and a Sanderling *(Calidris alba)*. The specimen was identified as *L. f. sibirica*, the eastern subspecies, by Lester L. Short, American Museum of Natural History. The species breeds in northern Norway, Finland, Sweden, northwestern Russia, and northeastern Siberia; this subspecies winters from southeastern Japan and China to Australia (Vaurie 1965, op. cit. pp. 406–407). There are also records from Sakhalin and the Kuriles (Yamashina 1974, Check-list of Japanese birds. Tokyo, Gakken Co., Ltd. p. 114).

These specimens were collected in connection with work for the Aleutian Islands National Wildlife Refuge, and they have been deposited at the University of Alaska Museum, Fairbanks. We thank Richard C. Banks, National Museum of Natural History, Joe T. Marshall, and Lester L. Short for their assistance with the identifications and Daniel D. Gibson for assistance with the identifications and help with the manuscript.

Predators and Blackbirds: the "Uncertainty Principle" in Field Biology

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A persistent concern in field studies of birds is the possibility that the activities of the scientist may inadvertently influence the extent of predation on eggs and hatchlings. Data on this question are scanty as, in most cases, it is difficult if not impossible to determine predation rates on nests that have not been studied. The few studies that have dealt with this question have reached inconsistent conclusions. Gillett et al. (1975), for example, found that frequently disturbed sections of a colony of Glaucous-winged Gulls *(Larus glaucescens)* had a higher chick mortality and lower egg mortality than did undisturbed sections of the colony. Conversely, Robert and Ralph (1975) found egg mortality to be directly proportional to the amount of disturbance in a colony of Western Gulls *(L. occidentalis)*, whereas chick mortality was inversely proportional to the amount of disturbance. In a third study, Willis (1973) investigated the effects of research activities on predation of Bicolored Antbirds *(Gymnopithys bicolor)* by noting that adults feeding at ant swarms had characteristic behavior patterns associated with each stage in the nesting cycle. By observing the behavior of banded adults, he determined which pairs were incubating eggs, feeding nestlings, or feeding fledged young, permitting estimation of survival rates of unvisited nests. The results of this study indicated no difference in predation rates between visited and unvisited nests.

In the course of a survey of the literature on Red-winged Blackbirds *(Agelaius phoeniceus)*, I obtained indirect evidence that research activity on marshes may contribute to predation on Red-wing nests. In addition to data I obtained during a 2-yr study of a marsh-breeding population of Red-wings, I found data from 10 other marshes and 5 upland sites at which Red-wings were studied for 2 or more consecutive years and for which the proportion of successful nests (nests fledging at least one young) in each year was reported. As a predator normally removes the entire contents of a nest, the proportion of successful nests may be considered to be a rough estimate of the amount of predation (Lack 1954). As shown in Table 1, on 10 of the 11 marshes (data from the first year of the twelfth marsh were not available) the proportion of successful nests was lower in the second year of the study than in the first (binomial probability = 0.012). The average decline in the proportion of successful nests was 22.9% (range: 6–50%). Four marshes were studied for 3 or more consecutive years. The trend continues on these marshes; the amount of predation is again higher in subsequent years of the study than it was in the first year, but the increase is not as large as that between the first and second years of the study.

The impact of human activity on predation seems to be less for upland study sites than in marsh habitats. In three of five upland study sites the proportion of successful nests was slightly lower (mean = 7%) in the second year than in the first. On the remaining two study sites, however, the trend was reversed and a larger proportion of successful nests was found during the second year than in the first.

In 1975 and 1976 I studied Red-winged Blackbirds on a marsh in Princeton, New Jersey. During the second year signs of mammalian predation were abundant. Nests were frequently torn down, vegetation around nests was flattened, and in many instances bloody feathers lay floating on the water. During the first year of the study I rarely found such signs.

Research workers may influence a predator's ability to find nests in a number of different ways. Predators may learn to follow human scent from nest to nest (Snelling 1968), or repeated flushing of birds

TABLE 1. The proportion of successful nests in marsh and upland habitats during the first, second, and subsequent years of work at the same site. Names of sites are given only if the author worked at more than one location

