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Reproductive Biology of American Robins Following a Dutch Elm Disease Control Program

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Reproductive biology of the American robin (*Turdus migratorius* Linnaeus) was studied on the Iowa State University campus during the spring and early summer of 1977. Although the robin breeding population was below that reported for similar habitats elsewhere, it was appreciably larger than during the late 1960's when a major reduction in number of breeding robins at Iowa State followed the use of DDT. Breeding robins, as indicated by number of nests, were more numerous in 1977 than in any year during the height of the Dutch elm disease control program, 1962-70. Basic reproduction parameters such as clutch size and hatching success were similar to those in the pre-DDT era suggesting that the robin population in 1977 had regained its pre-DDT level.
INDEX DESCRIPTORS: American robin, reproductive biology, DDT, Iowa State University campus.

The relationship between DDT used for the control of Dutch elm disease and mortality of songbirds was first investigated by Benton (1951) in the late 1940's. Subsequent field work (Blagbrough 1952) revealed that American robins (*Turdus migratorius* Linnaeus) were common victims when DDT spraying was carried out from March to May. Barker (1958) found a simple food chain of leaf litter, earthworms, and robins results in DDT becoming concentrated in robins. Bernard (1963) and Hunt and Sacho (1969) have experimentally confirmed the lethal effects of DDT on robins and other birds.

Several DDT-robin studies have dealt with Dutch elm disease control programs on university campuses. Mehner and Wallace (1959) and Wallace (1959) in Michigan, Hickey and Hunt (1960) and Hunt and Sacho (1969) in Wisconsin, and Weller (1971) in Iowa have traced robin mortality and population decline following recurrent DDT applications. Other DDT-robin studies have dealt with Dutch elm disease control programs in residential communities (e.g., Wurster et al. 1965) and pest control in agricultural areas (e.g., Johnson et al. 1976).

Response of robins to the discontinuance of spraying with DDT has been reported. Wurster et al. (1965) and Weller (1971) found a reduction in robin mortality when Methoxychlor was used in place of DDT. Hunt and Sacho (1969) reported an immediate increase in robin populations following discontinued DDT applications. However, in Michigan, G. J. Wallace (cited by Weller 1971) found no significant repopulation of robins five years after use of DDT was discontinued.

Although several studies have reported initial repopulation of robins following discontinued use of DDT, none have examined long-term population recovery and reproductive biology. In the spring and early summer of 1977, robin reproductive biology was studied on the Iowa State University campus and compared with the results of Weller (1971) on robin mortality and population levels in the 1960's.

STUDY AREA AND METHODS

Study area

An intensive program for Dutch elm disease prevention began on the Iowa State University campus in the fall of 1960. Initial hydraulic spraying of elms with DDT was followed by aerial spraying in 1966-67. DDT use was restricted to fall applications in 1964 and was discontinued after 1967. Methoxychlor was applied from 1964 to 1969 and again in 1972. Bidrin injections began in 1967 and following 1972, a number of systemic insecticides were used. Because only 25 elms (*Ulmus* sp.) remained out of an original population of approximately 1500, chemical control efforts were suspended in 1976 (R. W. Ferguson, pers. comm.).

Field surveys of robin populations and nesting activity were conducted on a 87 ha section of campus that had received prior DDT applications (Fig. 1). The study area was nearly identical to that in which Weller (1971) reported a major reduction in numbers of breeding robins and in survival of young. However, habitat changes on campus were noted with the loss of nearly all mature elms and their replacement with a variety of small trees.

The Iowa State campus has been extensively landscaped with a large number of ornamentals. As the result of careful selection and care, many shrubs and trees that are not native to Iowa or are found only under cultivated conditions are grown. At least 40 families and 199 species of woody plants are present on campus (Brady 1962).

Methods

Observations were made from 10 March to 20 July, 1977. Nests were located by searching wherever robins gave alarm calls or were seen carrying nesting material or food. Nest surveys averaged 2 to 3 hours with a total of about 200 hours spent in the field.

Nests were ordinarily examined and contents recorded every other day. On a few occasions longer periods of time intervened, and at certain stages the nests were checked daily. Nests above 1.5 m were usually examined with a mirror attached at right angles to a sectioned bamboo pole. Several nests were located at such a height or in such a position that clutch size was never determined although it was possible to record number of young by careful observation during adult feedings.

