# HOMING FLIGHTS OF HERRING GULLS UNDER LOW VISIBILITY CONDITIONS

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The homing ability of Herring Gulls (*Larus argentatus*) has been well established by Goethe (1937), Griffin (1943), Matthews (1952), and Southern (1970a). These authors believed that the number of birds returning to the nesting colony and their speed of return indicated a homing mechanism other than random dispersal from the release site. Griffin (1943) observed birds from an airplane, and Southern (1970b) used radio-tracking to follow the return flights of gulls. Both investigators found that the birds followed erratic courses and were influenced by large topographical features. Neither overcast skies nor wind direction had any clear influence on the homeward path of the birds, although with suitable wind conditions for soaring flight, birds tended to home more rapidly. Thus, the basis for homeward orientation was left in doubt.

In the present paper we report radio tracking studies of birds released at sea under both good and poor visibility conditions, to determine the importance of visual cues in the homing behavior of gulls.

## METHODS

All gulls were trapped on the greater Weepecket Island, 41° 30′ 40″ N, 70° 44′ 30″ W, 3 km WSW of Woods Hole, Mass., on the nest, with chicken wire funnel traps similar to those described by Griffin (1943). The birds were placed in cardboard boxes (60 x 40 cm) and taken to Woods Hole. During transport, the birds probably could have seen some features of the terrain through 3 cm ventilation holes in the sides of their boxes. The birds were kept at Woods Hole for 1 to 12 hours and then usually transferred to the power boat RV "Asterias." During transport to the release point in this vessel, the birds could see only the sky and the deck of the boat through ventilation holes. In some releases, the birds were transported to the release point by car (a tarpaulin covered the gull boxes on a roof top carrier) or inside an airplane. All birds flew well upon release and did not appear to be affected by handling or transportation, with the exception of some of the gulls transported for 8 hours to Maine by car. These birds were less active than normal upon arrival, but recovered before release.

Shortly before release the birds were removed from their boxes and fitted with a radio transmitter and harness (see below). Releases on land or from the boat were made by gently tossing the bird into the air. Releases from a "Heliocourier" airplane were made by slowing the airplane to about 50 km/hr and, at the same time, executing a sharp righthand turn. As the airplane drifted sideways the bird was ejected out the right rear window. This procedure caused minimal disturbance to the bird.

All the birds were marked with fluorescent spray paint on the head, breast or wings, thus affording recognition of individual birds for at least 10 days.

We used a 50 g 400 MHz transmitter attached to the bird by a nylon mesh harness that seemed to cause no discomfort. The gulls soon preened the harnesses under their feathers. The attachment was not, however, permanent. During normal preening captive birds abraided the forward section of the harness and removed it and the transmitter after about 10 days. The high frequency of the radio-tracking system allows the use of efficient transmitting and receiving antenna systems, giving long range and accurate directions from the receivers. The system is most useful over water or flat land because high frequency radio waves are blocked by hills. The frequency of the transmitter varies slightly with each wingbeat. This gives an unmistakable indication at the receiver when the bird is in the air, and whether it is flying or soaring. Further information on the system will be found in Lawson, Kanwisher, and Williams (Ms).

After release the bird's position was determined by intersecting bearings from two, or usually three, receiving stations. A mobile receiving station was used for the most northerly releases (Fig. 1). The angular accuracy of the receiving stations was always greater than 5°, and for the releases in Maine a receiving system with an accuracy of 1° was used. Because birds were a maximum of 20 km from the receiving stations, there is an uncertainty of not more than 1.5 km in the tracks. Any perturbation in the bird's path less than this might not be recorded unless it occurred near a receiving station.

A telemetry receiving station at Woods Hole monitored the nesting island 4 to 8 hours each day to check for returned birds. For releases in the Cape Cod area, the monitor was operated for two to five days after the release or until signals were received from the home island. For birds released in Maine, the monitor was continued for 10 days after the release. The nesting island was also checked visually with binoculars (average of 2 hr/day).

