AN EVALUATION OF REPORTED REPRODUCTIVE SUCCESS IN RED-WINGED BLACKBIRDS

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THE Bureau of Sport Fisheries and Wildlife, through its Ohio Blackbird Research Laboratory at Sandusky, Ohio, is conducting investigations on the Red-winged Blackbird (*Agelaius phoeniceus*), with the objective of reducing agricultural damage by this species. Nesting success in different substrates and micro-environments is an important variable in such study. Eight published studies that deal with the nesting success of Redwings (Table 1) have been reviewed and results compared by using statistical significance calculations. This approach was taken to establish firm con-conclusions, where possible, regarding conditions which control nesting success.

RECENT NESTING STUDIES REVIEWED

Smith (1943:195), in Cook County, Illinois, found an overall reproductive success (which he defined as the ratio of young fledged to eggs laid) of 59.7 per cent in 1941; there was no correlation between success and the size of the breeding population. Meanley and Webb (1963), in the marshes of Chesapeake Bay, Maryland, found that 57 per cent of active nests (those containing at least one egg or nestling) were successful in fledging one or more young in 1959–61. Success varied only from 58.6 per cent in 1959 to 52.8 per cent in 1961. They compared success by ecological communities, by kinds of plants in which nests were built, and by the height of nests above ground. Young (1963), in Wisconsin, found that 29 per cent of active nests were successful in 1959–60, and plotted survival curves through the nestling stage. Case and Hewitt (1963), in New York, found that 32 per cent of active nests were successful in 1960–61; there was markedly higher success in three marshes than in two upland situations. Brenner (1966), in a Pennsylvania marsh, found that 53 per cent of active nests were successful in 1960–64; success varied from 37 to 67 per cent during those years. The population declined from 42 to seven females in 3 years, and recovered to 17 females in the fourth year. He suggested that the amount and distribution of rainfall determined the number of nests constructed, but did not show that nesting success varied with rainfall. Fankhauser (1964), in Maryland, studied the re-nesting of color-marked females in 1962; he found that 50 per cent of all nests were successful: seven of 16 first nesting attempts, four of five second attempts, and one of three re-nestings. Goddard and Board (1967), in Oklahoma, found an overall nesting success of 26.7

TABLE 1

RED-WINGED BLACKBIRD REPORTED NESTING SUCCESS, BY ECOLOGICAL FACTORS

Source[1]	Habitat, Vegetation, Timing	Year	Nest Height	Active Nests	Successful Nests
1.	Cattail marsh	1941	–	167	([2])
2.	Tidal marsh	1959–61	<2 ft	44	20
	Tidal marsh	1959–61	2–4 ft	360	199
	Tidal marsh	1959–61	>4 ft	271	169
2.	Estuarine Shore	1959–61	All	299	159
	Brackish Tidal River	1960	All	176	122
	Brackish Bay	1959	All	88	57
	Fresh Tidal River	1960	All	50	23
	Salt Bay	1959	All	42	16
	Fresh Bay	1961	All	20	11
2.	Tidal marsh	1959	All	232	136
	Tidal marsh	1960	All	335	195
	Tidal marsh	1961	All	108	57
2.	Hightide-bush	1959–61	All	330	178
	Groundselbush	1959–61	All	179	116
	Grasses and sedges	1959–61	All	56	33
	Shrubs and trees	1959–61	All	35	24
	Cattails	1959–61	All	15	8
	Other vegetation	1959–61	All	35	12
3.	Cattail marsh	1959	–	238	83
	Cattail marsh	1960	–	280	67
4.	Cattail marsh	1960	–	379[3]	208
	Upland fields	1960	–	57[3]	17
	Cattail marsh	1961	–	402[3]	146
	Upland fields	1961	–	147[3]	48
5.	Initial nesting	1962	–	16	7
	Renesting after failure	1962	–	6	4
	Second nest	1962	–	3	1
6.	Cattails and sedges	1960	–	45	29
	Cattails and sedges	1961	–	24	12
	Cattails and sedges	1962	–	16	6
	Cattails and sedges	1963	–	6	4
	Cattails and sedges	1964	–	18	7

[1] Source: 1. Smith (1943)—Illinois. 2. Meanley and Webb (1963)—Maryland. 3. Young (1963)—Wisconsin. 4. Case and Hewitt (1963)—New York. 5. Fankhauser (1964)—Maryland. 6. Brenner (1966)—Pennsylvania. 7. Goddard and Board (1967)—Oklahoma. 8. Holcomb and Twiest (1968)—Ohio and Michigan.

