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AN OFFSHORE NOCTURNAL OBSERVATION OF MIGRATING BLACKPOLL WARBLERS

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Nisbet et al. (1963) and Nisbet (1970) presented evidence that part of the autumn migration route of the Blackpoll Warbler (*Dendroica striata*) is a long, over-water flight from northeastern North America directly to South America. Murray (1965, 1966a, 1976, 1979) disputed this hypothesis and favored a route down the eastern seaboard to Georgia and Florida, and then southeastward to South America (a route originally proposed by Cooke [1904]). Here, we present data from a sample of birds that died during a nocturnal accident at sea, and discuss these data in relation to the proposed migration routes of the species.

On 9 October 1979 at 20:15 (2 h after sunset), while aboard the USSR R/V BELAGORSK, Doherty saw about 30 small passerines flying within the area that was illuminated by the ship's lights. The ship's position was 40°57'N, 70°33'W, about 30 km south of Martha's Vineyard and 70 km from the Massachusetts mainland. By 21:00, an estimated 700 birds were flying around the ship. The sky had been overcast all day with a southwest wind. At 21:45, the wind had switched to northwest, and heavy rain began. Birds continued to fly around the ship for the next few hours; some struck the ship and were killed or stunned. By 00:15, no more flying birds were seen. From 20:15 to 00:15, the ship moved 20 km WNW. During this period, 28 dead and 22 stunned birds were retrieved from the decks. An additional 16 dead birds were found the following morning. Of these 66 birds, 64 were Blackpoll Warblers and two were Connecticut Warblers (*Oporornis agilis*). All of the stunned birds, which included the Connecticut Warblers, were released when they were able to fly. The dead Blackpoll Warblers were frozen when they were found, and were taken to Manomet Bird Observatory where they were examined by Doherty and T. L. Lloyd-Evans on 10 October. There were 30 adults (after hatching year) and 14 immatures (hatching year) in the sample of dead birds. Using the fat classifications used by Manomet Bird Observatory (see Cherry 1982), we determined that there were three birds with class 1, four birds with class 2, 11 birds with class 3, and 26 birds with class 4. Weights of these birds are suspect because the birds were weighed after being thawed and dried with a hair dryer.

Radar observations during autumn migration show that large numbers of passerine birds leave the northeastern coast of North America along south to south-southeasterly tracks (Drury and Keith 1962, Drury and Nisbet 1964, Richardson 1972, 1980) and fly directly to the West Indies and South America over the open ocean (Williams et al. 1977, Williams and Williams 1978, Larkin et al. 1979). The species composition of these flights is not fully established. Evidence from banding studies of fat deposition, departure dates, and occurrences on Bermuda led Nisbet et al. (1963) to suggest that Blackpoll Warblers participate in this long flight. Murray (1965), based on banding data from Island Beach, New Jersey, and other arguments, disagreed. Further evidence supporting the long, over-water flight hypothesis is provided by the autumn distribution of Blackpoll Warblers (Nisbet 1970). If Blackpoll Warblers were following the eastern seaboard to Georgia and Florida, as suggested by Murray, large numbers would be expected to occur in these states, but they are rare in Florida and Georgia. All major occurrences of these warblers have been associated with hurricanes and storms which could have blown birds into these areas from over the Atlantic Ocean (Nisbet 1970). Thus, the autumn distribution of Blackpoll Warblers does not support Murray's hypothesis. Our data do not unequivocally rule out either of the two hypotheses, although we feel that they are more consistent with the long, over-water flight hypothesis.

Given that most nocturnal passerine migrants depart during the hour after sunset and fly at airspeeds of 55 km/h (Able 1982), the time and position of the shipboard deaths indicate that the birds could have departed only from southeastern Massachusetts and Rhode Island. South to south-southeasterly departures of birds from New England that are observed with radar almost always occur after the passage of a cold front, which results in favorable northwesterly tailwinds (Drury and Nisbet 1964, Williams and Williams 1978). Surface weather charts for 9 October show that a weak, high pressure system had moved over the New England area by early afternoon. The front between the high and low pressure systems had moved offshore by the evening and was about 60 km past the ship when the deaths occurred. Assuming that the birds departed with tailwinds from south central New England, they would have encountered cross-winds and rain in the vicinity of the front, and then probably became disoriented and were attracted by the ship's lights. Nocturnal attractions to lighted structures are usually associated with overcast, rainy conditions and often occur at weather fronts (Stoddard and Norris 1967). Radar observations from Texas Tower III (a now-defunct offshore radar observatory, described by Drury and Nisbet [1964]) on the night of 10/11 October 1959 depict a scenario similar to that described above. A high pressure system was over New England, with a stationary front lying east-west to the south of Nantucket Island (Texas Tower III was 80 km SE of Nantucket Island). Birds were seen arriving from the north, meeting the front, and then flying in different directions.