Surface winds and visibility were noted every hour at each receiving station. The limits of fog banks were determined by observers on shore. In the case of the two longest tracks in Figure 2, observation from an airplane indicated that the fog extended to a height of more than 500 m over the release point and continued unbroken for at least 40 km seaward. During "good visibility" conditions, we could see at least 10 km and features of the shoreline were visible if the release were from a boat. During releases in fog, visibility was less than 0.5 km. If the fog began to break up as we approached a release site, we waited for complete dispersal of the fog before performing a clear weather release.

## RESULTS

*Behavior of birds on release.* Immediately after release, birds rested for a period of time preening their feathers. Other experiments (Griffin, 1943; Southern, 1970b) report that homing Herring Gulls

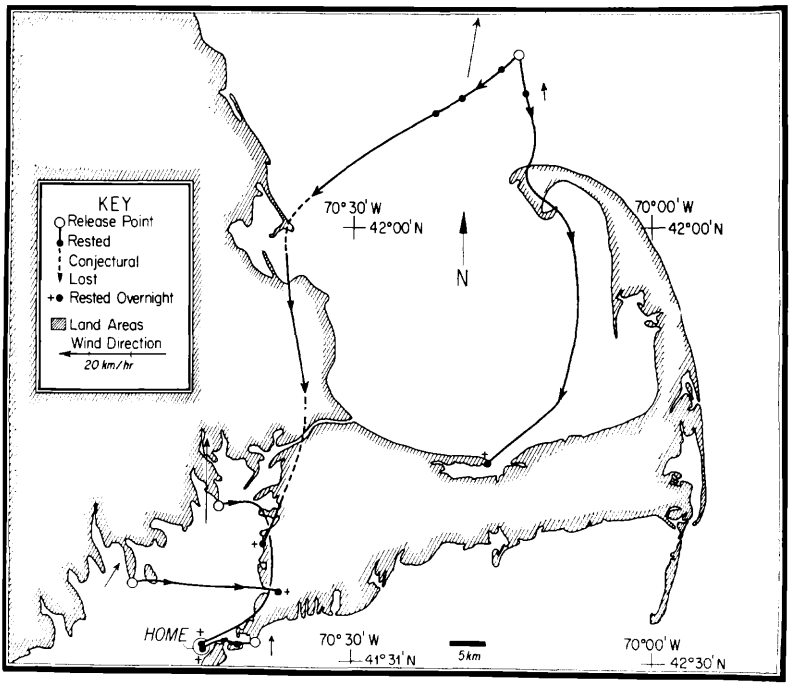


FIGURE 1. Tracks of Herring Gulls released under clear skies less than 100 km from the nesting colony (home). Arrows near the beginning of each track indicate the direction and speed of the surface winds at the time of release. "Rested Overnight" indicates the bird remained in one location until near sunset when we ceased tracking.

often rest for long periods on land. The two birds that we released on land (Fig. 1) rested for an average of 45 minutes before taking off. Birds released at sea in clear weather rested for shorter periods, the average being 9.4 min.

*Tracks of gulls under good visibility conditions.* Twelve birds were released under good visibility conditions. Figure 1 presents the tracks of five gulls released from different points in the Cape Cod area. The remaining seven were released in Nantucket Sound, of which two representative tracks are shown in Figure 2. Even when the birds could actually see their home island (such as the release 12 km NW of home, Fig. 1) they rarely flew directly toward the presumed goal. Instead, they usually chose a path that offered favorable wind conditions. Thus, the two birds released 92 km NNE of the home nesting area (Fig. 1) took two different routes. One bird, facing light southerly winds, flew south to the nearest land, then south across Cape Cod Bay to Barnstable where it spent the night. The other bird faced a much stronger wind (27 km/hr) and instead of flying into the wind, it flew SW to the mainland and then along the coast. The tendency of gulls to fly just inshore of the

