ECOLOGICAL FACTORS AFFECTING NEST BUILDING IN RED-WINGED BLACKBIRDS

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INTRODUCTION

This study is an investigation of the ecological factors influencing the time and duration of nest building, and dimensions of the nest of the Red-winged Blackbird (*Agelaius phoeniceus*). Nice (1937) states that the function of a nest is protection of the eggs and young. Therefore, the position of the nest, and the nest size, should vary according to species-specific demands and to individual needs and preferences. In some species younger or weaker nestlings are crowded from the nest by siblings (Young, 1963; Ricklefs, 1965). In this respect the size of the nest bowl should be of critical importance, hence our objective was to determine whether there was any relationship between nest success and the dimensions, height, and time of construction of nests.

PROCEDURE

Two geographic areas were included in this study. An upland breeding group of blackbirds was studied in Toledo, Ohio in 1964 and 1965. Marsh-breeding Redwings were studied at and near Toledo, and at Battle Creek, Michigan, some 125 miles from Toledo in 1965.

In 1965 certain plants in the Toledo upland field were measured on a weekly basis in order to determine the height of vegetation at the onset of nesting. At least five of the tallest plants of each species concerned were measured to the nearest half-inch.

Nest building was considered in four stages: 1) *just started* (only a few pieces of nesting material present); 2) *platform stage* (partially woven together or with some mud plastered to it, but no evidence of a bowl shape); 3) *bowl stage* (nest material woven and plastered together into an oval cup, but no inner grass lining); 4) *completed* (inner lining present).

A record was kept of the primary nest support and any additional vegetative supports. Nest height was measured to the near-half-inch by measuring the distance from the earth or water to the upper rim of the nest.

When a nest was completed, measurements to the nearest half-centimeter were made of the inner diameter, outer diameter, inner depth and outer depth. The outer-depth measurement included only the main structure.

OBSERVATIONS AND RESULTS

Vegetation Growth Affecting Nest Site Selection

The primary support for the 1965 upland nests (other than in trees and bushes) in Toledo was new goldenrod stems with some secondary supports of old and new wheatgrass, old goldenrod stems and old and new sweet clover. The wheatgrass grew from 12.1 to 25.4 inches, goldenrod from 5.1 to 25.6 inches, and sweet clover from 5.3 to 21.1 inches from 2 May to 24 May. The only numerous supports available for nests in upland fields before the new vegetation growth was old goldenrod, wheatgrass, and sweet clover stems; the tallest of the dead stems were 54, 34, and 36 inches, respectively. These stems were widely scattered and would have made poor cover for nests. The first five nests constructed in the upland were constructed on 11 May and all of these were in trees and bushes. The initial 15 nests were constructed between 11 and 17 May, and only three were in the low field vegetation. One found on 12 May was 9.5 inches up, supported by old and new goldenrod. The other two were constructed on 14 and 17 May and their major support was black raspberry. Of 25 nests that were started between 17 May and 14 June, 11 were supported in full or part by old and new wheatgrass, sweet clover or goldenrod and one by black raspberry. This indicates an increase in the use of lower nesting sites as the vegetation develops and provides better support and cover. The 11 nests supported by the annual herbs ranged from 7.5 to 17.5 inches in height.

In most instances, nests were discovered after they were in an advanced stage of building and, therefore, our data is limited. In Toledo, 12 nests required a mean of two days to reach the platform stage and four nests had a mean interval of 2.3 days between the platform and bowl stage. Eight nests required a mean of two days between bowl stage and completion. The mean time required for eight nests from beginning to completion was 3.1 days.

In Toledo, the mean time between nest completion and the first egg laid was 2.3 days for 18 nests constructed in May (time includes the day of completion and the day the first egg was laid). The range was from one to four days. For two nests in June, the time was one day for one nest and two days for the other. We suspect that nests constructed in June were renests after an unsuccessful first nest was destroyed.

In Battle Creek one nest was found when first started on 5 May and it required four days for completion. Time between nest completion and laying of the first egg for 18 nests in May was a mean of 3.8 days with a range between two and five days and for four nests constructed in June, the mean was 3.75 days with a range between three and five days.

Types of Nest Substrate

Table I gives the types of primary vegetative substrate for all nests. There were at least 23 different species of primary vegetative substrate and at least 12 species serving as secondary supports for nests. Among the species serving as secondary supports were rushes (*Juncus* spp.), cattail, wheatgrass, grapevine, sweet clover (dead stems), goldenrod (dead stems), meadowsweet, panicled dogwood, black raspberry, morning glory, elderberry and nettles.