Nest initiation dates were determined by backdating allowing 7 days for nest construction, 1 day for each egg, 13 days for incubation (including the day the last egg was laid) and 14 days for fledging (Young 1955).

Additional nest-site information was provided by the ornithology class at Iowa State. On 2-4, 12, and 13 May students surveyed common species of birds nesting on campus. Their results were helpful in finding several nests whose locations were not previously known and assured that a high percentage of all nests were found.

Trees or shrubs containing nests were identified, in most cases to species. The height of the nest above the ground and the total tree or shrub height were measured to the nearest foot with a Topcon range-height finder. All measurements were later converted to metric units. General nest position was noted (e.g., axil, saddled on limb, in crotch) and direction the nest faced in relation to the tree trunk was estimated to the nearest 45°. Nest cover was recorded, generally during clutch initiation, using a coverage estimation technique (Daubenmire 1959).

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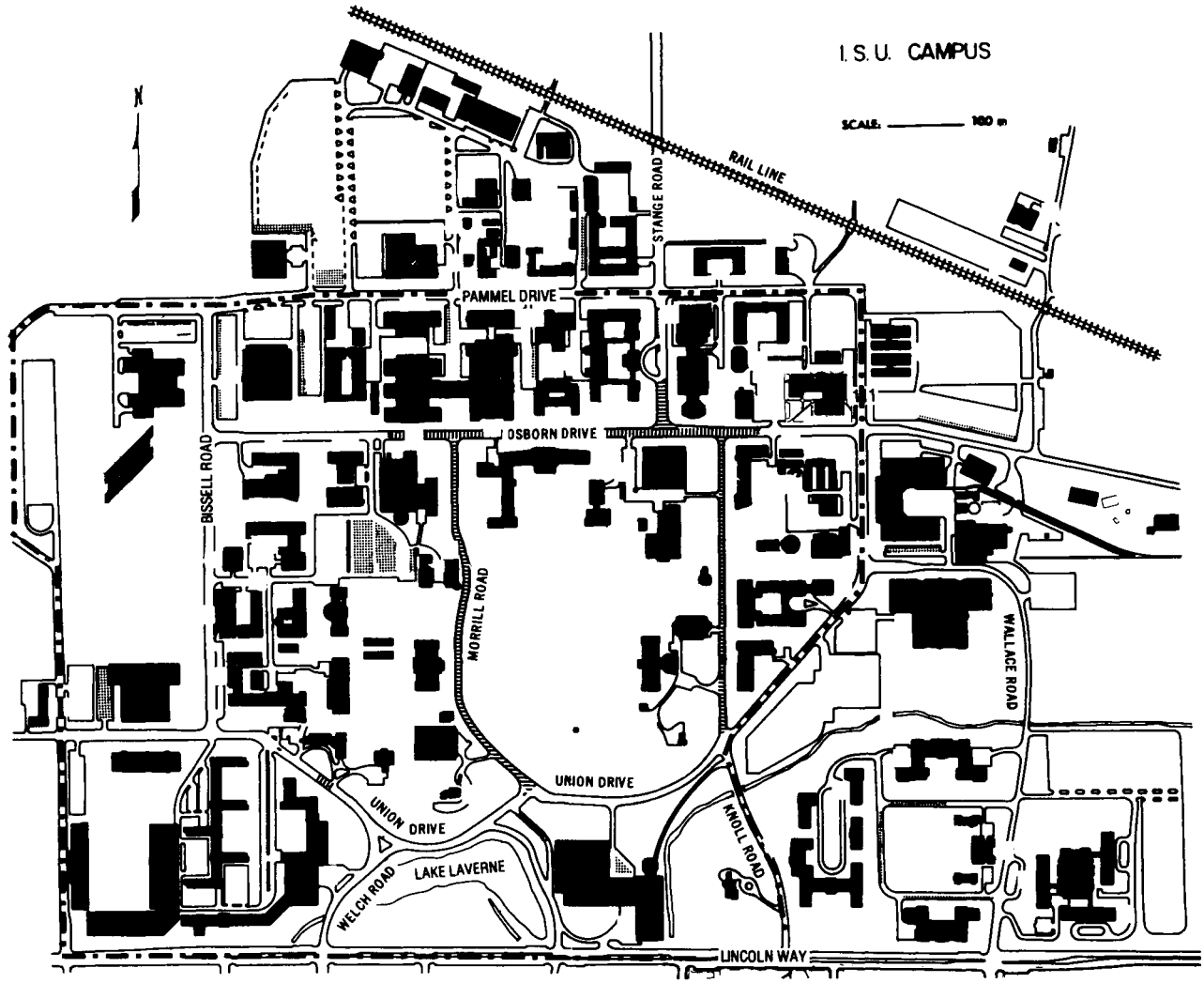