[2] 336 young fledged from 563 eggs laid; number of successful nests unknown.

[3] Estimated. Data specified number of deserted nests which were "active" in only one location containing 60 percent of all nests.

TABLE 1 (*Continued*)

Source	Habitat, Vegetation, Timing	Year	Nest Height	Active Nests	Successful Nests
7.	Early nests	1965	All	155	45
	Late nests	1965	All	88	20
7.	Old cattails only	1965	All	52	20
	Old and new cattails	1965	All	83	16
	New cattails only	1965	All	89	26
	Other plants	1965	All	19	3
7.	Cattails and sedges	1965	0–12 in	34	13
	Cattails and sedges	1965	13–24 in	125	34
	Cattails and sedges	1965	25–36 in	53	12
	Cattails and sedges	1965	> 36 in	31	6
8.	Marsh and upland	1964–65	< 24 in	79	15
	Marsh and upland	1964–65	24–48 in	34	10
	Marsh and upland	1964–65	> 48 in	44	19

Source	Vegetation	Year	Water Depth	Active Nests	Successful Nests
7.	Cattails and sedges	1965	0–10 in	155	36
	Cattails and sedges	1965	11–20 in	65	19
	Cattails and sedges	1965	> 20 in	23	10

per cent in 1965; they reported higher success for nests initiated before 1 June, those constructed in old cattails, those closer to the ground or water surface, and those over deeper water. Holcomb and Twiest (1968), in two marsh habitats and one upland habitat in Ohio and Michigan, found nesting success to be greater in nests more than 48 inches above the ground or water than in lower nests.

RESULTS OF ANALYSIS

The above eight studies included 3,013 active Redwing nests in eight states during nine different years, an average of 42 nests per state per year. This total sample, however, is inadequate for a meaningful statistical analysis of the differences between all eight states and between all nine years. Nevertheless, a comparison of the results obtained can reveal some of the factors that have or have not been shown to be important in nesting success. The data are well adapted to the chi-square analysis, and I have made comparisons both between and within the cited studies in order to determine in what respects the differences are of significance.

BETWEEN YEARS

If the data are grouped by years, the differences between years are large; but, except when data from the same locality are compared, it is impossible to say whether the differences are due to year-to-year changes or not. Brenner's study during five consecutive breeding seasons in Pennsylvania (Brenner, 1966) shows no significant differences between years in that locality ($P > 0.20$), but the sample size is less than 20 nests in three of the five years. In the Estuarine Shore community of Maryland studied by Meanley and Webb (1963), data collected for four consecutive years show no significant difference between years in the number of fledglings produced per adult female ($P > 0.50$). On the other hand, Case and Hewitt (1963) found a highly significant difference in nesting success between the two years of their study in New York ($P < 0.01$). Young (1963) also found a significant difference in nesting success between the two years of his Wisconsin study ($P < 0.01$). Difference between years at the same locality must, therefore, be regarded as possibly an important factor in nesting success.

BETWEEN LOCALITIES

In the three years 1960–62, comparable nesting data are available for more than one locality. In 1960, nesting success was very much lower in Wisconsin (Young, 1963) than in New York (Case and Hewitt, 1963) and in Pennsylvania (Brenner, 1966) ($P < 0.01$). In 1961, the difference between Pennsylvania and New York was not significant at the 0.05 level. In 1962, the difference between Pennsylvania (Brenner, 1966) and Maryland (Fankhauser, 1964) was not significant. These differences are between nests in similar habitat (cattail marshes); they must, therefore, be attributed to regional differences in the ecological environment, such as climate, predators, nutrition, water characteristics, etc.

HABITAT TYPES

Three studies provide direct comparison between nesting success in different habitat types. Meanley and Webb (1963) studied nests in marshes in different ecological communities. Success was significantly different ($P < 0.01$) among six communities; highest success was in Brackish Tidal River (two colonies, 1960), and lowest in Salt Bay (two colonies, 1959). The differences between communities may be real even though the data were collected in different years. In only one of the six communities were data collected for more than one year: the Estuarine Shore community, where four years of data showed no significant difference between years.