TABLE 1. REDWING PRIMARY NESTING SUBSTRATE - FREQUENCY OF USE OF DIFFERENT VEGETATION TYPES

Species	Battle Creek - Marsh	Toledo - Upland	Toledo - Marsh
Cornus racemosa	4	10	5
Salix sp.	11	2	1
Cornus stolonifera	9	—	—
Betula pumila	2	—	—
Typha latifolia	53	—	58
Lonicera sp.	3	3	—
Juncus spp.	10	—	—
Potentilla fruticosa	1	—	—
Sambucus canadensis	14	2	2
Rubus idaeus	3	—	—
Ulmus americana	1	8	—
Dead Shrub (Sp. unknown)	1	—	—
Solidago spp.	—	31	—
Rubus spp.	—	8	—
Vitis sp.	—	4	—
Acer negundo	—	3	—
Fagus grandifolia	—	1	—
Rhus typhina	—	1	—
Prunus virginiana	—	1	—
Rosa sp.	—	1	—
Quercus macrocarpa	—	1	—
Spiraea alba	—	1	—
Fraxinus sp.	—	1	—

Nest Height and Success

Table II indicates the height of nests above the earth or water in relation to the time in the breeding season and the type of vege-

TABLE II. REDWING NEST HEIGHT (INCHES) IN RELATION TO VEGETATION AND TIME OF BREEDING SEASON

	Nests in grasses, weeds, cattails, etc.	Nests in shrubs, bushes and trees	Combined data
Nests found through 15 May	N - 75 X̄ - 22.7 Range - 7.0 - 39.0	25 53.7 20.0 - 85.0	100 30.5 7.0 - 85.0
Nests found 16 May through 31 May	N - 47 X̄ - 21.9 Range - 10.0 - 38.5	30 63.7 22.0 - 158.0	77 38.2 10.0 - 158.0
Nests found 1 June through 15 June	N - 21 X̄ - 17.2 Range - 12.0 - 29.0	29 52.7 19.5 - 98.0	50 37.8 12.0 - 98.0
Nests found after 15 June	N - 1 X̄ - 25.0 Range -	3 48.0 40.0 - 59.0	4 42.3 25.0 - 59.0
Average	N - 144	87	231
Height	21.7	56.6	34.8

TABLE III. REDWING SUCCESS IN RELATION TO HEIGHT OF NEST

	N	Eggs laid	Young fledged	% Success
Nests Under 24 Inches	79	273	47 (15 nests)	17.2
Nests between 24 and 48 Inches	34	118	26 (10 nests)	22.0
Nests Above 48 Inches	44	158	55 (19 nests)	34.8

tation they were found in. Table III gives the success of Redwing nesting depending on the height from the earth or water surface.

Redwings were breeding earlier in the Toledo marsh habitats and we thought perhaps one reason for this was the presence of numerous suitable emergent vegetation nest sites such as cattails and rushes which give some height and cover to the nest. The upland Toledo population was not breeding as heavily in the lower vegetation until after it had become high enough to support and give cover to the nest. Most of these nests were constructed after 16 May when the goldenrod, sweet clover and wheatgrass had reached a more desirable height.

The height of the nest of Redwings nesting in low upland vegetation is being investigated further. M. L. Giltz (pers. com.) has found Redwings nesting on the ground in alfalfa fields in late April near Columbus, Ohio.

Nest Dimensions

The mean dimensions of all 228 nests measured at Toledo and Battle Creek were inner width, 7.5 cm (6.0-9.5), outer width, 12.2 ± .1 cm (9.5-16.0), inner depth, 6.5 ± .1 cm (4.0-8.5) and outer depth, 11.2 ± .1 cm (6.5-18.0). Table IV shows the dimensions of Redwing nests that were located over dry land or over water. Table V shows the dimensions of nests found above and below 42 inches from the earth or water. Table VI demonstrates the size of nests that were constructed before or after 1 June.

The differences between the means of nest dimensions in different samples were not significant at the .05 level when a Student's two-tailed t-test was employed; there was one exception. When Redwings nest above 42 inches the mean inner depth for 56 nests was 6.7 cm compared to 6.4 cm for 153 nests below 42 inches. There was a significant difference between these two sample means, indicating that as Redwings nest above 42 inches, the inner depth of nests is greater.

