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Clutch-size and prefledging survival in Red-winged Blackbirds at Williamstown Lake, New Brunswick.—Studies of clutch-size and survival of the Red-winged Blackbird (*Agelaius phoeniceus*) were summarized by Francis (Wilson Bull. 83:178–185, 1971; Auk 92: 815–817, 1975), Dolbeer (Auk 93:343–355, 1976), and Brown and Goertz (Wilson Bull. 90: 261–270, 1978). The Maritime Provinces of Canada represent the northeastern range limit of the species, and of its preferred habitat, cattail (*Typha latifolia*) marshes. I documented clutch-size and prefledging survival of red-wings for a dystrophic lake in New Brunswick. This lake has an intermixture of vegetation characteristic of the red-wing's preferred temperate zone cattail habitat and also ericaceous vegetation, more typical of the boreal zone. My clutch-size data were also compared to the Maritime Nest Records Scheme (MNRS) data compiled from cattail marsh and upland habitat.

Study area and methods.—Williamstown Lake, New Brunswick (46°20′N, 67°40′W) is a shallow (<7 m) man-made dystrophic lake of 370 ha adjacent to mixed forest and farmland. Nesting habitat included cattail, leatherleaf (*Chamaedaphne calyculata*), rhodora (*Rhododendron canadense*), bog rosemary (*Andromeda glaucophylla*), Labrador tea (*Ledum groenlandicum*), sedges (*Carex* spp.), and locally, wild rice (*Zizania aquatica*), all growing through a floating *Sphagnum* mat. Nests were generally found attached to dead cattail stalks and/or stems of one of the ericaceous species.

I started observing on 22 May 1976 while males were still courting females. Nests were revisited every three days to record clutch- or brood-size. Clutch-size was determined for 25 nests at Williamstown Lake and was summarized from 155 cards in the MNRS. Nest record usage was restricted to cards with a minimum of two-clutch entries, equal in size and from different days, to ensure that laying had ended.

Definitions of prefledging mortality follow Caccamise (Condor 80:290–294, 1978). Prefledging survival was calculated for 37 active nests using nest success, fledging success, and daily survival probability values.

Results and discussion.—I found only clutches of three and four eggs at Williamstown Lake (Table 1) compared to a clutch range of 2–7 eggs from the MNRS. The mean clutch-size (3.4 ± 0.5) at Williamstown Lake was significantly lower than the mean for the MNRS data for the Maritimes as a region ($\bar{x}$ = 3.7 ± 0.7, Mann-Whitney *U*-test, *U* for large samples = 1.67, $P < 0.10$), for New Brunswick ($\bar{x}$ = 3.7 ± 0.7, *U* for large samples = 1.78, $P < 0.10$), and for Nova Scotia ($\bar{x}$ = 3.7 ± 0.9, *U* for large samples = 11.52, $P < 0.001$), but did not differ significantly from the mean (3.6 ± 0.9) for the MNRS data for Prince Edward Island (*U* for large samples = 0.18, $P > 0.20$). The small mean clutch-size I found at Williamstown Lake is a consequence of the larger ratio of 3-:4-egg clutches found at Williamstown Lake (Table 1) and may suggest poorer quality nesting habitat. A larger sample for Williamstown Lake would have enabled a better comparison.

Predation accounted for the greatest loss of eggs or nestlings (Table 2) at Williamstown Lake, as has generally been found for other areas. Two nests (six eggs) were deserted following discovery for which I may have been responsible. However, evidence was inconclusive since incubation continued in similarly visited nests nearby.

TABLE 1

CLUTCH-SIZE OF RED-WINGED BLACKBIRDS AT WILLIAMSTOWN LAKE, NEW BRUNSWICK, AND FROM RECORDS OF THE MARITIME NEST RECORDS SCHEME

Location	N	2	3	4	5	6	7	$\bar{x}$	±SD	Ratio of 3-egg : 4-egg clutches
Williamstown Lake	25	0	14	11	0	0	0	3.4	0.5	1.27
New Brunswick[a]	56	2	17	35	1	0	1	3.7	0.7	0.48
Nova Scotia	26	1	6	18	1	0	0	3.7	0.9	0.33
Prince Edward Island	73	2	31	35	5	0	0	3.6	0.7	0.88
MNRS total	155	5	54	88	7	0	1	3.7	0.7	0.60
Total	180	5	68	99	7	0	1	3.6	0.7	0.68

[a] Not including data from Williamstown Lake.