Figure 1. *Study area on the Iowa State University campus in 1977 (study area boundary indicated by broken line).*

RESULTS

Chronology of nesting

Migrating robins arrived on the campus study area in mid March of 1977. The earliest recorded nest was started 30 March and the first egg was laid on 10 April. The latest date for a first egg was 27 June and the latest date any nest contained eggs was 6 July. The earliest fledging date was recorded 5 May and the latest 19 July. Figure 2 shows the distribution of active nests (those receiving at least one egg) throughout the breeding season in 1977.

Dividing the nesting season into 5-day intervals showed that maximum clutch initiation occurred between 6 and 10 May although for a 10-day period, 21-30 April ranked highest with 26 nests receiving first eggs (Fig. 3). A second peak between 26 and 30 May probably represented both second nests and renesting attempts. In Iowa, Klimstra and Stieglitz (1957) recorded the peak of initial nestings from 18-28 April in each of three years (1946-48). At Ithaca, New York, Howell (1942) found most first clutches of eggs were laid between 20 April and 5 May, second clutches between 25 May and 5 June, and third clutches between 5 and 15 July. No clutches were found to be initiated by robins during the first 15 days of July, suggesting that few third nestings were attempted on campus in 1977.

Nest Location

Nest height (93 nests) ranged from 0.9 m to 13.7 m with an average of 4.1 m (Table 1). Young (1955) found nest height for 202 nests ranged from 0.6 to 9.2 m with an average height of 2.3 m. In Illinois, robin nests ranged in height from 0.3 m to more than 15.2 m with averages of about 2.1 m for rural nests and 3.0 m for urban nests (Graber et al. 1971). Klimstra and Stieglitz (1957) found nest height ranged from 1.5 to 13.7 m with a mean height of 3.3 m. Of the 93 nests found on campus in 1977, 44 (47%) were 3.0 m or less in height. Howell (1942) examined 244 nests and found 122 (50%) were not over 3.0 m above the ground.

Graber et al. (1971) stated that nest height tends to increase by as much as 0.9 to 1.2 m as the season progresses. As shown in Table 2, later nests (those in which the first egg was laid after 15 May) were on the average 1.9 m higher than first nests. However, nest height to tree or shrub height ratios were nearly equal for first and later nests indicating, regardless of time of season, nest sites generally were selected near the center of trees or shrubs.

Of the nests under observation during this study, 63% were in trees,

Table 1. *Height of robin nests on the Iowa State University campus in 1977.*

Height (m)	Number of Nests
0-1	1
1.1-2	20
2.1-3	23
3.1-4	7
4.1-5	14
5.1-6	7
6.1-7	10
7.1-8	4
8.1-9	4
9.1-10	1
10.1-11	1
11.1-12	0
12.1-13	0
13.1-14	1
14.1-15	0
	93

Table 2. *Seasonal variation in robin nest height in trees and shrubs on the Iowa State University campus in 1977.*

	Number	Average nest height (m)	Average tree and shrub height (m)	Nest height ratio[a]
First nests	50	3.2	8.1	.39
Later nests[b]	32	5.1	12.1	.41
Combined	82	3.9	9.8	.40

[a]Nest height divided by tree or shrub height.

[b]Nests in which the first egg was laid after May 15.

Table 4. *Cover estimates for robin nests on the Iowa State University campus in 1977.*

Percent cover	First nests	Later nests[a]	Total nests
0-5	1	2	3
5-25	9	4	13
25-50	10	10	20
50-75	4	9	13
75-95	15	11	26
95-100	16	2	18

[a]Nests in which the first egg was laid after May 15.

