

NAVIGATION BY HAWKS MIGRATING IN SPRING

HELMUT C. MUELLER AND DANIEL D. BERGER

THE experiments of Kramer (1961), Matthews (1955), Sauer (1957) and others suggest that navigation may be highly accurate in at least some species of birds, but rapid homing over long distances and from presumably unfamiliar release areas has been demonstrated in only a few species: the homing pigeon (*Columba livia*) by Kramer and St. Paul (1952) and by Matthews (1951); the Manx Shearwater (*Puffinus puffinus*) by Matthews (1953); the Laysan Albatross (*Diomedea immutabilis*) by Kenyon and Rice (1958); and the Leach's Petrel (*Oceanodroma leucorhoa*) by Billings (1968). Many other species have shown only poor homing ability in experiments or have required considerable time to find their way home from the release points (see Matthews, 1955, pp. 22-27, for a partial list). Yet a number of these species of apparently poor homing ability migrate and "navigate" between distant summer and winter homes twice annually. This paper offers evidence suggesting that at least some members of one group of birds, the hawks, use an inefficient and indirect method of "homing" from winter home to summer home.

METHODS

Our data were obtained in studies of spring migration conducted at the Cedar Grove Ornithological Station on the west shore of Lake Michigan about 64 km north of Milwaukee, Wisconsin. The region is well known for its concentrations of hawks during migration. North- or southbound hawks are drifted eastward to the western shore of Lake Michigan by westerly winds (Mueller and Berger, 1961, 1967b). Reluctant to fly out over large bodies of water, the migrating hawks concentrate in a stream paralleling the shore of Lake Michigan.

An essentially dawn-to-dusk watch for hawk migration was maintained for a total of 355 days in the springs of 1953 through 1957 and 1962 through 1964. The direction of flight (north or south) of each hawk was recorded whenever possible. An effort was made to catch each hawk observed. Each caught bird was marked with a leg band furnished by the U. S. Fish and Wildlife Service and released. Some of these birds were subsequently reported shot or found dead.

RESULTS

Of 7,779 hawks of 15 species observed in spring, 741 individuals of 12 species were captured, banded, and released. Of the hawks observed about 40 per cent were southbound, i.e. in reversed migration. On many occasions both north- and southbound migrants were seen within a short interval of time. In fact on more than 60 per cent of the observation days on which 10 or more hawks were observed, less than 80 per cent of the hawks were migrating in one given direction (northward or southward). This high coincidence of north- and southbound migration in spring has

