

This could account for the variations in homing results that have been obtained for adult Ring-billed Gulls (Southern 1967) and some other species. It is unlikely that the various methods are equally effective for individuals of one species or that various species would have comparable degrees of ability for performing each type of orientation. Investigators in this area must develop techniques for designing multi-dimensional models for the interpretation of orientation data since the solutions to our present questions appear to be many faceted and it is unlikely that satisfactory answers can be obtained by continuing to examine each variable as if it is independent of all others.

SUMMARY

Ring-billed Gull (*Larus delawarensis*) 2–20-day-old chicks from a population at Rogers City, Michigan, were used in 680 orientation-cage trials. The apparently innate ability of chicks to select a southeasterly heading, the appropriate bearing for reaching their winter range, was compared when trials were conducted under various intensities of magnetic disturbance (0–7K, which equals disturbances of 0–200 gamma). During minor disturbances (0–3K) a statistically significant proportion of the experimental birds selected southeasterly headings, but during higher intensity “storms” (4–7K) there was a breakdown in such preferences and no statistically significant mean direction was present for the data. Evidence to date suggests that the mode of orientation used by young Ring-billed Gulls for selecting the direction of fall migration is altered by fluctuations in the earth’s magnetic field.

CHLORINATED HYDROCARBON RESIDUES AND REPRODUCTIVE SUCCESS IN EASTERN NORTH AMERICAN MERLINS

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Many species of predatory birds have suffered severe declines in their population numbers since the introduction of chlorinated hydrocarbons into the environment (see Hickey 1969 for a review). Symptoms clearly correlated with these declines include abnormally late breeding, thinner eggshells and increased egg breakage, the resulting apparent reduction in clutch size, and increased embryonic mortality. The Merlin (*Falco columbarius*), being a bird-eating falcon, would seem to be highly vulnerable to these sublethal effects of pesticide poisoning. To assess the degree to which these manifestations of pesticide poisoning are affecting the Merlin populations in North America, their breeding biology was studied on the island of Newfoundland, Canada, during the 1969 nesting season.

METHODS

Observations were made at 20 Merlin nests in Newfoundland to evaluate reproductive performance. Five unhatched eggs from four different nests were collected, their shell thickness indexes calculated accord-

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Accepted for publication 11 June 1971.

ing to Ratcliffe (1967), and the DDE residues in the egg contents determined, using the analytical techniques described by Peakall (1970). In addition, subcutaneous fat biopsies from adult Merlins were collected, as described by Enderson and Berger (1968), and analyzed for DDE residues. Frequently taken prey species, as determined from prey remains at nests, were also examined for DDE residues. Pesticide eggs (before 1947) from eastern Canada were obtained from museum egg collections and their shell thickness indexes calculated. Information on reproductive performance included with museum egg sets was also noted.

RESULTS AND DISCUSSION

Data on DDE residues in Merlins, their eggs, and their prey are given in table 1. Of 136 prey remains found

TABLE 1. Chlorinated hydrocarbon residues in Newfoundland Merlins, their eggs, and their prey.

Sample	No.	ppm-DDE ^a (oven dry wt. basis)	
Merlins			
Breeding adults (fat)	3	267	(131–495)
Unhatched eggs	5	40.4	(28.5–52.1)
Prey species			
Gray Jay (brain)	2	0.24	(0.18–0.30)
Robin (brain)	1	3.17	
Savannah Sparrow (brain)	2	2.10	(1.13–3.07)

^a Mean, and range in parentheses.

TABLE 2. Reproductive performance and eggshell thicknesses for eastern North American Merlins.

Sample	Egg dates	Clutch size	Eggshell thickness index ^a	Young per nest	% nests with young
Pre-pesticide					
Eastern Canada (n)	24 May-3 July (36 ^b)	4.2 (18 ^b)	1.33 (110 ^b)	3.8 (15 ^c)	
1969					
Newfoundland (n)	24 May-9 July (20)	4.3 (15)	1.21 (18 ^d)	3.0 (19)	95 (20)

^a Index = weight in mg/length × breadth in cm.

^b Data from museum egg collections.

^c Data from museum specimens, Craighead and Craighead (1940), Breckenridge (1938), and Lawrence (1949).

^d Includes post-pesticide eastern Canadian eggs from museum collections.

at Merlin nests, three species comprised over half of the Merlin's diet: the Gray Jay (*Perisoreus canadensis*), the Robin (*Turdus migratorius*), and the Savannah Sparrow (*Passerculus sandwichensis*). Since Newfoundland is essentially free of applied pesticides, it is not surprising that the resident jays have low levels of DDE while levels in the migratory robins and sparrows are higher.

The DDE residue levels found in breeding Merlins are lower than those reported in breeding Peregrine Falcons (Cade et al. 1968; Enderson and Berger, 1968) and migrant Merlins in the Midwest (Risebrough et al. 1970). Correspondingly, DDE residues in Merlin eggs were also lower than those found in Peregrine eggs.

Reproductive data are summarized in table 2. No marked delay in the breeding cycle is indicated by the range of egg dates for pre- and post-pesticide samples. Neither has the clutch size decreased significantly since pre-pesticide times. DDE residue levels in Newfoundland Merlins are apparently high enough to cause eggshell thinning. The 9 per cent reduction from pre-pesticide thicknesses is statistically significant ($P < 0.05$). Embryonic mortality appeared high in 1969; all five unhatched eggs collected for residue analysis contained dead embryos. The number of young per nest containing young decreased significantly ($P < 0.05$) since pre-pesticide times, even though no nestling mortality was recorded. This reduction in number of young seems to be due to increased egg loss and decreased hatchability. While no comparable pre-pesticide data are available on the percentage of nests that produced young, the 1969 figure is encouragingly high.

In summary, breeding Merlins in Newfoundland now carry deleterious levels of DDE in their bodies,

lay thinner shelled eggs, and produce young at a rate lower than in pre-pesticide times.

Support for this research was provided by the New York Zoological Society, the Frank M. Chapman Memorial Fund, and the Canadian Wildlife Service.

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Accepted for publication 27 September 1971.

FALL NOCTURNAL MIGRATION DURING TWO SUCCESSIVE OVERCAST DAYS

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On the afternoon of 13 October 1969 a cold front passed over the southeast coast of Louisiana, bringing with it complete, low overcast that persisted without breaking until midmorning of 15 October. By 15:15 CST on the first day the overcast had passed over

Grand Isle, about 65 km W of the mouth of the Mississippi River. A census of the woods on the island at that time showed only a few scattered passerine migrants.

That night I heard numerous thrush calls from aloft and decided to use a portable ceilometer and 8 × 40 binoculars to determine the direction of flight and the quantity of birds aloft (Gauthreaux, Bird-Banding 40:309, 1969). During the first watch, 20:45-21:15, I counted 32 birds (64/h), most flying towards 165° (fig. 1A). The surface winds were from the NNW at 10-20 knots, while those at about 2000 ft were from the NE. Although the great majority of call notes were from thrushes (6-7/min), both small and medium-sized passerines were observed in the ceilometer beam.