed for themselves. By picking up pieces of bread, carrying them a short distance and dropping them on the ground, F1 encouraged the brood to follow her. Before the young could reach her, she would eat some bread, pick it up and move away again.

The earliest avoiding reaction that I saw was on the seventh day after fledging, when the male of the 56-12 brood jumped over a gaping young and moved over the lawn. Six days later, however, during a very heavy rain of about two hours duration, the male brought food regularly to the young perched on a sheltered window ledge. After the rain the male again attempted to avoid them. Brackbill (1947a:115) records two young being fed by adults 17 days after fledging.

Young robins often picked up pieces of leaves, bark, and paper, then shook them and tossed them aside. These playful actions were also evident after the young became independent. In August, 1954, when I was trapping robins in a woodlot, the young pecked at the draw-string on the trap, often at knots.

The earliest antagonistic behavior that I recorded was in the 55-23 brood, which was feeding in leaf litter. Y51 came within 12 inches of Y53 which promptly chased it. Schantz (1939:166) observed a young that was out of its nest 11 days monopolizing a bird bath and driving robins and other species away when they alighted.

The first singing attempt noted was from Y16 of nest 54-41 when it gave a series of harsh notes. Mrs. Amelia Laskey reported a robin singing when it was about three weeks old (Nice, 1943:141).

Y76 bathing at a bird bath 15 days after it left the nest is the earliest record I have of this behavior. At first it appeared very inexperienced, only lowering its body partially into the water. On a second attempt it bathed for 20 seconds.

Even though the location and begging notes are still prominent in Stage 3, other call notes are given. A "yip" note is thought to be the forerunner of the "yeep" note, and it was given when birds were flushed.

I heard Y80 of the 57-16 brood give this note 10 days after it left the nest. Y43, from nest 55-19, gave a nasal "yeep, chur-chur" call two days after fledging; this is the earliest record of a vocalization resembling an adult call note. On May 31, 1957, I heard an independent young giving "huh" notes.

My final observations of young with their parents near the old nest site ranged from 10 to 20 days after fledging. The mean extent of the fledgling period for 15 broods was 14.9 ± .74 days, with first broods leaving their nests on the average of 1.5 days before second ones. However, both 56-12 and 57-2 were first broods, and they remained for 19 and 18 days respectively. Even when the 57-2 female was building her second nest, the young were tolerated, but she did not feed them. The last day that I observed the young from nest 56-12, the male pounced on one and drove it from the area. Brackbill (1947a:115) found two fledglings in the nesting territory for 24 days after nest leaving. Grace Townsend observed that Y33 was chased by the male parent when it ventured back to the nesting territory on the 29th day after fledging.

NESTING SUCCESS

Table 24 summarizes data on nesting success in East Lansing and Pittsburgh. A nest was considered successful if at least one young was fledged. The percentage of success in East Lansing varied widely from 100 in 1954 and 1956 to 47.8 in 1957. However, few nests were observed in 1954 and 1956. On the other hand, the percentage of success in Pittsburgh only varied from 61.5 in 1955 to 68.8 in 1956.

I found desertion and predation to be the major factors in nesting failure (Table 25). Nine of the 12 deserted nests that I recorded were in East Lansing. Two of them contained nestlings, and these were abandoned after two days of cold, wet weather. However, the only losses that I attributed to weather were those nests actually destroyed by storms. It is thought that the use of insecticides is responsible for some desertions. Of 18 young of different species in a sprayed area, Benton (1951:26) found only 8 (44 per cent) fledging, while in a similar unsprayed area, 15 out of 21 (71 per cent) fledged successfully.

Howell (1942:549) writes of the robins' preference for evergreens during the first nesting period. Koehler and Koehler (1945:17) found that 49 out of 64 (76.6 per cent) nests in spruces were successful. That there is an advantage in utilizing evergreen trees for first nests is indicated in Table 26. The percentage of success for nests in conifers was 75 while that for nests in deciduous species was only 44. Many of the nests in artificial sites were well protected and these show a relatively high success (66.7 per cent).

In Table 27 data for nests that I was able to follow from oviposition through fledging are given. My data are then compared with Howell's and Young's in Table 28. Of 501 active robin nests, Kendeigh (1942) found that 390 (78 per cent) produced at least one young. Since he did not check some nests after the nestlings were well developed, his data are not included in Table 28. From a survey of the literature on open nests of altricial species, Nice (1957) calculated the success of 7788 nests as 49.3 per cent, hatching success of 21,040 eggs as 59.8 per cent, and fledging success of 21,951 eggs as 45.9 per cent. The data on robins are markedly similar. The average number of young produced per active nest would be 1.3, and the average number per successful nest 2.3. Young's data are interesting in that he recorded the lowest percentage of successful nests, which, however, yielded the highest number of fledglings.

The fate of the unsuccessful eggs and fledglings from Table 27 is given in Tables 29 and 30 respectively. Some that disappeared from nests were probably taken by predators, but I did not attribute loss to this factor unless definite evidence --e.g., shell fragments, wounded young-- was found. Young (1949a:45) observed that 14 out of 46 (30.4 per cent) eggs were punctured by an avian predator, perhaps the common grackle. The 11 young whose loss I attribute to predation were probably killed by man and other mammals. One young of nest 54-45 was shot by a boy; one of nest 56-36 was killed by a cat. Claw marks were on one of the four dead nestlings from nest 56-10. Nests 55-9 and 55-13, which contained a total of five young, were smashed.

The fate of at least one nestling in nest 55-2 was unusual. Two young disappeared before May 13 at which time the other two were found on the ground beneath the nest. One was still alive and was returned to the nest.

Stoddard Smith reported that the female later took this young by the leg and hurled it from the nest.

FOOD AND FEEDING BEHAVIOR

Food Materials

Many data have been published on the diet of the robin. From a survey of the literature, Brooks (1939) lists about 80 published references. Beal (1915:5) reports on the analysis of 1236 stomachs secured at various times of the year. In his study 42.4 per cent of the food was determined as animate material, chiefly insects, while the remaining food items were principally fruits and berries. Beal further states that robins eat few seeds. During a period of heavy snow in March, 1956, a male and female ate many seeds of the foxtail millet (Setaria italica (L.) Beauv.) at my feeding station, and they continued taking them for several days after the snow melted. Martin et al. (1951:149-150) have data from 1423 specimens, 442 taken in winter, 316 in spring, 514 in summer and 151 in autumn. The percentage of plant food was 64, 21, 60 and 81 respectively. Caterpillars, beetles, and earthworms were the predominant animal foods.

During two summers Hamilton (1940, 1943) studied the diet of robins at Ithaca, New York, by examining collected droppings. In 1939 the frequency of occurrence of different food items in 700 droppings was determined as 80.13 per cent animal matter and 73.14 per cent plant matter. The plant families predominating in the fecal material were Rosaceae, Solanaceae and Caprifoliaceae. In 1942 plant remains occurred in 81.5 per cent of the droppings, with barberry (Berberis sp.) as the most important plant material. Of animal matter, which was found in 93.5 per cent of the droppings, beetles were the most prevalent.

Feeding Behavior

When a robin feeds on the ground, it probes into the soil from either a normal posture or a crouched one. Frequently, when it feeds from a crouched posture, it cocks its head to one side before probing. Sometimes the downward peck produces food, sometimes not. Of 61 successful probings that I recorded, 16 (26.2 per cent) were made from the normal posture while 45 (73.8 per cent) were from the crouched one. Twenty-six of the latter (57.8 per cent) were made after the robin cocked its head.

The question arises as to whether the robin cocks its head to see its prey better or to listen for it. Acute eyesight was demonstrated when a robin would suddenly run forward a few inches from a normal posture, peck at the ground and obtain an insect or other small arthropod. On June 5, 1957, while feeding on small worms in the lower level of a bird bath in Area 3, Y76 cocked its head before two out of five successful probings, even though the worms were plainly visible. On June 14, 1957, while collecting elm samaras on a street in Area 3, the female of nest 57-20 cocked her head before three out of seven pecks. In these two instances the bird was certainly not listening for prey. Unfortunately there are no available data on the robin's hearing acuity. However, Jackson (1951:344) observed a robin directly under his gaze taking earthworms that were not visible at the surface, from a depth of about three-fourths inches. It is possible that the observer was unable to detect the movements of small soil particles, which the robin could see.

When robins fed in leaf litter of woodlots, they scratched in the leaves, pecked at them and threw them aside. When they took fruits from trees and shrubs, they usually perched above or below the food. On two occasions, I noted individuals hovering in the air and snatching fruits.