Table 3. *Plants and structures used by robins as nest sites on the Iowa State University campus in 1977.*

	Number of nests	% of total
Trees		
Deciduous species (54%)		
Maple (*Acer nigrum, A. platanoides, A. rubrum, A. succharum, A. saccharinum*)	9	10
Oak (*Quercus palustris, Q. rubra, Q. alba, Q. bicolor*)	6	6
Hackberry (*Celtis occidentalis*)	4	4
Paper birch (*Betula papyrifera*)	1	1
Juneberry (*Amelanchier* sp.)	1	1
Buckthorn (*Rhamnus cathartica*)	1	1
Downy hawthorn (*Crataegus mollis*)	1	1
Honeylocust (*Gleditsia triancanthos*)	1	1
Little-leaf linden (*Tilia cordata*)	1	1
Pear (*Pyrus* sp.)	1	1
White poplar (*Populus alba*)	1	1
Crabapple (*Malus* sp.)	1	1
Smoketree (*Cotinus obovatus*)	1	1
Chokecherry (*Prunus virginiana*)	1	1
Sycamore (*Platanus occidentalis*)	1	1
Green ash (*Fraxinus pennsylvanica*)	1	1
Coniferous species (46%)		
Pine (*Pinus sylvestris, P. nigra, P. mugo, P. strobus*)	18	19
Spruce (*Picea abies, P. pungens*)	4	4
Douglas fir (*Pseudotsuga menziesii*)	3	3
White fir (*Abies concolor*)	1	1
Red cedar (*Juniperus virginiana*)	1	1
	59	63
Shrubs		
Deciduous species (78%)		
Honeysuckle (*Lonicera* sp.)	9	10
Lilac (*Syringa vulgaris*)	4	4
Viburnum (*Viburnum* sp.)	3	3
Golden bell (*Forsythia* sp.)	1	1
Tartarium maple (*Acer ginnala*)	1	1
Coniferous species (22%)		
Japanese yew (*Taxus cuspidata*)	5	5
	23	25
Structures		
Campus classroom buildings	9	10
Football stadium	2	2
	11	12
GRAND TOTALS	93	100.0

Table 5. *Summary of robin nesting data on the Iowa State University campus in 1977.*

	Number or %
Number active nests[a]	65
Number successful	31
% successful	48
Number of eggs	228
Average per nest	3.5
Number eggs hatched	145
% eggs hatched	64
Number of fledglings	95
Average fledglings per successful nest	3.1
% young fledged	66
% eggs producing fledglings	42
Total number of fledglings[b]	153

[a]Nests with complete histories.
[b]Total number from all 93 nests found.

Table 6. *Comparison of frequencies of robin clutch size on the Iowa State University campus with combined frequencies of two earlier studies.*

Number of eggs	Present study Number	%	Other studies[a] Number	%
1	3	5	2	1
2	1	2	8	3
3	21	32	136	50
4	40	62	125	46
5	0	0	2	1

[a]Howell 1942; Young 1955.

Table 8. *Robin nests, young fledged and mortality on the Iowa State University campus, 1962-70 and in 1977[a].*

	Robin nests	Young robins	Robin mortality
1962[b]	—	—	46
1963	—	—	60
1964	47	—	93
1965	—	—	—
1966	31	—	53
1967	18	1	48
1968	17	3	47
1969	31	28	22
1970	28	37	14
1977	69	54	4

[a]Observation up to late May in each year.
[b]1962-70 data from Weller (1971).

Table 7. *Comparative reproductive data, robins and several altrical birds.*

	Present study (1977)	Johnson et al. (1976)	Klimstra & Stieglitz (1957)	Young (1955)	Howell (1942)	Nice (1957)
Species	Robin	Robin	Robin	Robin	Robin	Several[a]
Number of active nests	65	102	87	176	136	7,788
Average clutch size	3.5	3.2	3.4	3.4	3.4	—
% hatching success	64	71	80	58	61	60
% egg to fledgling success	42	61	—	45	50	46
Average number of young produced per successful nest	3.1	2.6	—	2.9	2.4	—
% nest success	48	67	69 and 33	49	61	49

[a]Altricial birds with open nests.