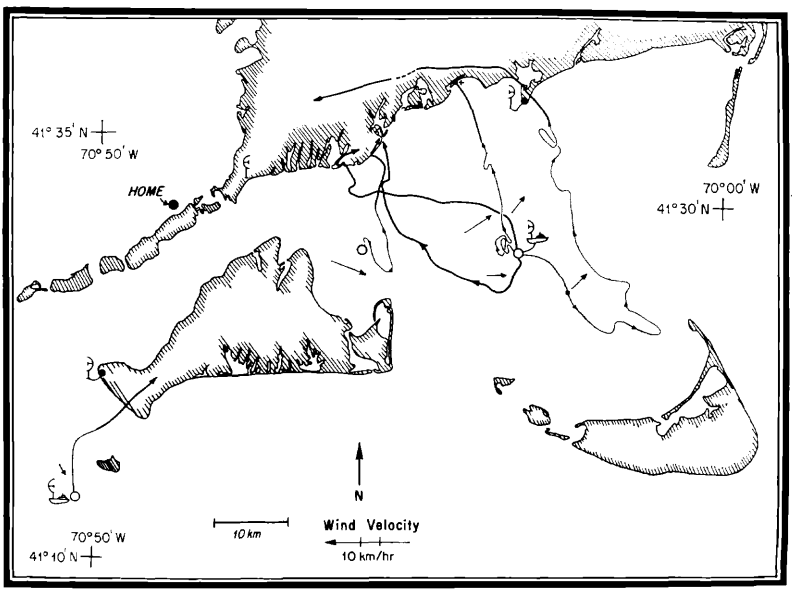


FIGURE 2. Tracks of Herring Gulls released in fog (plus two control birds) less than 50 km from the nesting colony. A heavy solid line represents tracks of birds under good visibility conditions. A fine solid line indicates the track of a bird flying through fog; this changes to a heavy solid line at the approximate point where the bird emerged from a fog bank. Tracking stations are indicated by antenna symbol. Other symbols as in Fig. 1.

coast appears related to their use of updrafts in these areas. Soaring flight in such areas was indicated by the modulation of the radio signal, and non-experimental birds often soared along similar routes during experiments. Apparently the birds actively directed their flights toward such favorable areas rather than being blown to such shores by the prevailing winds. Calculation of air velocities are uncertain due to inadequate data on the velocity of the wind near the birds. However, rough calculations using ground winds within 15 km of the birds indicate airspeeds of about 35 km/hr for the birds discussed above with headings differing by at least 30°. Similar calculations for the other releases in Figure 1 show that the bird's heading deviated from the homeward direction by as much as 60°, but these deviations could always be interpreted as movement toward land areas that might offer favorable flight conditions.

Only 2 of the 12 birds radio-tracked within 80 km of home were seen at the nesting colony within two days of release. This poor homing performance does not appear to be due to the weight or irritation of the transmitters; only 2 of 11 birds (released at three of the same sites) with only paint markings were seen at the nesting area within two days of release. Griffin (1943) also reports poor homing of birds released near the nesting colony. Radio monitors of the nesting island revealed that 6 of the 12 birds returned briefly to the

home area within two days after release. Since the monitor was not continuous, possibly the remaining birds also returned briefly. We received five reports of paint-marked birds in the Woods Hole area, but insufficient detail was given in the reports to identify individual birds.

*Tracks of gulls under poor visibility conditions.* Nine birds were released near Cape Cod under conditions such that land was not visible from the release point. Two birds were released in the rain and sat quietly in the water for as long as we cared to track them (4 hrs). Seven birds were released in dense fog. Of these, two which were released from a moving boat (the Woods Hole-Martha's Vineyard ferry) followed the ship to land. One bird, released from an airplane 18 km S of the nesting area, remained on the water without changing position significantly for four hours, at which point we ceased tracking.

The tracks of the remaining four birds are shown in Figure 2, along with the tracks of two birds released at the same points in clear weather for comparison. The four birds released in fog flew well, but their flights were not directed homeward as were those of birds released under clear skies. The birds did not appear to fly above the fog which was estimated to be at least 500 m deep. Increase in altitude would have resulted in greatly increased signal strength at distant receiving stations, and it is our estimate, based on tests with transmitters in the airplane, that the gulls were flying below 150 m. The flight paths of gulls in deep, widespread fog did not appear to be random. Birds often flew for considerable periods of time in one direction and then appeared to change course, often radically, and fly for an extended period in some other direction. This behavior often brought them either to the edge of the fog bank or to land.