Different indices of prefledging survival (e.g., nest success and fledging success) have given different estimates of success for previous studies (Smith, Ecology 24:183–207, 1943; Goddard and Board, Wilson Bull. 79:283–289, 1967; Young, Auk 80:145–155, 1963; Holcomb and Twiest, Bird-Banding 39:14–32, 1968; Francis 1971; Robertson, Can. J. Zool. 50:209–222, 1972). Ratios such as young/adult male may vary between areas in relation to different clutch- or harem sizes. Mayfield (Wilson Bull. 73:255–261, 1961; Wilson Bull. 87:456–466, 1975) suggested variation within indices of prefledging survival may be related to including or excluding nests found prior to incubation, while excluding nests eliminates pertinent data. A survey of the literature on red-wings suggests Mayfield's cautions were well founded since only Young (1963) and Caccamise (Condor 1978) stated clearly how their data were treated. Therefore, statistical comparisons of previous work (e.g., Francis 1971) should be viewed with caution.

TABLE 2

CAUSES OF PREFLEDGING MORTALITY FOR RED-WINGED BLACKBIRDS AT WILLIAMSTOWN LAKE, NEW BRUNSWICK, 1976

Cause	Eggs or nestlings lost	% total eggs or nestlings lost
Unhatched eggs	6E[a]	15
Egg predation	7E	17
Climate	3E	7
Unknown	9E	22
Nestling predation	11N[b]	27
Runt disappearance[c]	5N	12
Total	41	100

[a] E = eggs.
[b] N = nestlings.
[c] Designation to describe smallest nestling in clutches of four which failed to keep pace with siblings' growth and subsequently disappeared from the nest.

Mayfield's (1961, 1975) alternative index and daily survival probabilities (which has not been used for red-wings) reduces these difficulties by integrating a measure of time into the calculation. The major assumption required for the technique's use (i.e., that the rates of loss of eggs during incubation and nestlings during nestling period be consistent) can be validated for red-wings by the work of Young (1963) and Robertson (1972). For Williamstown Lake, probabilities of survival may be divided into component parts as follows (see Mayfield [1975] for details): (1) probability of nest (with some contents intact) surviving incubation $1 - (3/85.5)^{12} = 0.652$; (2) probability egg is fertile $1 - 6/40) = 0.85$; (3) partial egg losses $1 - (0/300.5)^{12} = 1$; (4) probability of egg becoming a nestling $a \times b \times c = 0.55$; (5) probability of a nest (with some contents) surviving nestling stage $1 - (3/75)^9 = 0.693$; (6) partial nestling losses $1 - (4/235)^9 = 0.857$; and (7) probability of an egg producing a fledgling $d \times e \times f = 0.329$.

The daily survival probability was the lowest of the three survival estimates derived in this study (33% as compared to 37% and 41% for fledging success and nesting success, respectively). Because of the small sample size from Williamstown Lake, I consider the survival probability calculation to be more accurate since nests found following commencement of incubation were included and the parameter of time has been quantified.

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Growth, diet, and mortality of nestling Great Blue Herons.—Patterns of growth and development have been described for a number of Ciconiiformes (Owen, Proc. Zool. Soc. London 133:597–617, 1960; Kahl, Condor 64:169–183, 1962; Siegfried, Living Bird 11: 193–206, 1973; McVaugh, Living Bird 14:163–184, 1975; Kushlan, Auk 94:164–167, 1977, Condor 79:31–36, 1977; Werschkul, Auk 96:116–130, 1979). However, growth has not been documented for the Great Blue Heron (*Ardea herodias*) and the diet of nestlings has been reported mainly for inland populations (Kirkpatrick, Am. Midl. Nat. 24:594–601, 1940; Kushlan, pp. 365–369 *in* Wading Birds, Natl. Audubon Soc., 1978). Additionally, only Pratt (Condor 74:447–453, 1972) has provided a partial description and schedule of nestling mortality in this species. In this study, I describe growth during the first month of life, compare growth between years in the same colony and with adult measurements, and fit growth to common growth equations. Also, I describe the diet of nestlings and discuss the timing and causes of nestling mortality in light of current ideas on the adaptive significance of asynchronous hatching and brood reduction.

Study area and methods.—Great Blue Herons were studied on Boot Island (45°08′N, 65°16′W), Nova Scotia, between April and August in 1977 and 1978. This 144-ha island is located in the Southern Bight of the Minas Basin at the mouth of the Gaspereau River. The river mouth provides one of three major foraging areas for the herons. Nests are located 9–12 m above ground in the tops of white spruce (*Picea glauca*). Numbers of breeding pairs decreased from 42 in 1977 to 26 in 1978. Clutch-sizes ranged between four and six with a mode of five eggs in both years. Mean clutch-size was 4.6 and 5.0 in 1977 and 1978, respectively. An average of 2.6 young fledged per breeding pair in 1977 and 3.1 young in 1978.