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Egg destruction by Eastern Meadowlarks.—Destruction of eggs by passerines is a relatively rare phenomenon confined mainly to the Troglodytidae and Mimidae. Egg pecking has been reported for Marsh Wrens (*Cistothorus palustris*; Allen 1914; Verner 1975; Picman 1977a, b; Bump 1986), Sedge Wrens (*C. platensis*; Picman and Picman 1980), House Wrens (*Troglodytes aedon*; Kendeigh 1941, Belles-Isles and Picman 1986a), Bewick's Wrens (*Thryomanes bewickii*; J. Picman, unpubl. data), Cactus Wrens (*Campylorhynchus brunneicapillus*; Anderson and Anderson 1973), Gray Catbirds (*Dumetella carolinensis*; Belles-Isles and Picman 1986b), and four species of Galapagos mockingbirds (*Nesomimus* spp.; Bowman and Carter 1971). In addition, at least two icterid species are also known to destroy eggs. Female Brown-headed Cowbirds (*Molothrus ater*) frequently remove one or more eggs from clutches of their hosts (e.g., Hann 1937, Mayfield 1977) and male cowbirds also seem to destroy eggs (Burgham and Picman, unpubl. data). Finally, Creighton and Porter (1974) and Schaeff and Picman (1988) observed Western Meadowlarks (*Sturnella neglecta*) destroying Horned Lark (*Eremophila alpestris*), Lark Bunting (*Calamospiza melanocorys*), and Japanese Quail (*Coturnix coturnix*) eggs.

The relative rarity of egg pecking among passerines could suggest high costs or low rewards associated with this behavior. For instance, egg-destroying activities may expose a given individual to aggression from the nest owners that may sometimes be much larger than the aggressor (Burt 1970, Picman 1983, Bump 1986). When egg pecking occurs despite such costs, the egg peckers probably derive some compensating advantage that may be sufficiently great in certain circumstances.

Theoretically, egg pecking should be favored when competition for limited resources is intense and the species involved cannot reduce competition through resource partitioning. This situation is likely to occur in simple, two-dimensional habitats where low food diversity and structural simplicity of the habitat preclude specialization. In such a situation, interspecific aggression promoting interspecific territoriality should be favored (Orians and Willson 1964). The egg-destroying behavior, as a mechanism of interference competition, should also be more frequently exhibited by species breeding in simple two-dimensional habitats such as marshes, savannahs, old fields, and meadows.

In 1986, I examined predation on artificial passerine nests in different habitats. Predation experiments conducted in a meadow habitat revealed that Eastern Meadowlarks (*Sturnella magna*) destroyed eggs placed in experimental nests. Because this is, to my knowledge, the first record of egg destruction by Eastern Meadowlarks, in this note I describe egg-pecking behavior of Eastern Meadowlarks from pictures of predation events, estimate the importance of meadowlarks as egg predators relative to other nest predators, and discuss the adaptive value of egg destruction by this species.

Methods.—Results were obtained during a study of predation patterns on passerine nests conducted from May to August 1986 in the Mer Bleue Bog conservation area near Ottawa, Ontario. To identify predators operating in the meadow, I used 10 automatic camera setups. These will take pictures of predators manipulating Japanese Quail eggs placed on a trigger in an experimental nest (see Picman 1987). The cameras (placed 25 cm above the ground) with experimental nests (placed on the ground) were distributed 10 m apart along a transect that was 20 m from any of the experimental quadrats described below. The camera transect was moved to a new location every 10 days, so that a fairly large area was sampled. The camera setups were visited every 24 h (usually between 14:00 h and 16:00 h), and if predation had occurred, a new egg was placed in an experimental nest and the camera was reset.

To determine predation rates in a meadow habitat, I distributed artificial nests made of grass (see Picman 1987), each containing one fresh quail egg, throughout three 80 m × 80 m quadrats (quadrats were separated by at least 20 m). The artificial nests, resembling Red-winged Blackbird (*Agelaius phoeniceus*) nests in size and appearance, were placed on the ground and camouflaged with surrounding vegetation to simulate natural nests. In the first set of experiments, designed to examine the effect of nest dispersion on predation, I distributed nests (without cameras) in uniform, random, and clumped spacing patterns (40 nests per quadrat). The choice of nest sites in selected areas was determined by the availability of vegetation (i.e., nests were placed in dense vegetation where they could be better concealed). Each of the three quadrats received all three nest distributions at different times (i.e., three time series of these experiments were conducted). Experimental nests were examined for predation on days 2, 4, 6, and 8 after start, and destroyed eggs were not replaced.