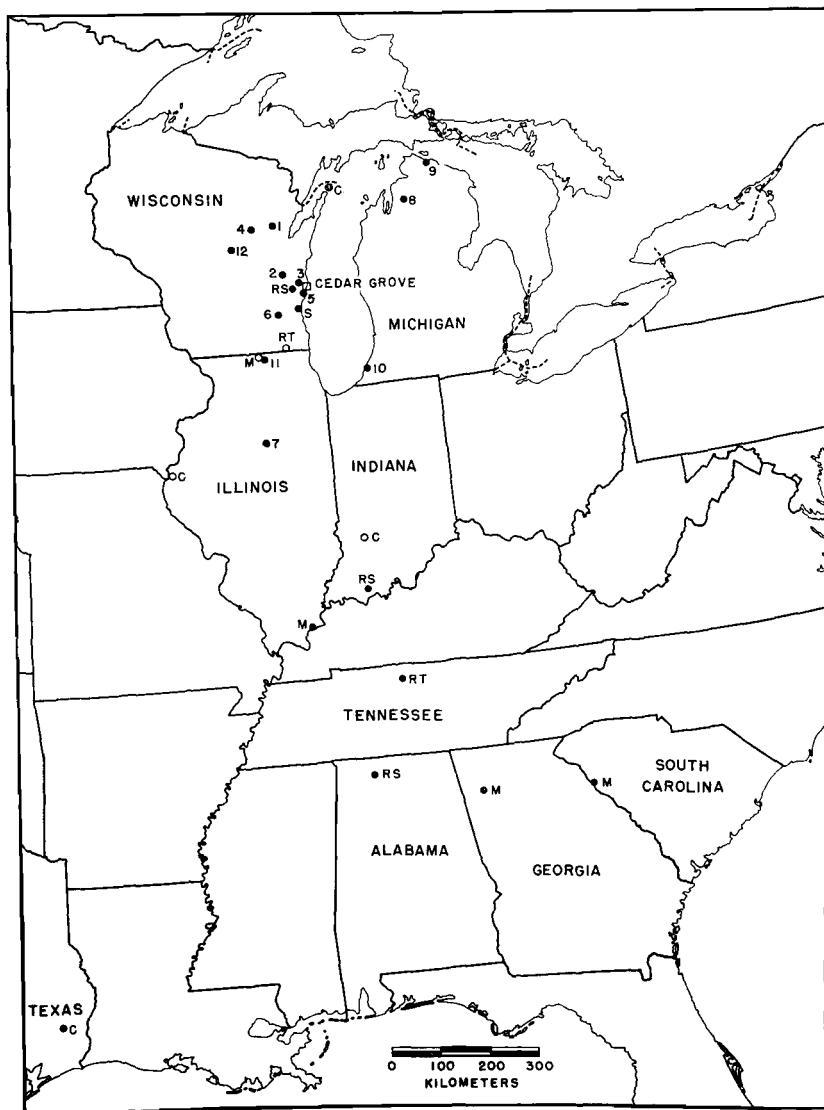


Figure 1. Distribution of recoveries of hawks banded during spring migration at Cedar Grove, Wisconsin. Closed circles with numerals are spring and summer recoveries; numerals refer to Table 1. Closed circles with alphabetic letters are winter recoveries. Open circles are fall migration recoveries. C, Cooper's Hawk; RT, Red-tailed Hawk; RS, Red-shouldered Hawk; M, Marsh Hawk; S, Sparrow Hawk.

puzzled us for some time. We now believe that at least some of the southbound birds are reorienting, or searching for summer homes to the south or east of Cedar Grove.

Of the 741 hawks banded at Cedar Grove 23 were subsequently killed or found dead elsewhere, and we trapped 3 hawks that had been banded in other localities (Figure 1); 12 of these 26 recoveries were taken in the same spring they were banded or during a subsequent breeding season (Table 1). Of these 12 recoveries, 3 were northbound when trapped at Cedar Grove (Table 1, Nos. 1-3); 7 were southbound (Table 1, Nos. 5-11) and the flight direction of the other 2 was not recorded (Table 1, Nos. 4, 12). All 3 northbound birds were recovered to the north and northwest of Cedar Grove (Figure 1); 4 of the 7 southbound birds were recovered to the south or southwest, and 3 to the east beyond the 100-km expanse of Lake Michigan (Figure 1).

DISCUSSION

Although the evidence is largely circumstantial, it appears that hawks return to places where they have previously bred (Bent, 1937; Craighead and Craighead, 1956, p. 222; Herbert and Herbert, 1965). Evidence also seems to suggest that most hawks return to the vicinity of their birthplaces to breed (Olsson, 1958; Mebs, 1964; Mueller and Berger, MS). We have previously discussed (Mueller and Berger, 1967a) the fidelity of birds of other species to breeding or birth localities and the determinants of the routes followed by diurnal migrants. The dates of the recoveries of the hawks listed in Table 1 suggest that the birds were recovered on, or en route to, their breeding areas. Six of the hawks listed in Table 1 were juvenals when trapped, and not all hawks breed in the juvenal plumage. As Mebs (1964) has shown that many young Common Buzzards (*Buteo buteo*) do not return to their birthplaces until they attain breeding age, it is of interest to determine the minimum breeding age of the species listed in Table 1. Cooper's Hawks (*Accipiter cooperii*) begin to breed in the juvenal plumage (Bent, 1937, p. 117). Breeding by juvenal Marsh Hawks (*Circus cyaneus*) may not be uncommon (Frances Hamerstrom, pers. comm.). Red-tailed Hawks (*Buteo jamaicensis*) apparently do not breed in the juvenal plumage. Apparently most Sparrow Hawks (*Falco sparverius*) breed when they are 1 year old. Thus of the species listed in Table 1, only the Red-tailed Hawk is not known to breed in the juvenal plumage.

The distribution of winter and autumn recoveries of hawks banded in spring migration at Cedar Grove suggests that most of the members of this population of migrants have their winter homes to the south and south-southeast (Figure 1). Thus, hawks breeding in lower Michigan would

TABLE 1
BREEDING SEASON AND SPRING RECOVERIES OF HAWKS BANDED IN SPRING MIGRATION AT CEDAR GROVE

Map no.	Species	Age	Sex	Date banded	Flight direction	Date recovered	How recovered
1	Cooper's Hawk	Adult	♀	10 April 1954	North	7 July 1957	Found dead
2	Marsh Hawk	Adult	♀	6 April 1955	North	ca. 12 April 1955	Killed
3	Cooper's Hawk	Adult	♀	3 April 1956	North	ca. 16 July 1958	Found dead
4	Red-tailed Hawk	Juvenal	?	22 May 1963	?	1 May 1964	Killed
5	Sparrow Hawk	?	♀	6 April 1957	South	1 July 1957	Killed
6	Cooper's Hawk	Juvenal	♀	6 April 1957	South	4 June 1957	Killed
7	Marsh Hawk	Juvenal	♀	17 April 1964	South	Spring 1964	?
8	Cooper's Hawk	Adult	♀	20 April 1953	South	14 May 1953	Killed
9	Sparrow Hawk	?	♂	4 April 1956	South	20 June 1957	Killed
10	Marsh Hawk	Juvenal	♀	7 May 1964	South	11 May 1964	Found dead
11	Red-tailed Hawk ¹	Juvenal	?	17 May 1962	South	23 April 1963	Trapped
12	Marsh Hawk ²	Juvenal	♂	16 July 1962	?	10 April 1963	Trapped

¹ Nestling banded near Rockford, Illinois.