The system used for orientation during the straight portions of these flights is not clear. Specifically, we cannot rule out the use of the sun as a compass. Although observers could not detect the position of the sun from the boat at the time of release, possibly a bird flying even 150 m above the surface could determine the approximate position of the sun through the upper layers of fog. In all cases, the fog began to break up during the latter part of the experiments, and observers on the boat saw the sun (a brighter area in the fog) before the gull had flown clear of the fog bank. There is, however, no indication that the gulls could determine homeward directions by the sun during these experiments.

As a control for these experiments, seven birds were released with transmitters under good visibility conditions at the same release points. The average heading for each of these control birds was within 60° of the homeward direction and, as described in the previous section, these deviations could be interpreted as flight toward land areas that might offer favorable flight conditions.

*Releases of birds 350 km from home.* Releases near Cape Cod indicated that landmarks played an important part in the orientation of Herring Gulls near their nesting colony, but left in doubt the

orientation mechanisms used by birds at greater than 80 km. Thus, we made a number of releases 350 km NE of the nesting colony near Mt. Desert Island, Maine. The results of these releases are shown in Figure 3. Birds released under clear skies flew rapidly toward the mainland and rested there until nightfall when tracking was sus-

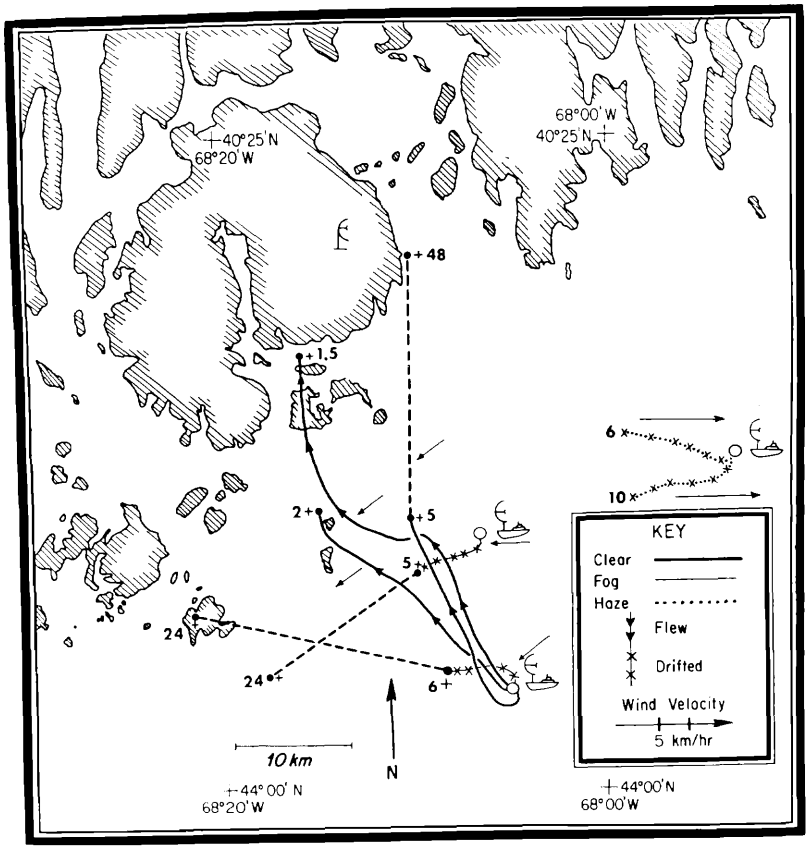


FIGURE 3. Tracks of Herring Gulls released near Mt. Desert Island, Maine, 350 km NNE of their home island. Numbers indicate hours after release, other symbols as in Fig. 1. In some experiments strong currents drifted birds which were sitting on the water (see key to figures).

pended. Homeward orientation was not detected, although only one of the birds was in the release area the next day. (This lack of homeward orientation may have been due to the long trip from Massachusetts by car. Southern (1970b) and Griffin (1943) report that long periods of transportation affected some of their birds adversely.) Birds released under low visibility conditions of fog or heavy haze, in which the land could not be seen from the release site, sat on the water until we ceased tracking. The movements of these birds

away from the anchored ship (Fig. 3) were due to the effects of winds, currents, or swimming by the bird.