TABLE 1
EGG PREDATORS, IN DECREASING ORDER OF SIGNIFICANCE, AND TYPE OF DAMAGE TO EXPERIMENTAL EGGS

Predator	No. of cases (% of total)	Description of egg damage
Skunk	102 (71)	Empty shells ranging from small fragments to ¾ of an egg; squeezed, flattened shells; in or within 40 cm of the nest
Eastern Meadowlark	32 (22)	Punctured eggs (holes 4–10 mm) with contents; broken eggs with most, some, or no contents, depending on the extent of egg damage; eggs usually in nest, sometimes 20–30 cm away from nest
Raccoon	5 (3)	Entire eggs always removed
Woodchuck	3 (2)	Broken, empty shell within 30 cm of the nest
Northern Harrier	1 (1)	The entire egg missing
American Crow	1 (1)	The entire egg missing
Total	144 (100)	

The subsequent time series of these experiments were separated by at least five days. In the second set of experiments, designed to examine the effect of prey density on nest predation patterns, 40, 20, and nine nests were distributed uniformly in the same quadrats as in the first set of experiments. In these experiments, each quadrat again received all three nest densities. Subsequent time series were separated by at least two days. In this paper, I combined results of both sets of experiments to examine overall nest predation rates and the effect of time in a season on predation.

Results.—The camera study yielded a total of 144 cases of predation events. The most important predators were striped skunks (*Mephitis mephitis*) which appeared in 102 (71%) cases. Skunks usually broke the quail eggs; the type of egg damage inflicted by skunks is described in Table 1. Eastern Meadowlarks appeared on 32 (22%) photos in pecking position. In most of these cases, birds in the photos were touching the egg with their beaks, suggesting that they had just pecked an egg placed on a trigger mechanism, thereby setting off the camera. Fourteen (44%) eggs destroyed by meadowlarks had one or two punctures (in 11 of these, egg contents were undisturbed, and in the remaining three, the yolk had been removed, but most of the albumen was intact). In 12 (38%) cases, only small pieces of shell were found in or near the nest. Finally, in six (19%) cases of meadowlark predation, one-half or more of the egg shell was found in the nest (in only one of these cases was some albumen still present in the shell). However, it is possible that in some of these 18 cases, during which the eggs were more extensively damaged, the meadowlark visit was followed by a visit from another predator such as the skunk. This is supported by the fact that in three of these cases, I found squeezed, empty egg shells at the nest. This type of egg damage is characteristic of skunk predation (Table 1). Finally, the remaining cases of predation involved raccoons (*Procyon lotor,* five cases), woodchucks (*Marmota monax,* three cases), a Northern Harrier (*Circus cyaneus,* one case), and an American Crow (*Corvus brachyrhynchos,* one case). The damage to eggs by these predators is described in Table 1.

Between 19 May and 5 August 1986, a total of 567 artificial nests with single quail eggs were offered to predators during six series of experiments in three quadrats. The predation

TABLE 2
PREDATION ON EXPERIMENTAL NESTS

Day	Cumulative No. (%) of depredated eggs	No. eggs that survived
2	123 (22)	444
4	204 (36)	363
6	259 (46)	308
8	323 (57)	244

rate was greatest in the first two days of exposure (Table 2). A cumulative total of 323 (57%) eggs were destroyed in the course of eight days of exposure.

Based on cumulative data by day eight of all experiments, predation rates varied from 30% to 91% among six samples (Table 3). The proportion of depredated nests differed significantly among experiments, and predation was generally higher in the second half of the breeding season (Table 3).

To estimate the relative importance of meadowlark predation, I examined the appearance of depredated eggs. Punctured eggs are characteristic of meadowlarks (Table 1) and thus were used as an index of meadowlark predation. In the six experiments, between 0 and 38% of all depredated eggs had one or two punctures. The highest proportion of punctured eggs was found between 7 and 15 July, late in the breeding season (Table 3), when I observed two adult meadowlarks and three juveniles on two of the three quadrats. The recently fledged juveniles were following adults foraging on the quadrats or in adjacent meadows. In addition, there was another pair staying relatively close to the study quadrats. When all experiments are combined, 31 of the 323 depredated eggs (10%) were merely punctured (Table 3). Egg contents were intact in all but one of these 31 eggs. This index may underestimate meadowlark predation, since many pecked eggs may show more damage (see above; Table 1). In the camera study, of all eggs depredated by meadowlarks, approximately 44% were merely punctured while 56% had more extensive damage. If similar rates apply to the six experiments done between May and July, it is possible that another 40 eggs were destroyed by this species.