On June 25, 1955, while fluttering near an Amelanchier shrub, F3 picked one fruit. On September 13, 1956, a few robins feeding on wild grapes and black cherries in Area 3 flew from branches up to fruits, took them on the wing, and returned to perches below. Bernard Van Cleve told me that he observed similar behavior of a female gathering ants from a tree trunk. Cleveland (1923:254) watched robins catching periodical cicadas (Magicicada septendecim (L.)) in mid-air as well as moving over the tree trunks like woodpeckers in their search for these insects. Hodges (1948:164) noted about 12 robins feeding on aquatic insects as the birds skimmed over the surface of the water and even plunged into it.

Communal Feeding Areas

Robins spend an appreciable amount of time in flocks, which frequent open areas as well as wooded ones. This behavior is particularly evident before nesting begins in the spring and again after nesting in the summer. In both East Lansing and Pittsburgh, robins were found in increasingly large numbers in wooded sections from late June until August, when practically the entire population had deserted urban areas. As early as the last week of June, I found young feeding on the red-berried elder (Sambucus pubens Michx.) in woodlots of East Lansing.

Some robins were found in all wooded areas that I investigated in East Lansing in late summer, but the largest numbers were always in a woodlot northeast of the East Lansing Junior High School on Abbott Road. In this woodlot there was an extensive thicket of buckthorn (Rhamnus frangula L.), which not only provided food but also protection (Plate 6-B). Common grackles, starlings, cowbirds and cedar waxwings made use of this site as well. The robins fed on the buckthorn drupes, as well as in the leaf lit-

ter of the woods and on adjacent lawns. In 1953 the first record of robins making use of the buckthorn thicket was on July 29, after which the ripening fruits attracted many. The droppings of birds were colored a deep blue, and it was easy to note that birds feeding on these fruits ranged throughout the woods as well as on the nearby lawns, streets and sidewalks. Robins ate the fruits whole. On August 6, 1953, one individual took three drupes in one-half minute; another took five in three-fourths of a minute. This 25-acre woods was disturbed by construction in 1955, but robins continued to use the area. From 7:45 to 8:15 P.M. on July 27, 1957, I counted 70 moving from the woods to the high school lawn nearby before they flew to the night roost.

One robin was collected in the Abbott Road woods in August, 1954. Analysis showed that 90 per cent of the stomach contents was composed of beetles belonging to the family Histeridae, 1 per cent to the wasp family Calcidae and 9 per cent unidentifiable. The stomach of one collected in a Pittsburgh communal feeding area on August 4, 1955, was filled entirely with the pulp and seeds of bittersweet nightshade (Solanum dulcamara L.).

Near Area 2, a woodlot adjacent to a municipal golf course attracted robins in late summer. Both Crataegus and black cherry were plentiful. The birds fed on fallen haws, some of which were soft and rotten. One young took a haw in its bill, beat the fruit on the ground and took three bites in 30 seconds. This same individual speared a haw and moved its beak so that it was able to get a small piece. The bird then threw the remaining part to the ground and later retrieved it for another bite.

Communal feeding areas which attracted robins consistently had the following characteristics: a good supply of fruiting shrubs and trees, areas of exposed leaf litter with little herbaceous cover, and adjacent

expanses of lawns. To determine the type of food items which flocks of robins might utilize in the leaf litter and soil, four soil samples were collected in 1956, two from the Abbott Road woods and two from a small woods on the Red Cedar River in Area 3. A six-inch square was marked off on the surface, and all of the soil within these bounds to the depth of six inches was collected. The animals were counted and identified as follows.

Sample	Lumbricidae	Other Oligochetes	Coleoptera Adult	Coleoptera Immature
Abbott Road				
1	2	-	1 Histeridae	1 Carabidae
			1 Scarabaeidae	
2	7	-	1 Curculionidae	2 Curculionidae
				2 Elateridae
Area 3				
3	3	17		1 Elateridae
4	2	32		

Four post-nesting recoveries of banded robins were made in woods used as daytime feeding areas: F4 in a woodlot of Area 1, 525 feet from her second nesting site on September 3, 1955; F1 in a woods of Area 2, 375 feet from her first nest on September 30, 1954; and two young of nest 54-40 mentioned previously. Whether they utilized the same area for any length of time was not determined. In August, 1954, I banded over 10 young in the Abbott Road woods, but I was not able to find them on succeeding days.

Drinking Water

During an eight-hour period I watched three robins as they came to

drink water at bird baths and pools. The air temperature was fairly uniform, approximately 70° F.. Usually a robin took more than one swallow when it came to water. The tabulation is given below.

	Length of Observation in Minutes	Bird	Times at Water	Beakfuls of Water	Beakfuls per Hour
	130	54-45 female	1	4	1.8
	44	54-45 female	2	8	10.9
	153	54-45 female	3	24	9.4
	77	54-45 male	1	6	4.7
	72	F1	1	1	.8
Total	476		8	43	5.4

ROOSTING

In the evening robins fly to roosting areas where they remain until early morning. Howell (1940:21) writes that during the nesting season only the male goes to a roost while the female remains on the nest. Later when the young are able to fly well, they also move to a night roost.

Before leaving their nesting territory or feeding grounds at night, robins exhibited considerable restlessness. They flew back and forth between the ground and perches in trees or on houses, often giving call notes. Sometimes they joined other robins flying overhead. From one to two hours before sunset at the Abbott Road woods, robins moved from the buckthorn thicket through the eastern part of the woods to the open areas beyond. I observed the same behavior at the communal feeding grounds near Area 1. Here the robins shifted to the adjacent golf course before repairing to the roost.

Abel (1914), Bailey (1932), Black (1932), Bolander (1932), Brewster (1890), Ganier (1924), Howell (1940), Pearson (1910), Speirs (1946), Stover (1912) and Youngworth (1929) describe roosts and/or roosting behavior, of which Brewster's account is the most complete. Most of these roosts were in wooded areas.

Robins commonly roost with other species of birds, especially starlings, grackles and cowbirds. I observed this at a roost in a residential section of East Lansing and at one in a woods directly north of Ingram, a suburb of Pittsburgh. The roost at Highland Park in Pittsburgh was composed almost entirely of robins.

I made observations at Ingram only in the late summer of 1953. Situated on a northern slope, the roost covered an undetermined portion of a second growth wooded area that was about one mile in length and one-fourth mile in width. There were many Crataegus thickets. I studied the East Lansing roost in the summers of 1953, 1954 and 1957. It covered somewhat more than six city blocks, with minor fluctuations in boundaries. The roost in Highland Park was the densely shrubby northern embankment of a reservoir plus adjoining wooded areas. The shrubs, largely mock-orange (Philadelphus coronarius L.), were from six to eight feet in height. Bernard Van Cleve and I studied this area from 1955 through 1957.

Figure 31 shows the flock size that Stanley Belfore and I recorded at the Ingram roost on two evenings in 1953. No attempt was made to count the total number of robins, since they were arriving from a number of directions. It can be seen that they arrived singly and in small groups, which were loose, straggling ones. The largest flock was composed of about 50 individuals. Likewise, most of the aggregations that Brewster (1890: 369) and Stover (1912:170) observed were small. However, Youngworth (1929: 105) records robins coming to a roost in groups ranging from 150 to 200. At two winter roosts, Bolander (1932:142) and Pearson (1910:208) describe some flocks as enormous.

On five clear evenings at the Highland Park roost robins flying into the area were counted, and at five-minute intervals the light intensity was measured with a Weston Master Lightmeter (Figure 32). Flying at 100 feet or more above the roost, the early arrivals descended toward the vegetation in almost vertical dives. Sometimes they went to the reservoir to drink or to the lawn to forage. With the advent of darkness, robins streamed into the roost in progressively larger numbers, sometimes only

Figure 31. The composition of robin flocks arriving at the Ingram roost in Pittsburgh on the evenings of August 27 and September 11, 1953.