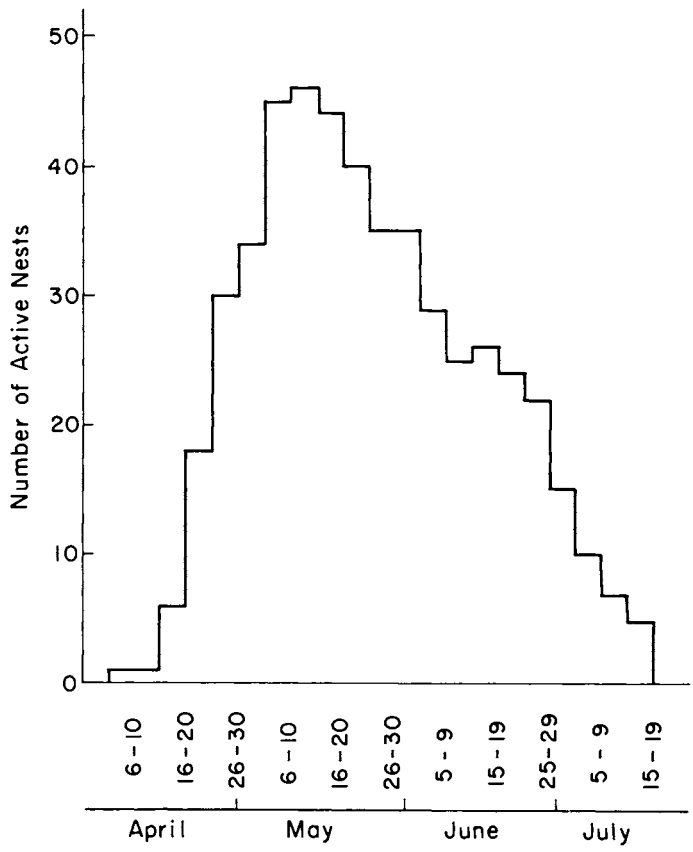

Figure 2. *Distribution of active robin nests throughout the 1977 nesting season on the Iowa State University campus.*

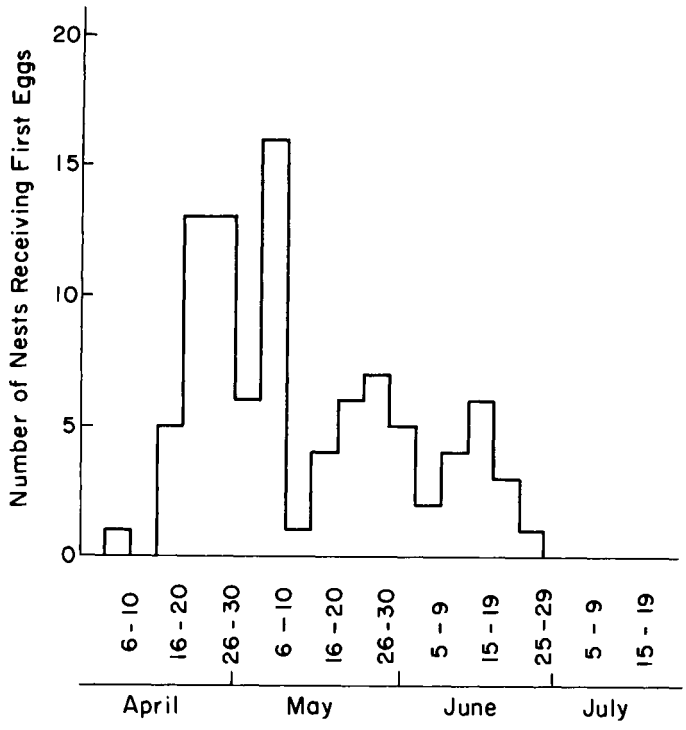

Figure 3. *Initiation of egg-laying by robins on the Iowa State University campus in 1977.*

25% in shrubs, and 12% on buildings (Table 3). Graber et al. (1971) reported a similar distribution for robin nests in northern and central Illinois although the percentage in shrubs was smaller. Howell (1942) reported that 58% of the early nests in a New York study were located in evergreens and 25% in deciduous trees; later nestings showed a reverse trend with 38% in evergreens and 48% in deciduous trees. Robins nesting on campus in 1977 showed a similar seasonal preference.