Case and Hewitt (1963) compared three marsh habitats and two upland habitats. In 1960, the marsh habitats did not differ among themselves in nesting success, but differed greatly from the upland habitats ($P < 0.01$). In 1961, the marshes differed significantly among themselves ($P < 0.01$), but did not differ from the two upland habitats. Success was much lower in 1961 in the marsh habitats, the proportion of successful nests being about the same as in the upland habitats. These results suggest that subtle ecological deficiencies in some marshes will be masked in good years. In less favorable years, these deficiencies will assume more importance and result in poorer nesting success.

An important factor in the habitat is the vegetation in which the nest is built. Meanley and Webb (1963) listed the plant species in which nests were built. I grouped these into six classes, and found that nesting success differed significantly among classes ($P < 0.01$); greatest success was in groundselbush (*Baccharis halimifolia*), poorest success in a miscellaneous grouping of fern and herbs. Success also was high in shrubs and small trees. Goddard and Board (1967) compared the success of nests in different growth stages of cattail, and they reported higher success in old cattails and lower in a combination of old and new cattails. The chi-square analysis shows the differences to be not significant ($P > 0.05$). These two studies together suggest that nest success is related to the vegetation form, with relatively sturdy shrub-like forms more favorable than less sturdy herbs and vines; but that species and growth stage within a single vegetation form have only a minor effect.

NEST PLACEMENT

The height of nests above the water or ground has been suggested as a factor affecting nest success. Goddard and Board (1967) reported that nesting success was greater as the depth of the water below the nest increased. The data given fail to show a significant difference ($P > 0.10$). Goddard and Board also found that nesting success decreased from 38.2 per cent for nests less than 1 foot high to 19.4 per cent for nests more than 3 feet above the surface; chi-square analysis of their data shows that this difference in nest success was not significant ($P > 0.30$). Meanley and Webb (1963) also compared nest success by height, but found the opposite—that the higher nests were more successful than the lower. Analysis of their data, however, also shows that the difference with height was not significant ($P > 0.05$).

Holcomb and Twiest (1968) also found reproductive success (ratio of young fledged to eggs laid) to be significantly greater as the nest height increased; success ranged from 17.2 per cent for nests under 24 inches high to 34.8 per cent for nests above 38 inches. The number of successful nests also was significantly different at different heights ($P < 0.02$). However, these data combined nests in grasses, weeds, and cattails at a mean height of 21.7 inches, and nests in shrubs, bushes, and trees at a mean height of 56.6 inches. The reported differences in nest success, therefore, may in fact be related to nest substrate rather than to height per se.

TIME OF NESTING

Nesting success and clutch size were reported higher in nests initiated prior to 1 June than in later nests (Goddard and Board, 1967). Neither of these findings were significant ($P > 0.70$ for nesting success, and $P > 0.10$ for clutch size).

DISCUSSION AND CONCLUSIONS

The above analysis of reported nesting studies shows several real differences. Nesting success may differ between years, but the differences may not appear every year or in all regions. Large differences in nesting success may be expected between geographical regions, even in the same year. Differences in success among habitat types are frequently found, but the magnitude is affected by year-to-year variations and by geographical location. Nesting success has been shown to be related to vegetation form; mechanical sturdiness probably is the important factor (Orians, 1961). Other hypotheses relating success to nest location (including nest height above ground, depth of water, or time of nest initiation) are not substantiated by analysis of the authors' data.

The factors responsible for differences between years and between regions most probably are meteorological, since other factors generally are constant. Development of vegetation forms needed for successful nesting depends on the distribution of precipitation and temperature for each region. Long-term climatic conditions determine the development of ecological communities, but one abnormal year may radically change conditions and reduce food and cover below that necessary for fledging young. Catastrophic weather events, which are direct results of the meteorological pattern but are different in various localities, are obviously important: storm tides may inundate marshes, heavy rains may kill nestlings or even adults by chilling, and strong winds may flatten vegetation or knock down nests. Weather factors also are related to the greater nest success in sturdier vegetation forms, since such nests are less likely to be knocked down by wind and rain.