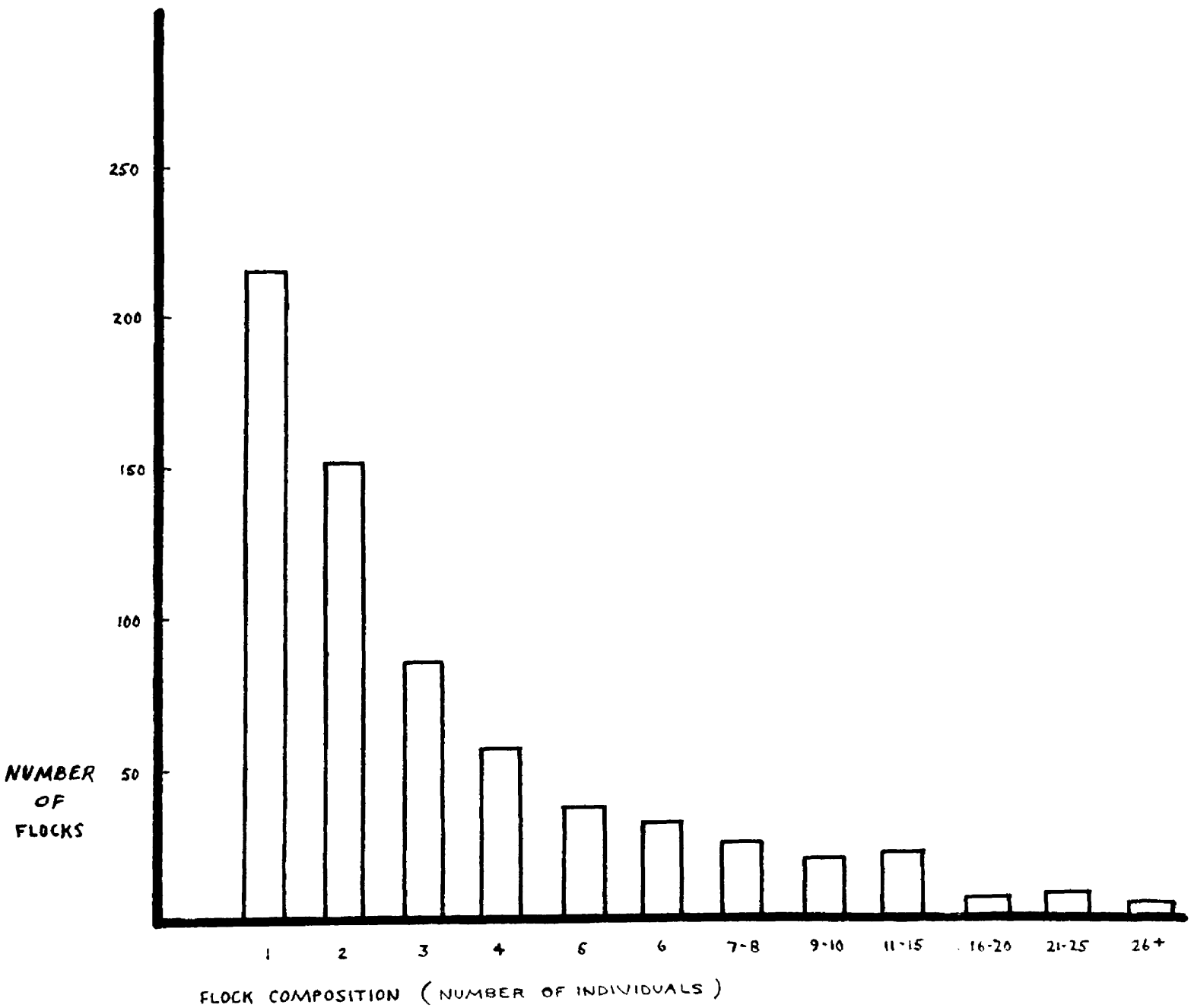
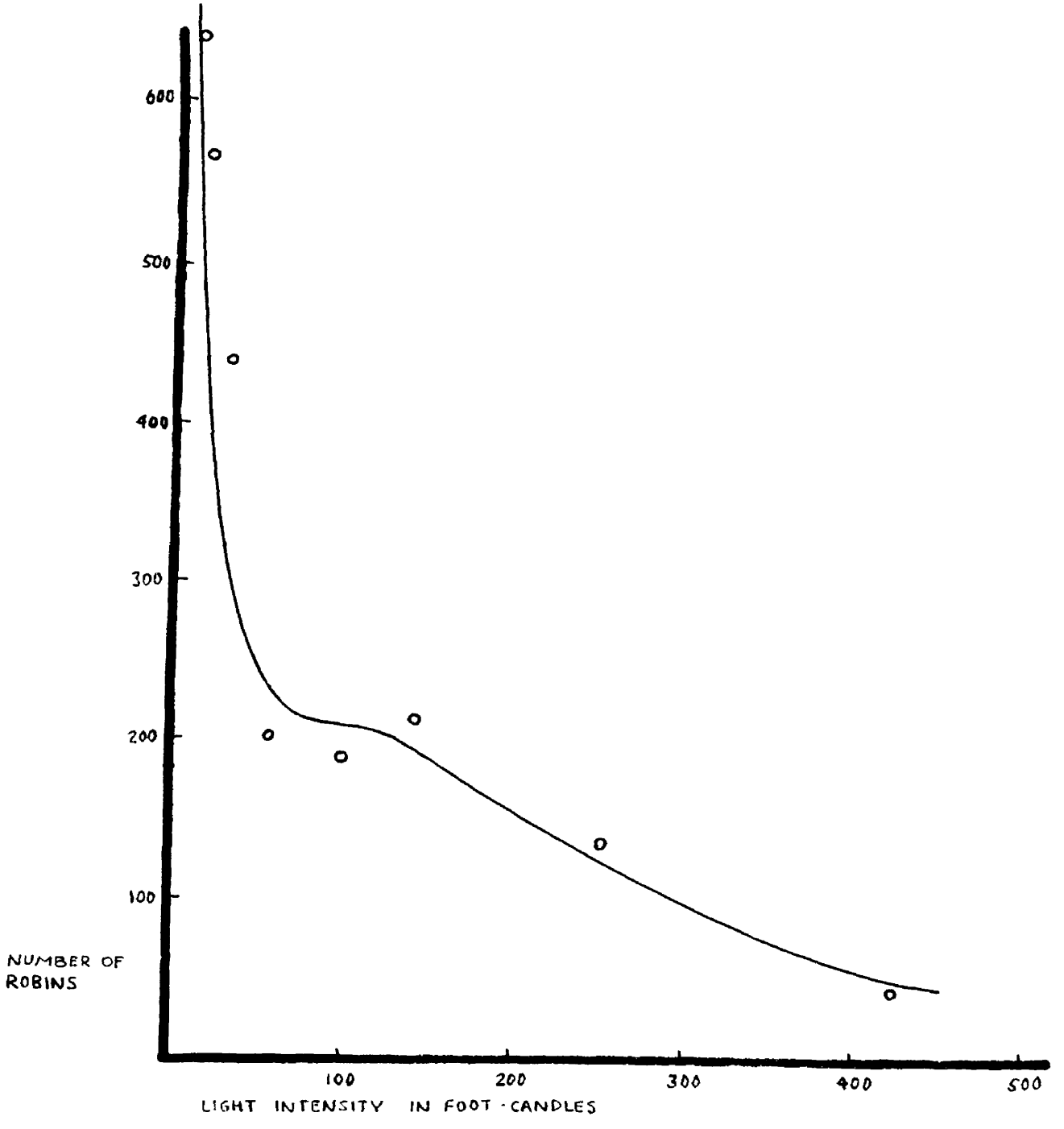

250
200
150
100
50
NUMBER OF FLOCKS
1
2
3
4
5
6
7-8
9-10
11-15
16-20
21-25
26+
FLOCK COMPOSITION (NUMBER OF INDIVIDUALS)

Figure 32. Arrival of robins at the Highland Park roost during five evenings in August, September and October, 1955.


600
500
400
300
200
100
NUMBER OF ROBINS
100
200
300
400
500
LIGHT INTENSITY IN FOOT-CANDLES

five or six feet above the shrubs. Abel (1914:172) and Brewster (1890: 370) made similar observations. Bernard Van Cleve's observation on January 15, 1956, indicates that robins may experience difficulty in finding the roost if they arrive after dark. He found about 10 robins fluttering about the guard rails of the reservoir. It is thought that they left their feeding grounds late, and that with the onset of darkness the ring of lights around the reservoir attracted them.

At the East Lansing roost the majority of robins arrived after the starlings, grackles and cowbirds, which occupied the central part of the area. Consequently, robins were concentrated in the periphery. In the morning robins left first, and at daybreak many of them were on nearby lawns. Gradually they spread back to communal feeding grounds. In August, 1953, I noted that few if any were at the daytime feeding area in the Abbott Road woods until about one hour after sunrise. On the other hand, Bolander (1932:143) and Youngworth (1929:105) observed robins leaving night roosts in continuous streams. During the nesting season the males evidently leave the roost very early. On a visit to a roost on June 17, 1941 at 3:35 A.M., Speirs (1946:78) found the area being rapidly deserted by the robins.