From our observation, we cannot positively determine the direction that the birds were travelling before they came to the ship. If the birds were part of a west-southwesterly movement heading for coastal New Jersey, Delaware, and Maryland,then they could have departed only from Nantucket Island, because it is the only land within 120 km ENE of the sighting. A coastal west-southwesterly movement would probably have included birds known to migrate in that direction, such as the Yellow-rumped Warbler (*D. c. coronata*), the most abundant warbler at this time of year at coastal locations (Murray 1966b). Instead, only Blackpoll Warblers, a species for which there is good evidence for a long, over-water flight, and Connecticut Warblers, a species whose pattern of distribution during the autumn migration closely matches that of the Blackpoll Warbler (Nisbet 1970), were found. Thus, it is likely that the birds were travelling south to south-southeastward, and were starting a long, over-water flight.

Another line of evidence supporting a south to south-southeasterly direction of travel for these birds is that they departed with northwest winds just after the passage of a cold front. Under these conditions in Nova Scotia, the predominant flight direction is south to south-southeastward, while southwesterly migration predominates two or three nights after the passage of a cold front (Richardson 1978, 1980). Nisbet and Drury (1969) reported a similar observation from moon-watching at Lincoln, Massachusetts.

Birds starting a long, over-water flight should have large fat reserves and, thus, high weights. The weights of the

collected samples were considerably lower than the proposed average departure weight of 20 g (Nisbet et al. 1963). The weights are suspect, however, because drying the specimens may have caused water weight loss. Most (84%) of the birds had fat classes of 3 or 4. A random sample of Blackpoll Warbler weights for fat classes 3 and 4 from the autumn migrations at Manomet Bird Observatory shows that live birds with fat classes of 3 and 4 (class 3 mean = 16.5 g, SD = 2.2, n = 50; class 4 mean = 19.6 g, SD = 2.4, n = 50) weigh close to 20 g. Thus, the fat levels of the dead birds suggest that most of the birds had sufficient fat reserves to complete a trans-Atlantic crossing.

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ARTERIOVENOUS ANASTOMOSES IN THE INCUBATION PATCH OF HERRING GULLS

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Arteriovenous anastomoses (AVAs) are large vessels through which the blood may be shunted directly from arterioles to venules without passing the capillaries. Thus, the AVAs allow a high level of local blood flow without overburdening the capillary net. The AVAs are particularly abundant in the skin of homeothermic animals. In birds, they are numerous in the feet (Schumacher 1916, Midtgård 1980) and in the naked skin areas of the head (Wodzicki 1929, Baumel et al. 1970, Midtgård 1984b). Histologically, the AVAs are characterized by irregular lumina (3–8 times larger than those of capillaries), muscular walls, and by being more or less tortuous. In contrast to capillaries, which serve tissue nutrition, AVAs are believed to have a thermoregulatory role in most skin areas. For example, the AVAs in the feet provide the structural basis for a high level of peripheral blood flow, which is important for dissipating heat at high ambient temperatures (Wolfenson 1983).

Since the incubation patch is highly vascular and important for transferring heat from the incubating bird to the eggs (Drent 1975), it might be assumed that AVAs also are present in this skin area. A survey of the literature dealing with the histology of the incubation patch showed that AVAs have not been reported from this area of the skin. It is likely that the AVAs have been overlooked, especially since many investigators are unfamiliar with their histological appearance. This contention is supported by the fact that AVAs have been identified in the thoracic skin of the domestic fowl (*Gallus gallus* var. *domesticus*; Midtgård 1984a). In order to establish whether AVAs are present in the incubation patch, I examined the Herring Gull (*Larus argentatus*). This species was chosen because