A potentially important factor about which little is known is the energy balance (the balance of net energy exchange with the environment by radiation, conduction, convection, and evaporation on one hand, and internal energy sources on the other) of the developing embryo and nestling. Metabolic response of Redwings to temperature has been studied under laboratory conditions by Dyer (1968); and Collins (1968) studied the effect of environmental temperatures on nest temperatures and development rates in the field. The net radiation received from short-wave sun and sky radiation and long-wave earth radiation, the fluxes of heat and water vapor, and local air turbulence also affect the energy balance (Birkebak, 1966; Gates, 1968). These may be important determinants of the success of the breeding season.

Analyses of nesting success should include all these factors if they are to uncover causal relationships between the animal and the environment. Both large-scale and micrometeorological data must supplement the usual measurements of more stable components of the ecosystem.

SUMMARY

An analysis of eight studies of nesting success in Red-winged Blackbirds shows that there are significant differences in success among years, localities, ecological habitats, and vegetation form. Differences in nest success as related to nest height, water depth, and time of initiating nests were not substantiated by statistical analyses.

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LITERATURE CITED

Birkebak, R. C. 1966. Heat transfer in biological systems. Internatl. Rev. Gen. and Exp. Zool., 2:269-344.

Brenner, F. J. 1966. The influence of drought on reproduction in a breeding population of Red-winged Blackbirds. Amer. Midl. Naturalist, 76:201–210.

Case, N. A. and O. H. Hewitt. 1963. Nesting and productivity of the Red-winged Blackbird in relation to habitat. Living Bird, 2:7–20.

Collins, J. M. 1968. The effect of environmental temperature on the rate of development of embryonic Red-winged Blackbirds. Unpubl. M.S. Thesis. University of Guelph, Ontario.

Dyer, M. I. 1968. Respiratory metabolism studies on Red-winged Blackbird nestlings. Canadian J. Zool., 46:223–233.

Fankhauser, D. P. 1964. Renesting and second nesting of individually marked Red-winged Blackbirds. Bird-Banding, 35:119–121.

Gates, D. M. 1968. Energy exchange and ecology. Bioscience, 18:90–95.

Goddard, S. V. and V. V. Board. 1967. Reproductive success of Red-winged Blackbirds in north central Oklahoma. Wilson Bull., 79:283–289.

Holcomb, L. C. and G. Twiest. 1968. Ecological factors affecting nest building in Red-winged Blackbirds. Bird-Banding, 39:14–32.

MEANLEY, B. AND J. S. WEBB. 1963. Nesting ecology and reproductive rate of the Red-winged Blackbird in tidal marshes of the upper Chesapeake Bay region. Chesapeake Sci., 4:90–100.

ORIANS, G. H. 1961. The ecology of blackbird (*Agelaius*) social systems. Ecol. Monogr., 31:285–312.

SMITH, H. M. 1943. Size of breeding populations in relation to egg-laying and reproductive success in the Eastern Red-wing (*Agelaius p. phoeniceus*). Ecology, 24:183–207.

YOUNG, H. 1963. Age-specific mortality in the eggs and nestlings of blackbirds. Auk, 80:145–155.

U.S. BUREAU OF SPORT FISHERIES AND WILDLIFE, OHIO BLACKBIRD RESEARCH LABORATORY, P.O. BOX 2097, SANDUSKY, OHIO 44870, 4 OCTOBER 1970.

PUBLICATION NOTES AND NOTICES

Three state check-lists have recently appeared.

GEORGIA BIRDS: Pocket Check-list. By J. Fred Denton and Milton Hopkins, Jr. Georgia Ornithological Society, 1969: 4 × 6 in., 57 pp., $0.75.

Obtainable from Louis C. Fink, c/o Trust Company of Georgia, P.O. Drawer 4418, Atlanta, Georgia 30302.

AN ANNOTATED LIST OF IOWA BIRDS. By Woodward H. Brown. Reprinted from the Iowa State Journal of Science, 1971: 6 × 9 in., 81 pp., $1.00.

Obtainable from the Iowa Ornithologists Union, Woodward H. Brown, Treasurer, 4815 Ingersoll Avenue, Des Moines, Iowa 50312.

THE LIST OF WEST VIRGINIA BIRDS. By George A. Hall. Reprinted from The Redstart, 1971: 6 × 9 in., 17 pp., $0.50.

Obtainable from the Brooks Bird Club, Inc. 707 Warwood Avenue, Wheeling, West Virginia 26003.