SUMMARY

The life cycle of the robin was studied in Pittsburgh, Pennsylvania, and in East Lansing, Michigan, during the years 1953 to 1957 inclusive.

The seasonal distribution was observed at a roost in Pittsburgh. The first spring migrants appeared as early as mid-February or as late as the first days of March. In the fall there was a decrease in robins until mid-November, when the winter population usually became stabilized. With the exception of the winter of 1955-56, when there was a heavy crop of various fruits, few wintering robins were in the Pittsburgh area.

Of 29 winter (November-March) recoveries of robins banded in East Lansing, 69 per cent were between the latitudes of 30° and 35° N.; many of these recoveries were almost directly south of East Lansing.

Several threat postures and displays, some similar or identical to ones described by Dilger (1956) for the genera Catharus and Hylocichla, are used to establish and maintain territories, and to intimidate other robins as well as other species at communal feeding areas.

Several observations suggest the existence of some relatively undeveloped form of courtship feeding in the robin.

The whisper song has a dual purpose: it functions in the establishment and maintenance of the pairing bond and also serves as a threat. A probable role of the carolling song, which decreases after the eggs have hatched, is declaration of territory. Songs were given on perches ranging from ground level to a height of 60 feet. Resident males in territories showed some preference for one song perch. One flight song, which has been recorded only once in the literature, was heard.

A definite trend in song cessation was noted by the first part of July in 1955 in Pittsburgh, and in 1956 in East Lansing. The last songs of the season were heard the first week of August. In Pittsburgh, with the exception of one year, there was a period of song resumption during September and the first part of October, some of it undoubtedly due to the first songs of birds of the year.

The populations of robins ranged from 12 pairs per 100 acres in an aspen community of northern Lower Michigan to 120 pairs per 100 acres in suburban areas of Pittsburgh. In East Lansing numbers of dead and dying robins, the declining populations, and the failure of adults to produce young are believed to be due to DDT and other insecticides.

Maximum territory, determined according to a method given by Odum and Kuenzler (1955), was about 2.5 acres in three instances. Utilized territories, determined by 20 or more irregularly spaced observations, ranged in size from .24 to .87 acres in 12 cases. There appeared to be a correlation between territory size and population density.

In late April and early May there was a peak of nesting activity in Pittsburgh. Two peaks of nesting activity were noted in East Lansing in 1957, one in late April and early May, and another in late May and early June.

Several females were observed testing potential nest sites, but some males appeared to influence the selection. The first nesting activity began after a rise in temperature. The average time for construction of 12 nests was 4.5 days.

Twenty-one per cent of the first nests in the Lansing area and 29.4 per cent of the first nests in Pittsburgh were in conifers. In Pittsburgh 29.1 per cent of all nests were in artificial sites while in the Lansing

area only 2.1 per cent were in such locations. The lack of tall shade trees in Pittsburgh study areas probably forced robins to make use of artificial sites that offered adequate height. The average height of 83 nests in Pittsburgh was 14.5 feet, and of 48 nests in the Lansing area it was 20.3 feet. These heights were greater than those found in undisturbed areas by other workers. No preferred height was evident for individual females. However, the second nest was usually higher than the first. The distances separating nests built in the same year by known females varied from 25 to 230 feet.

Linear measurements of 17 collected nests and the dry weights of 19 were determined. An undescribed species of Protocalliphora was found in 40 per cent of 20 nests collected in Pittsburgh. Five of the eight parasitized nests were successful in producing young. Six other examples of arthropods were also found in robin nests.

For seven nests the average time between their completion and the appearance of the first egg was four days. The mean clutch size for 42 nests in Pittsburgh was 3.4 ± .11, and for 13 in East Lansing it was 3.5 ± .18. A decrease in clutch size was evident in June. The mean incubation period for 12 clutches was 12.5 ± .19 days. Twenty-one periods of attentiveness by the female averaged 36.4 minutes, and 23 periods of inattentiveness averaged 6.3 minutes. Several observations of males sitting on eggs were made.

The mean extent of the nestling period for 37 individuals was 13.9 ± .16 days. For approximately 16 hours of observations at seven robin nests, the feedings to the young averaged 6.4 per hour. Adults ate excreta in varying degrees at all stages of nestling growth. The average interval between the fledging of a first brood and the completion of a second nest

was 11.4 days in five cases, and between the fledging of a first and a second brood it was 41.7 days in three cases.

The mean extent of the fledgling period for 15 broods was 14.9 ± .74 days. It was divided into three stages: Hiding Stage (0-3 days after fledging), Early-flying Stage (4-6 days after fledging), and Semi-dependent Stage (7 days after fledging until the young became independent). Three sets of fledglings confined their activities to areas ranging from one acre to 5.8 acres. However, some young moved considerable distances a short time after they left the nest.

Nesting success averaged 66.7 per cent for 36 nests in East Lansing as well as for 48 nests in Pittsburgh. First nests in conifers were much more successful (75 per cent) than those in deciduous trees (44 per cent). Desertion and mammalian predators were major factors in nesting failures. Of 161 eggs, 70.8 per cent hatched and 49.1 per cent produced fledglings.

The robin probes in the ground for food from either a crouched position or a normal posture. It depends primarily upon eyesight for obtaining food. After breeding, robins feed in flocks, usually in woodlots adjacent to open areas, where there is a good supply of fruiting shrubs and exposed leaf litter.

During eight hours of observation, three robins took, on the average, 5.4 beakfuls of water per hour.

Three night roosts were observed: one in shade trees along East Lansing streets, one in a second growth woods in Pittsburgh, and another on a shrubby embankment of a reservoir in a Pittsburgh city park. Robins usually flew to roosts singly or in small, loose, straggling groups. With the advent of darkness they moved into the roosts in increasing numbers. In the morning they spread back to communal feeding grounds gradually.

APPENDIX I

Table 1

The Avifauna of the Study Areas

Common Name	Scientific Name	Area 1	Area 2	Area 3
Mallard	*Anas platyrhynchos*			x**
Sparrow hawk	*Falco sparverius*		0*	
Ring-necked pheasant	*Phasianus colchicus*	x	x	x
Mourning dove	*Zenaidura macroura*		x	x
Black-billed cuckoo	*Coccyzus erythrophthalmus*			0
Screech owl	*Otus asio*	0		
Barred owl	*Strix varia*			0
Nighthawk	*Chordeiles minor*	x	x	x
Chimney swift	*Chaetura pelagica*	x	x	x
Ruby-throated hummingbird	*Archilochus colubris*			x
Yellow-shafted flicker	*Colaptes auratus*	x	x	x
Red-bellied woodpecker	*Centurus carolinus*			x

*One or two individuals in area
**More than two individuals in area

Table 1 (continued)

Common Name	Scientific Name	Area 1	Area 2	Area 3
Hairy woodpecker	Dendrocopus villosus			0
Downy woodpecker	Dendrocopus pubescens	0	0	x
Great crested flycatcher	Myiarchus crinitus			0
Eastern phoebe	Sayornis phoebe			0
Eastern wood pewee	Contopus virens			x
Purple martin	Progne subis		x	
Blue jay	Cyanocitta cristata			x
Black-capped chickadee	Parus atricapillus	x	x	x
Tufted titmouse	Parus bicolor	0		x
White-breasted nuthatch	Sitta carolinensis	0		x
House wren	Troglodytes aedon	x	x	x
Carolina wren	Thryothorus ludovicianus	0		
Catbird	Dumetella carolinensis	x	x	x
Brown thrasher	Toxostoma rufum		0	0

Table 1 (continued)

Common Name	Scientific Name	Area 1	Area 2	Area 3
Wood thrush	Hylocichla mustelina	0	0	
Starling	Sturnus vulgaris	x	x	x
Red-eyed vireo	Vireo olivaceus			x
Warbling vireo	Vireo gilvus	0		
House sparrow	Passer domesticus	x	x	x
Baltimore oriole	Icterus galbula			0
Common grackle	Quiscalus quiscula		x	x
Brown-headed cowbird	Molothrus ater	x	x	x
Cardinal	Richmondena cardinalis	x	x	x
Indigo bunting	Passerina cyanea			0
American goldfinch	Spinus tristis	x	x	x
Rufous-sided towhee	Pipilo erythrophthalmus	0		x
Chipping sparrow	Spizella passerina		x	x
Song sparrow	Melospiza melodia	x	x	x
Total		21	21	34