Habitat	Location	Proportion of successful nests			Reference
		1st yr	2nd yr	3+ yr	
Marsh		.906	.643	.493	Brenner 1966
	Airport Marsh	.667	.558		Case & Hewitt 1963
	Inlet Valley Marsh	.700	.220		Case & Hewitt 1963
	Spencer Marsh	.836	.337		Case & Hewitt 1963
		.457	.390		Holm 1973
		.571	.258		Lenington 1977
	Clark's Pond	.662	.406	.413	Robertson 1972
	All Saint's Marsh	.676	.617		Robertson 1972
		no data	.560	.430	W. Searcy pers. comm.
		.339	.446		Weatherhead & Robertson 1977
		.612	.474	.394	Wiens 1965, Snelling 1968
		.350	.240		Young 1963
Upland		.330	.280		Dolbeer 1976
	500 ft site	.294	.230		Case & Hewitt 1963
	1,200 ft site	.368	.395		Case & Hewitt 1963
	Hyland Farm	.257	.219		Robertson 1972
	Hausman's Field	.400	1.000		Robertson 1972

may direct a predator's attention to nest locations. In addition, it is a common practice for blackbird researchers to place markers near nest sites as an aid in relocating nests. Predators could learn to associate such markers with a nearby meal. Presumably, the response of predators to human activity differs with the type of predator. Those such as mammals and snakes that hunt primarily using scent are most likely to take advantage of scent trails. Birds may be more responsive to visual cues.

In upland habitats, where the density of Red-wing nests is considerably lower than on marshes (Case and Hewitt 1963, Robertson 1972), it may be more difficult for predators to learn to find nests.

Whatever the proximal cause in the decline of the proportion of successful nests, it is clear that the very process of measurement is introducing changes in the phenomena being measured.

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Permeability of Magpie and Blackbird Eggshells to Water Vapor: Variation Among and Within Nests of a Single Population

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Circumstantial evidence from studies of domestic fowl indicates that permeability of avian eggshells is a genetically controlled character (Smith 1973, Wangensteen et al. 1974). If permeability of an avian eggshell is, in fact, largely an expression of the genome of the female producing the egg, it is likely that the majority of the variation in permeability in a sample of eggs (and in the population from which the sample is drawn) is attributable to genetic differences among various females. Consequently, it may be that little new information about the population can be obtained by collecting more than one egg laid by a single female (Sokal and Rohlf 1969: 206ff).

To evaluate the hypothesis that most of the variation in permeability of eggs in a population stems from differences among clutches as opposed to differences among eggs within clutches, we collected three eggs from each of 10 nests of Black-billed Magpies (*Pica pica*) located east of Fort Collins, Colorado (T8N, R67W, S36, Weld County; elevation 1,554 m). Three eggs also were collected from each of 10 nests of Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) nesting at Latham Reservoir near Greeley, Colorado (T4N, R65W, S1-2, Weld County; elevation 1,402 m). In the laboratory the eggs were placed randomly in vented desiccators above anhydrous calcium sulfate to maintain a dry atmosphere (Ar et al. 1974). The desiccators were held in a constant temperature cabinet at 25°C, a temperature too low for embryogenesis to proceed (White and Kinney 1974). Each egg was weighed six times on an analytical balance at intervals of 24 h, and the rate of weight loss—which is attributable largely to the escape of water vapor (Ar et al. 1974, Rahn et al. 1976)—was computed using a linear regression procedure. Subsequently, the volume of each egg was determined by displacement of water (Lynn and von Brand 1945), and surface area was calculated using the equation derived by Hoyt (1976).

Since vapor pressure inside the eggs approximated the vapor pressure of pure water at 25°C (i.e. 3.167 kPa; Lomholt 1976, Taigen et al. 1978), and since vapor pressure of the atmosphere inside the desiccators was zero, the permeability of eggshells to water vapor was calculated using the equation

$$K_{H_2O} = \dot{M}_{H_2O}/(\Delta P_{H_2O} \cdot A)$$

where K_{H_2O} is permeability of an eggshell to water vapor ($\mu g \cdot day^{-1} \cdot Pa^{-1} \cdot cm^{-2}$), $\dot{M}_{H_2O}$ is the rate of water loss in the desiccator ($\mu g \cdot day^{-1}$), ΔP_{H_2O} is the gradient in vapor pressure across the eggshell (Pa), and A is the surface area of the eggshell (cm^2). All values for permeability were adjusted to sea level conditions (barometric pressure = 101.325 kPa).

Data for eggs of both magpies and blackbirds were subjected to one-way analysis of variance, Model II (Sokal and Rohlf 1969), which revealed that variation in permeability of eggshells to water vapor is significantly larger among clutches than within clutches (Table 1). We subsequently partitioned the variance using methods outlined by Sokal and Rohlf (1969), and found that fully 85% of the total variation in permeability of magpie eggs could be assigned to the "among clutch" component. For eggs of Yellow-headed Blackbirds, 56% of the total variation in permeability stemmed from differences among clutches. [Similar analyses were performed on data for conductance of magpie and blackbird eggs to water vapor ($\bar{\bar{x}} = 8.566$ and 9.091 $\mu g \cdot d^{-1} \cdot Pa^{-1}$, respectively), and on surface area of eggs ($\bar{\bar{x}} = 22.5$ and 12.9 cm^2, respectively), and similar results were obtained in every instance.]