TABLE 3
PREDATION ON QUAIL EGGS DURING SIX CONSECUTIVE EXPERIMENTS CONDUCTED BETWEEN 19 MAY AND 5 AUGUST, 1986

Experiment number	Date of start	No. (%) of depredated eggs	Total No. of nests	No. (%) depredated eggs with punctures
1	19 May	36 (30)	120	1 (3)
2	4 June	84 (70)	120	0 (0)
3	17 June	38 (32)	120	0 (0)
4	7 July	48 (70)	69	18 (38)
5	17 July	54 (78)	69	7 (13)
6	28 July	63 (91)	69	5 (8)
Total	—	323 (57)	567	31 (10)

The total estimate for the impact of meadowlarks on experimental clutches (i.e., punctured plus more damaged eggs) is thus 22% of all depredated eggs. The relative importance of the other predators, however, cannot be estimated from data on appearance of depredated nests because depredation signs are not unique for individual predators (see Table 1).

Discussion.—To my knowledge, this is the first record of egg destruction by Eastern Meadowlarks, although the closely related Western Meadowlark may destroy eggs and kill nestlings (Creighton and Porter 1974, Schaeff and Picman 1988). The two meadowlark species may thus exhibit similar nest-destroying tendencies.

Eastern Meadowlarks were the second most important predator (after striped skunks) responsible for more than 20% of all predation in the study area. This suggests that Eastern Meadowlarks could significantly affect the reproductive success of co-occurring birds such as Bobolinks (*Dolichonyx oryzivorus*), Red-winged Blackbirds, and Savannah Sparrows (*Passerculus sandwichensis*), that were present on or near the study quadrats.

In this study, a maximum of four adults and several fledglings could have been responsible for the destruction of eggs that could be ascribed to meadowlarks. Unfortunately, because meadowlarks in the study area were not individually marked and these birds sometimes moved long distances suggesting very large feeding territories, the number, sex, and age of individuals involved in predation events could not be determined.

Two hypotheses have been proposed to explain the occurrence of egg pecking by small passerines (Orians and Willson 1964; Verner 1975; Picman 1977a, b; Picman and Picman 1980; Belles-Isles and Picman 1986 a, b). First, eggs are an important food source, and egg destruction is a form of predation. Second, through destruction of clutches of competitors, birds may achieve partial or complete interspecific territoriality, thereby reducing competition for limited resources. In general, the "competition hypothesis" offers a more plausible explanation for more intensively studied species such as Marsh Wrens for several reasons. First, individuals of the species exhibiting egg-destroying behavior rarely consume egg contents (Picman 1977a, b; Picman and Picman 1980; Belles-Isles and Picman 1986a, b). Second, species involved may exhibit complete or partial interspecific territoriality (e.g., Burt 1970, Verner 1975, Picman 1980, Bump 1986), presumably as a result of interspecific interactions (Leonard and Picman 1986). Third, some of these species also kill small nestlings without eating their flesh (e.g., Picman 1977a, b; Belles-Isles and Picman 1986a; Bump 1986). Fourth, egg-pecking responses may be influenced by the prevailing type of competition (i.e., intra- vs interspecific competition; Picman 1984).

The fact that contents of many eggs attacked by Eastern Meadowlarks seemed intact is more consistent with the competition hypothesis. However, the two hypotheses are not mutually exclusive and thus the final test will require more data on the frequency of egg pecking and egg consumption as a function of food availability, the frequency of egg destruction as a function of intensity of competition for limited resources, and the effect of egg destruction by meadowlarks on distribution of other co-occurring species.

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Influence of nest cover on habitat selection in Clay-colored Sparrows.—Prevailing hypotheses (Rosenzweig 1981, 1985; Conner et al. 1986) contend that feeding opportunity is the primary influence on habitat selection in birds. Feeding opportunity may indeed determine habitat selection for many bird species because birds, in general, must feed themselves