Table 2

Some Mammals of the Study Areas

Common Name	Scientific Name	Area 1	Area 2	Area 3
Virginia opossum	*Didelphis virginiana*	x	x	x
Raccoon	*Procyon lotor*	x	x	x
Dog	*Canis familiaris*	x	x	x
Domestic cat	*Felis domestica*	x	x	x
Eastern chipmunk	*Tamias striatus*	x	x	x
Eastern fox squirrel	*Sciurus niger*	x		x
Norway rat	*Rattus norvegicus*	x		
Eastern cottontail	*Sylvilagus floridanus*	x	x	x
Total		8	6	7

Table 3

Foreign Recoveries of Robins Banded at East Lansing, Michigan

Band No.	Date Banded	Age When Banded	Date of Recovery	Record	Place of Recovery
A234230	June 5, 1935	Y*	February 2, 1936	MSU	Montrose, Mississippi
A234415	May 21, 1936	-	January 16, 1937	MSU	Drasco, Arkansas
A256715	May 10, 1931	Y	November 10, 1931	MSU	Winfield, Tennessee
A316195	May 30, 1930	-	February 23, 1931	Ludwig	Greenville, South Carolina
A372055	May 17, 1931	-	November 18, 1932	Ludwig	Bowman, Georgia
A372172	July 31, 1931	-	Winter, 1933	Ludwig	Manatee, Florida
A372190	May 31, 1931	-	March 15, 1933	Ludwig	Fort Green, Florida
A390720	May 22, 1932	-	March 11, 1933	Ludwig	Russelville, Alabama
B366238	July 19, 1932	-	January 11, 1933	Ludwig	Plant City, Florida
B366289	May 20, 1933	-	January 25, 1934	Ludwig	Fulton, Mississippi
C325882	June 10, 1934	-	May 22, 1936	Ludwig	Crystal Springs, Mississippi
C326325	June 23, 1934	-	February 23, 1936	Ludwig	Arnaudville, Louisiana
343782	May 18, 1925	-	February 2, 1926	MSU	Durant, Mississippi

*Young of the year

Table 3 (continued)

Band No.	Date Banded	Age When Banded	Date of Recovery	Record	Place of Recovery
461962	April 1, 1929	-	February 26, 1930	MSU	Plant City, Florida
626952	June 1, 1933	Y	March 1, 1934	MSU	Spring City, Tennessee
646185	June 18, 1928	-	March 3, 1929	Ludwig	Moreauville, Louisiana
646192	June 25, 1928	-	February 20, 1929	Ludwig	Toone, Tennessee
646193	June 25, 1928	-	February 7, 1930	Ludwig	Statesboro, Georgia
34-331578	May 25, 1935	-	December 6, 1935	Ludwig	Brooklyn, Mississippi
34-362882	May 20, 1936	-	August 1, 1940	Ludwig	Starkville, Mississippi
36-219733	May 30, 1941	Y	November 10, 1946	MSU	Brilliant, Alabama
36-219868	October 17, 1947	-	January, 1950	MSU	Bay Minette, Alabama
36-322806	April 24, 1937	-	January 26, 1939	Ludwig	Wesson, Mississippi
37-344337	July 25, 1937	-	January 19, 1939	Ludwig	Hope, Arkansas
37-344431	May 17, 1938	-	January 16, 1939	Ludwig	Nashville, Georgia
37-344467	May 17, 1938	-	March 6, 1943	Ludwig	Kennedy, Alabama
37-344560	May 21, 1938	-	March 12, 1941	Ludwig	Tuskegee, Alabama

Table 3 (continued)

Band No.	Date Banded	Age When Banded	Date of Recovery	Record	Place of Recovery
37-344980	July 16, 1938	-	February 24, 1939	Ludwig	Denmark, South Carolina
38-339183	May 20, 1939	-	February 9, 1940	Ludwig	Orange, Texas
39-319223	September 19, 1939	-	January 9, 1940	Ludwig	Lewisburg, Tennessee

Table 4

Michigan Recoveries of Robins Banded at East Lansing

Band No.	Date Banded	Age When Banded	Date of Recovery	Record	Place of Recovery
A372022	May 11, 1931	Y*	July 5, 1933	Ludwig	Macomb County
A390521	May 20, 1932	-	April 23, 1934	Ludwig	Grand Rapids
A390652	June 20, 1932	-	November 14, 1932	Ludwig	Flushing
B366264	October 5, 1932	-	June 18, 1933	Ludwig	Grand Rapids
484816	April 25, 1933	-	October 19, 1934	MSU	Haslett
508778	May 31, 1928	-	September 24, 1928	Ludwig	Eaton County
34-331356	May 12, 1935	-	June 26, 1939	Ludwig	Ingham-Eaton County line
37-344391	September 30, 1937	-	June 13, 1939	Ludwig	Saginaw
37-344835	June 18, 1938	-	May 3, 1939	Ludwig	Hamilton
41-311196	July 21, 1942	-	August 21, 1944	Ludwig	Grand Rapids

*Young of the year

Table 5

Song Cessation of the Robin

Location of Study	Time of Study	Beginning of Cessation	General Cessation	Last Song	Reference
Cold Spring Harbor, Long Island	1915	July 7	August 1	August 10**	Fry (1916)
Allegany State Park, New York	1927-1940	July 28, August 15* August 2	July 29, August 15* August 6	July 25, August 22* August 11	Saunders (1948a)
Fairfield County, Connecticut	1941-1946	July 18, July 30* July 26	July 30, August 6* August 4	August 7, August 23* August 14	Saunders (1948a)
Berks County, Pennsylvania	1944	July 20	August 14	August 18	Vaurie (1946)
Pittsburgh, Pennsylvania	1955	July 2	July 30	August 5	This study
East Lansing, Michigan	1956	July 3	July 23	August 5	This study

*Average date appears below the earliest and latest dates.
**Last day of observation

Table 6

Call Notes of the Robin and Conditions Under Which They Are Given

Conditions	"Yeep"	Laughing Call	"Huh"	"Yeep-huh-huh-huh"	"Skeet-urp"
Selecting nest site					
Male	x	x		x	
Female	x	x			
Building nest (female)			x		
Nest with eggs approached and/or examined by man	x		x	x	
Nest with young approached and/or examined by man	x*	x	x		
After adult leaves nest	x	x	x	x	
Adult coming to nest	x		x		
Adult relieving another at nest	x	x	x		
Young out of nest approached by man	x*		x	x	
Young out of nest; dog or cat in area	x				

*Recorded 10 or more times

Table 6 (continued)

Conditions	"Yeep"	Laughing Call	"Huh"	"Yeep-huh-huh-huh"	"Skeet-urp"
Recently destroyed nest approached by man	x				
After copulation (female)	x				
Joining mate		x			
Territorial intrusion					
Owner	x*	x	x		x
Intruder	x	x			
Owner in territory (no evident stimulus)		x	x	x	
After territorial combat	x				
Chasing another robin	x*	x		x	
Moving from one site or perch to another	x	x	x	x	x
Flushed from a site or perch	x		x		
In flight	x	x	x		
Flying into roost and at roost	x	x	x	x*	

*Recorded 10 or more times

Table 6 (continued)

Conditions	"Yeep"	Laughing Call	"Huh"	"Yeep-huh-huh-huh"	"Skeet-urp"
Other species of birds					
Perching close to robin	x				
Robin pursued	x		x	x	
Pursuit by robin	x	x			
Hawk flying overhead	x	x	x	x	
After a song	x	x			
Antiphonal calling	x	x			
Tape recording					
"Yeep"	x	x			
Laughing call		x			
Dummy robin	x	x	x	x	
Feeding flock	x	x	x	x	x
Before dawn	x*	x*			
At dusk	x*	x*	x	x	x

*Recorded 10 or more times

Table 7

Nesting Populations of Robins

Location	Habitat	Time of Census	Nesting Pairs	Pairs per 100 Acres	Reference
Sanbornton, New Hampshire	Residential area	June, 1935	11/4.5 a.	244*	Weeks (1935)
Black Forest, Colorado	Western yellow pine forest	Summer, 1945	9/75 a.	12	Hering (1948)
Northern Lower Michigan	Grassland	Summer, 1946	-	0	Kendeigh (1948)
Northern Lower Michigan	Aspen-red maple forest	Summer, 1946	-	5	Kendeigh (1948)
Northern Lower Michigan	Pine-aspen forest	Summer, 1946	-	12	Kendeigh (1948)
Northern Lower Michigan	Cedar-aspen forest	Summer, 1946	-	7	Kendeigh (1948)
Northern Lower Michigan	Cedar-balsam forest	Summer, 1946	-	7	Kendeigh (1948)
Northern Lower Michigan	Beech-maple-pine forest	Summer, 1946	-	1	Kendeigh (1948)
Latah County, Idaho	Douglas fir forest	Summer, 1947	-	0	Johnston (1949)