The small number of birds followed by radio-tracking in Maine was supplemented by visual observation of initial orientation of birds released without radio transmitters. Two birds released under good visibility conditions both sat for less than 13 minutes and then took off to the northwest. Five birds were released in fog or in haze and all sat in the water for more than 20 minutes until they drifted out of sight (0.25 to 3 km).

None of the birds released in Maine, with or without transmitters, was seen again in the home area. Griffin's results (1943) indicate that Herring Gulls might be expected to return from such a release in 2 to 3 days. The radio transmitters should have been operative for at least this period, but no signals were detected from the home island up to 10 days after release.

*Home range.* In several cases, it was possible to follow the movements of gulls once they had returned from homing experiments. Both radio-tracking and visual identification of marked birds indicated daily flights from the nesting area to feeding grounds usually 2 to 13 km distant. One bird was seen 40 km from the nest following the Nantucket ferry. The limited home range data indicate that gulls from the Weepecket Islands must be intimately familiar with the area used for release in Figures 1 and 2. Banding or marking studies cited in Griffin (1943) and by Drury and Nisbet (1972) indicate that Herring Gulls might be expected to be familiar with an area 200 km in radius around their nesting colony. Drury and Nisbet (1972) believe that the population of gulls we studied probably spends part of the winter around New York City or Boston. Thus, the wide experience of these animals would allow them to recognize a large area by visual landmarks (see also Southern, 1970b).

## DISCUSSION

From our studies it appears that visual orientation by means of landmarks is a sufficient explanation of the orientational abilities of Herring Gulls within familiar territory. Gulls released in the fog appear unable to orient their flight in a homeward direction; instead, they appear to make flights in one direction for a period of time and then reorient and fly in a different direction until some familiar landmark is found. Similar behavior was recorded for Gannets by Griffin and Hock (1949). Some gulls returned to familiar landmarks by following ships through fog.

The initial orientation of gulls at the release point is dependent not only upon visibility conditions, but also upon the wind. This has been noted by several investigators (Griffin, 1943; Gerdes, 1962; Southern, 1970a), but their releases made on land revealed little pattern in the direction of initial orientation. Our data indicate that gulls released at sea will choose the homeward path that involves minimal effort rather then the shortest path. This behavior might in part explain the large scatter in initial orientation of Herring Gulls reported by others.

The lack of movement of gulls released 350 km from home in fog or haze suggests that visually perceived features of the landscape play an important role in the orientation of birds at these distances as well as in releases near the nesting colony. Whether these cues are used in the homing process or whether the birds were only seeking a resting place is uncertain.

Herring Gulls are frequently seen more than 50 km from shore, and on most evenings large numbers of these gulls may be seen approaching the north and east coasts of Cape Cod from the sea. Thus, although the birds may depend heavily upon landmarks, they are not bound to the coasts. Short flights away from and back to a coast would require only a method of maintaining course on the outward flight and reversing this course for the return flight. Our releases in fog indicated that the birds frequently maintained their course for 6 km without reference to landmarks. This might be done either by use of a sun compass, or by flight at a constant angle to the wind or to wave patterns (Griffin, 1969).

## SUMMARY

Flights of Herring Gulls were followed by radio-tracking both near the nesting colony and at a distance of 350 km from the home colony. Under good visibility conditions, the birds appeared to choose not the shortest route home but one requiring the least effort. Birds released in fog within 50 km of the home area appeared to fly a search pattern made up of more or less straight components 3-10 km long until they reached the edge of the fog bank or some familiar landmark. Birds released in the rain near home or in haze or fog 350 km from home sat on the water for more than 4 hrs. Homeward orientation was not observed at 350 km.

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