Of the nests found in trees, 26 (44%) were in an axillary position, 28 (47%) were saddled on limbs, and 5 (8%) were positioned in the crotch of the tree. No strong preference for any compass direction was noted. Knupp et al. (1977) reported nearly the same results on nest position for robins in northern Maine.

Howell (1942) stated that many robin nests are constructed without regard to concealment although the typical nest is partly concealed and elevated beyond the easy reach of predators. In this study, nest sites that provided nearly complete cover were more frequently selected early in the season. Also, very few nests on campus in 1977 were without at least some minimal amount of cover (Table 4).

Nesting success

Table 5 summarizes the nesting data gathered on campus in 1977. Of the 93 nests found, only 65 with complete histories were considered for an evaluation of clutch size and hatching and fledging success. Clutch size was never determined for the remaining 28 nests although each was known to be active from observation of adults feeding young. All nests which fledged at least one young were considered successful.

Frequencies of clutch sizes in this study were compared with combined data obtained in two other studies (Table 6). The significance of the higher that expected frequency of four-egg clutches is questionable considering Young (1955) reported a similar observation with 41 four-egg and 27 three-egg clutches in one of three study years in Wisconsin.

Table 7 compares robin reproductive data obtained on the Iowa State campus with data presented in four other robin studies, as well as one study of birds which build open nests and have altricial young. As indicated, breeding success of robins on the Iowa State campus agrees quite closely with that computed in other robin studies and for that of open-nesting passerines.

DISCUSSION

Estimates of robin population density in habitats similar to those on the Iowa State campus are available. Calhoun (1948) determined a robin density of 134 pairs per 40.5 ha on 7.1 ha of the Ohio State University campus. Wallace (1959) used 5 robin pairs on approximately 2.0 ha of the Michigan State campus to estimate a density of 100 pairs per 40.5 ha. Hunt (1960) reported a range of 159 to 198 robin pairs per 40.5 ha of residential habitat in Wisconsin. Using a state-wide strip census in Illinois, Graber and Graber (1963) found a breeding population of 50 to 65 pairs per 40.5 ha of urban residential habitat.

As determined from the nest-activity curve (Fig. 2), there were at least 46 breeding pairs of robins on campus in 1977 (=22 pairs per 40.5 ha). However, a somewhat larger breeding population was indicated by a contemporaneous total of 55 nests either under construction or with eggs or young. Assuming as did Young (1955), that there is no significant nonbreeding segment in the adult robin population, then the population density on campus in 1977 was about half of the lowest previous estimate.The reasons for this are not apparent.

Breeding success of robins in this study agrees quite closely with those of earlier robin studies and for open-nesting passerines suggesting population stability. Few dead robins were found on campus in 1977 indicating that epidemic disease or pesticide residues were not the cause (Table 8). Drought conditions that have intensified in central Iowa during the past year (total precipitation in April and May, 1977, was only half of normal) may have resulted in reduced food supplies and in a stable but smaller robin population.

Although robin breeding numbers were below what several investigators have determined for pre-pesticide or no-pesticide conditions, the population on campus in 1977 was appreciably larger than during the late 1960's when a rapid decline in robins on campus was documented (Weller 1971). Table 8 shows this and the results of robin nesting surveys in 1977. Results in each year include all nests found up to late May.

Robin breeding numbers, as indicated by number of nests, have shown a sharp increase to nearly 2.5 times the 1970 level. Breeding numbers of robins are higher in 1977 than in any previous year shown (Table 8). The number of young robins fledged has also shown a substantial increase. Robin mortality was not conspicuous as indicated by the low number of dead found on campus.

Unfortunately, no robin population estimates are available for the campus prior to 1960. However, basic reproductive parameters such as clutch size and hatching success followed in this study are similar to those reported by Klimstra and Stieglitz (1957) and Klimstra (in litt.) for a section of campus in the late 1940's. This suggests that the robin population in 1977 is reproducing as well as in the pre-DDT era on campus. Furthermore, the population estimated to be present in 1977 is larger than any found in the years 1962-70.Thus, the robin population appears to have regained its pre-DDT level. Why population density is so much lower than that reported for other comparable habitats is unknown.

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