*Calculated from author's data

Table 7 (continued)

Location	Habitat	Time of Census	Nesting Pairs	Pairs per 100 Acres	Reference
Latah County, Idaho	Douglas fir forest that had been logged quite heavily	Summer, 1947	-	2.5	Johnston (1949)
Madison, Wisconsin	Arboretum	1947	19/5.2 a.	365*	Young (1949a; 1955)
Madison, Wisconsin	Arboretum	1948	15/5.2 a.	288*	Young (1955)
Madison, Wisconsin	Arboretum	1949	12/5.2 a.	231*	Young (1955)
Northern Lower Michigan	Aspen-oak-pine forest	July, 1952	6/50 a.	12	Mehner (1952)
Pittsburgh	Deciduous woodlot	Mid-April to mid-May, 1954	8/10 a.	80	This study
Pittsburgh	Area 1	Spring, 1954	6/5 a.	120	This study
Pittsburgh	Area 1	Spring, 1955	6/5 a.	120	This study
Pittsburgh	Area 1	Summer, 1955	5/5 a.	100	This study
Pittsburgh	Area 1	Spring, 1956	5/5 a.	100	This study
Pittsburgh	Area 2	Spring, 1954	9/7.5 a.	120	This study
Pittsburgh	Area 2	Spring, 1955	9/7.5 a.	120	This study

*Calculated from author's data

Table 7 (continued)

Location	Habitat	Time of Census	Nesting Pairs	Pairs per 100 Acres	Reference
Pittsburgh	Area 2	Spring, 1956	9/7.5 a.	120	This study
East Lansing	Area 3	Summer, 1956	5/15.5 a.	32	This study
East Lansing	Area 3	Spring, 1957	9/15.5 a.	58	This study
East Lansing	Horticultural gardens	Summer, 1954	5/5.5 a.	91	This study
East Lansing	Horticultural gardens	Summer, 1956; spring, 1957	2/5.5 a.	36	This study

Table 8

Size of Nesting Territories

Nest	Individuals	Stage of Nesting Cycle	Number of Observations	Time in Hours During Which Observations Were Made	Extent of Territory in Acres	Pairs per 100 Acres
54-6	-	Nest building	70	6.3	.48	120
55-1 and 55-14	M5, F1	From building 55-1 through building 55-14	68	4.8	.24	120
55-8	M2, F3	Incubation and feeding young	74	4.1	.48	120
55-23	M2, F3	Incubation and feeding young	154	12.1	.60	100
55-22	F4	Incubation and feeding young	51	2.8	.62	100
-	M2	Establishing territory in 1956	27	2.1	.54	100
56-3	M4, F6	Nest building	72	5.5	.70	100
56-3	M4, F6	Incubation and feeding young	44	3.6	.60	100
56-21	M4, F6	Incubation and feeding young	22	2.5	.44	100

Table 8 (continued)

Nest	Individuals	Stage of Nesting Cycle	Number of Observations	Time in Hours During Which Observations Were Made	Extent of Territory in Acres	Pairs per 100 Acres
56-4	M5	Establishing territory through feeding young	57	4.1	.42	120
56-6	M1, F1	Establishing territory through feeding young	70	4.0	.87	120
56-12	-	Establishing territory through feeding young	22	1.3	.70	100
56-24	-	Incubation	40	3.0	2.38	32
56-24	-	Feeding young	60	4.0	2.60	32
57-13	-	Incubation	40	3.0	2.38	58

Table 9

Nesting Sites of the Robin

Common Name	Scientific Name	Pittsburgh		Lansing and E. Lansing	
		Number	Per Cent	Number	Per Cent
Ginkgo	*Ginkgo biloba* L.			1	2.1
Yew	*Taxus* sp.	1	1.0		
Spruce	*Picea* spp.	14	13.6	2	4.3
Pine	*Pinus* spp.	6	5.8	1	2.1
Arbor vitae	*Thuja occidentalis* L.	2	1.9	3	6.4
Other conifers		5	4.9		
Crack willow	*Salix fragilis* L.	4	3.9		
Poplar	*Populus* sp.	1	1.0		
American elm	*Ulmus americana* L.	3	2.9	9	19.2
Oak	*Quercus* spp.	2	1.9	2	4.3
Sycamore	*Platanus occidentalis* L.	1	1.0		
Apple	*Pyrus malus* L.	3	2.9	8	17.0

Table 9 (continued)

Common Name	Scientific Name	Pittsburgh		Lansing and E. Lansing	
		Number	Per Cent	Number	Per Cent
Crab-apple	*Malus* spp.	8	7.7	3	6.4
Hawthorn	*Crataegus* spp.	3	2.9		
Wild plum	*Prunus americana* Marsh.			1	2.1
Peach	*Prunus persica* (L.) Batsch	1	1.0		
Sour cherry	*Prunus cerasus* L.			1	2.1
Black cherry	*Prunus serotina* Ehrh.	7	6.8		
Norway maple	*Acer platanoides* L.			8	17.0
Silver maple	*Acer saccharinum* L.	3	2.9	3	6.4
Box elder	*Acer negundo* L.			1	2.1
White ash	*Fraxinus americana* L.	1	1.0		
Common lilac	*Syringa vulgaris* L.			1	2.1
Honeysuckle	*Lonicera* spp.	1	1.0	2	4.3
Other deciduous species		7	6.8		

Table 9 (continued)

Common Name	Scientific Name	Pittsburgh		Lansing and E. Lansing	
		Number	Per Cent	Number	Per Cent
Artificial sites		30	29.1	1	2.1
Total		103	100.0	47	100.0

Table 10

Nest Sites Used For First and Later Nestings

Nest Site	Pittsburgh		Lansing and East Lansing		Ithaca, New York (Howell, 1942:550)	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
First nests in evergreens	25	29.4	4	21.0	34	57.6
First nests in deciduous trees and shrubs	32	37.7	14	73.7	15	25.4
First nests on artificial sites	28	32.9	1	5.3	10	17.0
Total	85	100.0	19	100.0	59	100.0
Later nests in evergreens	3	16.7	2	7.1	23	38.3
Later nests in deciduous trees and shrubs	13	72.2	26	92.9	29	48.3
Later nests on artificial sites	2	11.1	0	0.0	8	13.4
Total	18	100.0	28	100.0	60	100.0

Table 10 (continued)

Nest Site	Pittsburgh		Lansing and East Lansing		Ithaca, New York (Howell, 1942:550)	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Season's nests in evergreens	28	27.2	6	12.8	57	47.9
Season's nests in deciduous trees and shrubs	45	43.7	40	85.1	44	37.0
Season's nests on artificial sites	30	29.1	1	2.1	18	15.1
Total	103	100.0	47	100.0	119	100.0

Table 11

Nesting Heights of Robins

Height in Feet	Area 1	Area 2	Area 3	Pittsburgh, Including Areas 1 and 2		Lansing and East Lansing, Including Area 3	
				Number	Per Cent	Number	Per Cent
0-4	0	2	0	7	8.4	2	4.2
5-8	4	12	1	29	35.0	9	18.8
9-12	3	3	7	13	15.7	9	18.8
13-16	3	3	4	9	10.9	8	16.6
17-20	0	4	0	4	4.8	1	2.1
21-24	0	0	0	0	0	1	2.1
25-28	3	5	2	8	9.6	3	6.2
29-32	3	0	1	6	7.2	2	4.2
33-36	1	0	4	3	3.6	7	14.6
37-40	2	0	1	3	3.6	3	6.2
41+	1	0	3	1	1.2	3	6.2

Table 11 (continued)

Height in Feet	Area 1	Area 2	Area 3	Pittsburgh, Including Areas 1 and 2		Lansing and East Lansing, Including Area 3	
				Number	Per Cent	Number	Per Cent
Total	20	29	23	83	100	48	100
Average Height	21.2	12.5	23.5	14.5		20.3	