² Nestling banded in Portage County, Wisconsin.

have to be displaced westward while migrating northward in order to occur in Wisconsin. This was probably the case with recoveries No. 8, 9, and 10 of Figure 1. These birds were presumably reorienting or searching for their summer homes when they were intercepted in their southbound flight at Cedar Grove. The 3 birds presumably continued southward around the south end of Lake Michigan. One of these birds, a Marsh Hawk (Figure 1, No. 10), apparently traveled some 350 km around the south end of the lake in less than 3.5 days. The 4 birds recovered to the south and southwest (Figure 1, Nos. 5, 6, 7, and 11) presumably had overshot the home area and were returning southward when trapped at Cedar Grove.

At least two theoretical explanations are possible for the observed high coincidence of bidirectional migration and the peculiar distribution of recoveries of banded birds: (1) The system of navigation the hawks use is crude and results in longitudinal and latitudinal displacements of considerable magnitude, (2) hawks wander widely while returning to their breeding areas. Neither of these explanations calls, or offers evidence, for an accurate navigational system.

ACKNOWLEDGMENTS

This work was in part supported by a grant from the National Science Foundation (GB-175). We are indebted to John T. Emlen for frequent counsel and encouragement. The Cedar Grove Ornithological Station is a joint project of the University of Wisconsin and the Wisconsin Conservation Department.

LITERATURE CITED

- BENT, A. C. 1937. Life histories of North American birds of prey, part 1. U. S. Natl. Mus., Bull. 167.
- BILLINGS, S. M. 1968. Homing in Leach's Petrel. *Auk*, 85: 36-43.
- CRAIGHEAD, J. J., AND F. C. CRAIGHEAD. 1956. Hawks, owls and wildlife. Harrisburg, Pennsylvania, Stackpole Co.
- HERBERT, R. A., AND K. G. S. HERBERT. 1965. Behavior of Peregrine Falcons in the New York City region. *Auk*, 82: 62-94.
- KENYON, K. W., AND D. W. RICE. 1958. Homing of Laysan Albatrosses. *Condor*, 60: 3-6.
- KRAMER, G. 1961. Long-distance orientation. Pp. 341-371 in *Biology and comparative physiology of birds*, vol. 2 (A. J. Marshall, ed.). New York, Academic Press.
- KRAMER, G., AND U. V. ST. PAUL. 1952. Heimkehrleistungen von Brieftauben ohne Richtungs-dressur. *Verh. deut. Zool. Ges.*, 172-178
- MATTHEWS, G. V. T. 1951. The experimental investigation of navigation in homing pigeons. *J. Exp. Biol.*, 28: 508-536.
- MATTHEWS, G. V. T. 1953. Navigation in the Manx Shearwater. *J. Exp. Biol.*, 30: 370-396.
- MATTHEWS, G. V. T. 1955. Bird navigation. London, Cambridge Univ. Press.
- MEBS, T. 1964. Über Wanderungen und bestandsgestaltende Faktoren beim Mäusebussard (*Buteo buteo*) nach deutschen Ringfunden. *Vogelwarte*, 22: 180-194.

- MUELLER, H. C., AND D. D. BERGER. 1961. Weather and fall migration of hawks at Cedar Grove, Wisconsin. *Wilson Bull.*, 73: 171-192.
- MUELLER, H. C., AND D. D. BERGER. 1967a. Wind drift, leading lines, and diurnal migration. *Wilson Bull.*, 79: 50-63.
- MUELLER, H. C., AND D. D. BERGER. 1967b. Fall migration of Sharp-shinned Hawks. *Wilson Bull.*, 79: 397-415.
- OLSSON, V. 1958. Dispersal, migration, longevity and death causes of *Strix aluco*, *Buteo buteo*, *Ardea cinerea*, and *Larus argentatus*. *Acta Vert.*, 1: 85-189.
- SAUER, F. 1957. Die Sternorientierung nachtlich ziehender Grasmucken (*Sylvia atricapilla*, *borin* und *curruca*). *Z. Tierpsychol.*, 14: 29-70.

Department of Zoology, University of Wisconsin, Madison, Wisconsin 53706 and the Cedar Grove Ornithological Station, Route 1, Cedar Grove, Wisconsin 53013. Present address of first author: Department of Zoology, University of North Carolina, Chapel Hill, North Carolina 27514.