Forty nests had fledgings leaving them. The dimensions of these nests were of interest for if they were larger, it might be possible that a bigger nest bowl provided enough additional space to allow the nestlings more freedom of movement and prevent excessive crowding. The mean nest dimensions in the successful nests were

TABLE IV. DIMENSIONS OF REDWING NESTS EITHER OVER WATER OR NOT OVER WATER (CM)

		Water	No Water
		N = 91	N – 137
Inner Width	$\bar{X}$	7.5 ± .1	7.5 ± .1
	Range	6.5 – 9.0	6.0 – 9.5
Outer Width	$\bar{X}$	12.3 ± .1	12.2 ± .1
	Range	10.5 – 15.0	9.5 – 16.0
Inner Depth	$\bar{X}$	6.4 ± .1	6.6 ± .1
	Range	4.0 – 8.0	4.5 – 8.5
Outer Depth	$\bar{X}$	11.3 ± .2	11.1 ± .2
	Range	8.0 – 15.5	6.5 – 18.0

not significantly different from the mean size of all 228 nests. The mean dimensions in centimeters for the 40 successful nests were 7.6 (inner width), 12.2 (outer width), 6.5 (inner depth), and 11.1 (outer depth).

Twelve nests were measured when the nest was first completed and then measured again after fledgings had departed to find whether nest size flexibility might have some effect on nesting success. All of the mean dimensions were greater after the young had fledged. The mean differences in dimensions (cm) at the time when the nest was completed and the time when the fledgings departed was .8 (inner width), .9 (outer width), .1 (inner depth) and .5 (outer depth).

DISCUSSION

One important factor that should not be overlooked by the investigator is that the nest size of altricial birds is probably highly dependent on the size of the adult bird, which is variable within the species. Since an incubating bird spends the majority of time on the nest, if it has a cup shape, the dimensions will in most cases be decided, at least in part, by the size of the incubating parent.

Nest Building and Egg Laying

Nest building took three days in the birds we studied. This is similar to the four-day period reported by Beer and Tibbitts (1950), but is shorter than the six days reported by Allen (1914). Beer and Tibbitts reported that some birds require a longer time to build early nests. There was no evidence of a difference in time required to build a nest in May or June. The time between nest completion and laying of the first egg was less in June nests than May nests for Toledo and Battle Creek. The mean time between nest completion and laying of the first egg in May was 2.3 days (18 nests) in Toledo, and 3.8 days (18 nests) in Battle Creek. We have no explanation for this difference of 1.5 days between the two popu-

TABLE V. DIMENSIONS OF REDWING NESTS (CM) DEPENDENT ON HEIGHT FROM EARTH OR WATER

	Toledo - Upland Population		Toledo and Battle Creek Marsh Populations		Combined Data from All Nests	
	Under 42 Inches	Over 42 Inches	Over 42 Inches	Under 42 Inches	Under 42 Inches	Over 42 Inches
	N = 29	N = 25	N = 31	N = 124	N = 153	N = 56
$\bar{X}$	7.7 ± .1	7.6 ± .1	7.5 ± .1	7.4	7.5	7.6 ± .1
Inner Range Width	7.0 – 8.5	6.5 – 9.5	6.5 – 9.0	6.0 – 8.5	6.0 – 9.5	6.0 – 9.5
$\bar{X}$	11.9 ± .2	11.5 ± .2	12.8 ± .3	12.3 ± .1	12.2 ± .1	12.2 ± .3
Outer Range Width	9.5 – 15.0	10.0 – 13.0	10.5 – 16.0	10.5 – 15.0	9.5 – 16.0	9.5 – 16.0
$\bar{X}$	6.6 ± .2	6.7 ± .1	6.7 ± .1	6.3 ± .1	6.4 ± .1	6.7 ± .1
Inner Range Depth	5.0 – 8.5	5.5 – 8.5	5.0 – 8.0	4.0 – 8.0	4.0 – 8.5	4.0 – 8.5
$\bar{X}$	10.5 ± .3	11.1 ± .4	11.7 ± .4	11.2 ± .2	11.0 ± .1	11.4 ± .3
Outer Range Depth	6.5 – 15.0	8.0 – 15.5	8.0 – 15.0	7.0 – 15.5	6.5 – 15.5	6.5 – 15.5
Average Ht. of Substrate (Inches)	18.4	62.6	58.4	23.8	22.7	60.3
Range	7.0 – 36.5	43.0 – 126.0	42.5 – 98.0	8.0 – 41.0	7.0 – 41.0	42.5 – 126.0

TABLE VI. DIMENSIONS (CM) OF REDWING NESTS CONSTRUCTED BEFORE OR AFTER 1 JUNE

		Before 1 June	After 1 June
		N = 174	N = 54
Inner Width	$\bar{X}$	7.5	7.6 ± .1
	Range	6.0 – 9.5	6.5 – 9.0
Outer Width	$\bar{X}$	12.2 ± .1	12.5 ± .2
	Range	10.0 – 16.0	9.5 – 15.0
Inner Depth	$\bar{X}$	6.4 ± .1	6.6 ± .1
	Range	4.0 – 8.5	4.5 – 8.5
Outer Depth	$\bar{X}$	11.2 ± .2	11.1 ± .2
	Range	6.5 – 18.0	8.0 – 15.0

lations. Beer and Tibbitts (1950) found four days as the typical loafing period but extremes of one to ten days in late and early nesters.