Table 12

Nesting Heights of Known Females

Female	Male	Nest	Height in Feet
F1	M1	54-2	7
F1	M1	54-30	10
F1	M5	55-1	6
F1	M5	55-14	20
F1	M1	56-6	13
F3	unmarked	54-9	9
F3	M2	55-8	9
F3	M2	55-23	8
F3	unmarked	56-2	25
F4	unmarked	55-22	50
F4	unmarked	56-13	30
F6	M4	56-3	13
F6	M4	56-21	7.5

Table 12 (continued)

Female	Male	Nest	Height in Feet
F9	M6	57-11	9.3
F9	M6	57-17	50.0
F10	M7	57-3	11.5
F10	M7	57-13	13.5
F11	M8	57-2	8.5
F11	M8	57-22	30.0

Table 13

Structure of Robin Nests

	Number of Nests	Per Cent
Lining (based upon analyses of 12 nests)		
Grasses	12	100.0
Twigs under six inches in length	2	16.7
Roots	2	16.7
Leaves	2	16.7
Herbaceous stems	1	8.3
Flower petals	1	8.3
Foundation (based upon analyses of 17 nests)		
Grasses	17	100.0
Roots	14	82.4
Twigs under six inches in length	13	76.5
Twigs over six inches in length	12	70.6
Cord and string	9	52.9
Bark	8	47.1
Paper	7	41.2
Leaves	7	41.2
Inflorescences	4	23.5
Cloth	2	11.8
Herbaceous stems	1	5.9

Table 14

Measurements and Weights of Robin Nests Collected in Pittsburgh and East Lansing

	Maximum	Minimum	Average
Weights in grams (based upon 19 nests)			
Lining	12	2	8
Foundation and cup	398	134	231
Measurements in millimeters (based upon 17 nests)			
Long outer diameter	210	112	139
Short outer diameter	150	105	121
Long inner diameter	117	88	104
Short inner diameter	106	78	95
Outer depth	100	63	80
Inner depth	65	26	45
Depth of lining	28	4	13

Table 15

Occurrence of Protocalliphora in Robin Nests Collected in Pittsburgh

Nest	Habitat	Height in Feet	Pupal Cases	Adult Flies	Robins Fledged
54-8	Area 1	9	17	24	3
54-26	City park	9	1	0	unknown
54-50	City park	-	13	11	unknown
55-23*	Area 1	8	22	5	3
56-1	Area 1	5.5	19	14	3
56-3	Area 1	13	56	49	1
56-8	Area 2	7	44	51	4
56-28	Residential	-	14	6	unknown

*A second nest

Table 16

Clutch Size in Robin Nests

Clutch Size	Pittsburgh		East Lansing	
	Number	Per Cent	Number	Per Cent
2	4	9.5	1	7.7
3	17	40.5	4	30.8
4	20	47.6	8	61.5
5	1	2.4	0	0.0
Total	42	100.0	13	100.0
Mean clutch size	3.4 ± .11		3.5 ± .18	

Table 17

Monthly Clutch Size in Robin Nests

Dates	Maryland (Davis, 1955:211)		New York (Davis, 1955:211)		Pennsylvania		Michigan	
	No. of Nests	Mean Clutch Size	No. of Nests	Mean Clutch Size	No. of Nests	Mean Clutch Size	No. of Nests	Mean Clutch Size
April 1 - 30	15	3.40	23	3.70	17	3.70	2	3.50
May 1 - 31	54	3.54	38	3.50	23	3.26	5	3.80
June 1 - 30	20	3.24	11	3.36	2	3.00	6	3.33
July 1 - 31	2	2.50	3	3.00	-	-	-	-
Total	91	3.42 ± .06	75	3.52 ± .07	42	3.43 ± .11	13	3.54 ± .18

Table 18

Attentive Behavior of Female Robins During Incubation

Nest	Date of Observation	Time of Observation	Average Temperature (°F.)	Attentive Periods in Minutes	Changes of Position	Nest Probings	Inattentive Periods in Minutes
54-6	May 3	6:00-7:15 P.M.	55	34	4	1	5
							8
54-7	May 1	10:32-11:54 A.M.	72	35	2	-	2
				45	1	-	
54-31	May 30	3:10-4:17 P.M.	65	42	1	-	7
				11	1	-	7
54-31	May 31	3:50-4:52 P.M.	70	-	-	-	16
54-45	June 30	11:00-12:15 P.M.	77	-	-	-	4
54-45	July 3	1:40-3:35 P.M.	62	43	2	-	2
				45	2	-	5
				20	1	-	
54-45	July 5	11:19-12:03 P.M.	66	24	2	-	7
				9	1	-	1
				59	-	-	3
				70	-	-	1
							13
54-45	July 10	8:45-10:00 A.M.	62	72	7	7	3

Table 18 (continued)

Nest	Date of Observation	Time of Observation	Average Temperature (°F.)	Attentive Periods in Minutes	Changes of Position	Nest Probings	Inattentive Periods in Minutes
55-23	June 10	5:55-7:04 P.M.	60	24	2	4	7 9
55-23	June 11	2:15-3:11 P.M.	62	56	6	3	-
56-24	July 14	8:30-11:03 A.M.	71	12 35 8 61	- - - -	0 0 1 0	7 4 4 7 15
57-6	May 7	1:10-1:42 P.M.	65	25	-	-	7
57-13	May 31	1:20-2:40 P.M.	71	35	-	-	-
Average				36.4	1/14.4 min.	1/18.9 min.	6.3

Table 19

Attentive Behavior During the Nestling Period

Nest	Date of Observation	Time of Observation	Age of Nestlings in Days	Feedings				Intervals Between Feedings		
				Male	Female	Total	Average per Hour	Extremes		Average
52-1	July 12	10:15-11:15 A.M.	8-9	2	5	7	7	1	27	9.5
54-7	May 18	6:07-6:56 P.M.	10-11	0	2	2	2.4	-	25	25.0
54-8	May 1	12:45-1:08 P.M.	3	0	1	1	2.6	-	-	-
54-45	July 17	10:33-12:20 P.M.	7	8	0	8	4.5	2	22	14.0
54-45	July 21	1:06-1:40 P.M.	11	1	2	3	5.3	9	25	17.0
54-45	July 22	12:55-1:45 P.M.	12	10	0	10	12.0	2	8	5.2
54-45	July 23	7:08-8:25 P.M.	13	6	0	6	4.7	8	36	15.4
55-19	July 12	1:29-2:10 P.M.	2	3	0	3	4.4	13	25	19.0
55-23	June 14	12:45-1:19 P.M.	1	0	2	2	3.5	-	24	24.0
55-23	June 25	10:20-11:20 A.M.	12	3	8	11	11.0	1	11	4.4
55-23	June 25	1:46-2:50 P.M.	12	2	9	11	10.3	1	22	7.9
55-23	June 26	9:15-10:37 A.M.	13	0	7	7	5.1	3	21	9.5

Table 19 (continued)

Nest	Date of Observation	Time of Observation	Age of Nestlings in Days	Feedings				Intervals Between Feedings		
				Male	Female	Total	Average per Hour	Extremes		Average
55-23	June 26	11:08-11:41 A.M.	13	0	5	5	9.1	1	10	5.3
56-24	July 23	9:51-10:43 A.M.	2-3	1	2	3	3.5	14	30	22.0
56-24	Aug. 2	6:45-7:15 A.M.	12-13	0	3	3	6.0	1	18	9.5
56-24	Aug. 2	3:20-5:37 P.M.	12-13	1	16	17	7.4	1	27	8.3
Total		15.6 hours		37	62	99	6.4	1	36	12.0

Table 20

Nest Sanitation

Nest	Date of Observation	Time of Observation	Age of Nestlings in Days	Excreta Carried From Nest			Excreta Eaten			Average Feces Removal per Hour
				Male	Female	Total	Male	Female	Total	
52-1	July 12	10:15-11:15 A.M.	8-9	0	1	1	1	1	2	3.0
54-8	May 1	12:45-1:08 P.M.	3	0	0	0	0	1	1	2.6
54-45	July 23	7:08-8:25 P.M.	13	0	0	0	5	0	5	3.9
55-23	June 26	9:15-10:37 A.M.	13	0	1	1	0	3	3	2.9
55-23	June 26	11:08-11:41 A.M.	13	0	1	1	0	0	0	1.8
Total		4.6 hours		0	3	3	6	5	11	3.1

Table 21

Interval Between Broods

Location	First Nest	Brood Fledged	Second Nest	Second Nest Completed	Interval Between Fledging of First Brood and Completion of Second Nest in Days	Brood Fledged	Interval Between Fledging of First and Second Broods in Days
Area 2	54-2	May 15	54-30*	May 26	11	-	-
Area 2	55-1	May 16	55-14	June 1	16	unknown	-
Area 1	55-8	May 16	55-23	May 27	11	June 26	41
Area 3	57-2	May 21	57-22	June 5	15	July 8	48
Area 3	57-11	May 17	57-17	May 21	4	June 22	36
Average					11.4		41.7

*Nest destroyed

Table 22

Attentive Behavior by Male to Fledglings

Nest	Days After Fledging	Time	Number of Feedings	Feedings per Hour	Intervals Between Feedings		
					Extremes		Average
54-53	7	10:35-11:14 A.M.	6	9.2	2	9	4.8
55-19	4	9:45-10:25 A.M.	2	3.0	-	11	11.0
57-2	8	2:30-2:55 P.M.	4	9.6	1	8	4.0
57-15	10	3:50-4:15 P.M.	3	7.2	1	2	1.5
57-20	4	10:50-11:08 A.M.	4	13.3	5	8	6.0
Total		2.5 hours	19	7.8	1	11	4.9

Table 23

Time Fledglings Remain With Parents in Nesting Area

Days After Fledging	First Brood	Second Brood	Total
10	1	0	1
11	1	0	1
12	1	0	1
13	2	0	2
14	1	2	3
15	0	1	1
16	0	0	0
17	0	3	3
18	1	0	1
19	1	0	1
20	0	1	1
Total	8	7	15
Mean Extent of Fledgling Period	13.8	16.3	14.9 ± .74

Table 24

Nesting Success

		Number of Nests	Successful	Per Cent Successful
East Lansing	1954	8	8	100.0
East Lansing	1956	5	5	100.0
East Lansing	1957	23	11	47.8
Pittsburgh	1954	19	13	68.4
Pittsburgh	1955	13	8	61.5
Pittsburgh	1956	16	11	68.8
Total East Lansing		36	24	66.7
Total Pittsburgh		48	32	66.7

Table 25

Nesting Failure

		Desertion	Predation	Weather	Observer	Total
East Lansing	1957	9	2	0	1	12
Pittsburgh	1954	1	2	3	0	6
Pittsburgh	1955	1	3	1	0	5
Pittsburgh	1956	1	2	1	1	5
Total		12	9	5	2	28
Per Cent of Total		42.9	32.1	17.9	7.1	100.0

Table 26

Success in First Nests According to Sites

	Conifers			Deciduous Species			Artificial Sites		
	Total Nests	Success-ful	Per Cent Successful	Total Nests	Success-ful	Per Cent Successful	Total Nests	Success-ful	Per Cent Successful
Pittsburgh	11	9	81.8	16	9	56.3	12	8	66.7
East Lansing	5	3	60.0	9	2	22.2	0	0	0.0
Total	16	12	75.0	25	11	44.0	12	8	66.7

Table 27

Nesting Data

		Active Nests	Successful Nests	Per Cent Successful	Eggs Laid	Eggs Hatched	Per Cent Hatched	Fledged	Per Cent of Nestlings Fledged	Per Cent of Eggs Producing Fledglings
East Lansing	'54, '56, '57	12	8	66.7	45	29	64.4	21	72.4	46.7
Pittsburgh	'54	11	8	72.7	37	22	59.5	18	81.8	48.6
Pittsburgh	'55	10	6	60.0	36	31	86.1	17	54.8	47.2
Pittsburgh	'56	14	10	71.4	43	32	74.4	23	71.9	53.5
Total		47	32	68.1	161	114	70.8	79	69.3	49.1

Table 28

Comparison of Nesting Data

Reference	Years	Active Nests	Successful Nests	Per Cent Successful	Eggs Laid	Eggs Hatched	Per Cent Hatched	Fledged	Per Cent of Nestlings Fledged	Per Cent of Eggs Producing Fledglings	Average Number Fledged per Active Nest	Average Number Fledged per Successful Nest
Howell (1942)	2	136	78	57.4	259	157	60.6	131	83.4	50.6	1.0	1.7
Young (1955)	3	176	86	48.9	548	316	57.7	246	77.8	44.9	1.4	2.9
This study, East Lansing	3	12	8	66.7	45	29	64.4	21	72.4	46.7	1.8	2.6
This study, Pittsburgh	3	35	24	68.6	116	85	73.3	58	68.2	50.0	1.7	2.4
Total		359	196	54.6	968	587	60.6	456	77.7	47.1	1.3	2.3

Table 29

Fate of Robin Eggs

		Disappeared	Sterile or Addled	Observer	Predator	Deserted	Total
East Lansing	'54	2	0	0	0	0	2
East Lansing	'57	2	1	4	5	2	14
Pittsburgh	'54	5	6	2	0	3	16
Pittsburgh	'55	4	0	1	0	0	5
Pittsburgh	'56	4	5	0	2	0	11
Total		17	12	7	7	5	48
Per Cent of Total		35.4	25.0	14.6	14.6	10.4	100.0

Table 30

Fate of Robin Nestlings

		Predator	Disappeared	Deserted	Fell or Thrown From Nest	Weather	Found Dead After Fledging	Total
East Lansing	'54	1	1	0	0	0	0	2
East Lansing	'57	0	0	6	1	3	0	10
Pittsburgh	'54	0	0	1	2	0	1	4
Pittsburgh	'55	5	7	0	2	0	0	14
Pittsburgh	'56	5	0	0	1	3	0	9
Total		11	8	7	6	6	1	39
Per Cent of Total		28.2	20.5	17.9	15.4	15.4	2.6	100.0

APPENDIX II

PLATE 1

A. Facing north on Willow Avenue, the western boundary of Study Area 1, Pittsburgh.

B. Facing northeast on Willow Avenue in Study Area 1.

PLATE 2

A. A backyard in the northeastern corner of Study Area 1.

B. Hillside covered with Lonicera japonica Thunb., marking a portion of the southern boundary of Study Area 2, Pittsburgh.

PLATE 3

A. Facing west on Lebanon Avenue in Study Area 2.

B. A portion of the northern boundary of Study Area 2.

PLATE 4

A. Facing north on Cedar Street in Study Area 3, East Lansing.

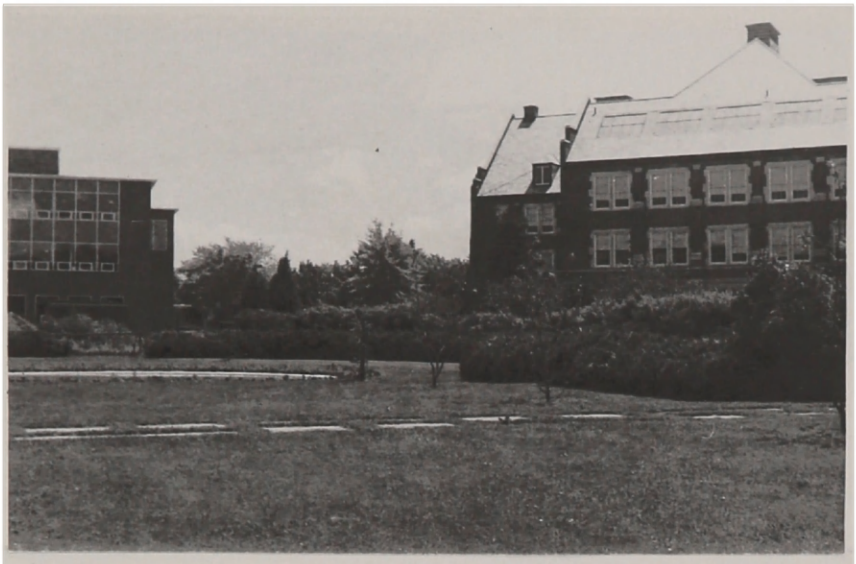
B. Facing north on Bogue Street, the western boundary of Study Area 3.

PLATE 5

A. A portion of the eastern boundary of Study Area 3.

B. Field and adjoining woodlot on Cedar Street in Study Area 3.

PLATE 6



A. Horticultural Gardens, Michigan State University, East Lansing.

B. Buckthorn (Rhamnus frangula L.) thicket, west of the East Lansing Senior High School, that was utilized as a daytime feeding area by robins in the summer.

PLATE 7

A. Y79 of nest 57-16 at two days.

B. Y79 of nest 57-16 at six days.

PLATE 8

A. Y79 of nest 57-16 at seven days.

B. Y79 of nest 57-16 at eight days.

PLATE 9

A. Y79 of nest 57-16 at nine days.

B. Y79 of nest 57-16 at 10 days.

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