Nesting Substrate and Height of Nest

Since the Redwing appears to have adapted to a variety of habitats one might postulate that they are opportunistic in selection of a nest site. However, there could be differences in nesting success, depending on the height of the nest. When reviewing Table I, the variety of vegetation used as the nest support is evident, and there is a change in the per cent of nests found in trees and shrubs as the breeding season progresses. This is probably due to the movement of Redwings into areas that previously offered little in the way of cover for the nest.

Nest Height

Allen (1914) reported that nests in April and May were located at an average height of eight or ten inches above water, but by the middle of June the average had risen to 25 inches. He relates this change to the increased growth of the vegetation.

Some birds exhibit marked change in nest site selection with changes in vegetative cover and growth, and increase in temperature. Nice (1937) reported the increase in height of Song Sparrow (*Melospiza melodia*) nests as the season progressed. Walkinshaw (1944, 1939) recorded an increase in nest height of the Chipping Sparrow (*Spizella passerina*) and of the Field Sparrow (*Spizella pusilla*) as the season progressed and, likewise, Horvath (1964) recorded a change in nest height and tree species selection for the Rufous Hummingbird (*Selasphorus rufus*). Taylor (1965) reported that the nest height of the Mockingbird (*Mimus polyglottos*) and the Brown Thrasher (*Toxostoma rufum*) progressively increased throughout the months from March through August. He did not indicate how this affected their nesting success. Meanley and Webb (1963) reported that the nesting success for Redwings increased from 45 per cent for nests below two feet to 62 per cent for those above four feet. We also found that nesting success increased with the height of the nest (see Table III). On the basis of this criterion alone it would seem that it would be advantageous for Redwings to nest at higher elevations. The availability of suitable higher nesting substrate may be limited in this territorial species. Orians (1961) mentions the variety of nesting areas selected by the Redwing and suggests that the chief requirement is apparently vegetation strong enough to support the nest, surrounded by suitable feeding grounds. In our observations, even when higher nesting substrate appeared to be available, the nests were more often found in lower vegetation.

Verner and Willson (1966) report that polygynous species nest primarily in marshes, prairies, or savannah-like habitats where productivity resulting from solar energy is concentrated into a narrow vertical belt of vegetation. The polygynous mating system in the Red-winged Blackbird may not succeed as well if the birds are nesting in an area where there is a broader vertical belt such as brushy or woody habitats. This may be one reason for the lack of Redwings nesting at higher levels. Also, Nickell (1965) reported that there may be some competition between the Catbird (*Dumetella carolinensis*) and Redwings for suitable nesting sites. There may be other interspecific conflicts occurring in a broader vertical belt of vegetation than would occur in the narrow belt where most Redwings nest.

Nest Dimensions

Holcomb (1966) compared the means of the dimensions as reported by Beer and Tibbitts (1950) with the mean dimensions of 24 upland nests in Toledo. There was a larger inner width but a smaller inner depth in the upland populations. The mean inner depth for 22 nests studied by Beer and Tibbitts (1950) was 7.1 cm. This was greater than any of those reported in this paper.

The significant difference (.05 level) between the sample means of inner depths in nests above or below 42 inches in height indicates that the female may build the nest deeper when it is higher or that the nest substrate determines the nest dimensions to some extent, for the nests above 42 inches were in trees or bushes instead of annual plants.

SUMMARY

Red-winged Blackbird (*Agelaius phoeniceus*) nest building habits were studied. The time required for four stages in nest building are described. The mean time required to build a nest was three days. There was a delay of one to five days between nest completion and egg laying.

Twenty-three species of primary nest supports are listed. There was a change in use of low versus high vegetation as nest supports

at different times in the nesting season. Nesting success varied between 17.2 per cent for nests built under 24 inches to 34.8 per cent for those above 48 inches.

Mean dimensions (cm) of 228 Redwing nests were: inner width (7.5), outer width ($12.2 \pm .1$), inner depth ($6.5 \pm .1$) and outer depth ($11.2 \pm .1$). Successful nests were not significantly different in size from unsuccessful nests. The mean inner depth of nests built over water was not greater than those over dry land; it was not greater in nests built late in the nesting season when compared with early nests.

The mean inner depth of nests built over 42 inches in elevation was significantly greater than in nests below 42 inches.

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