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INITIAL ORIENTATION AND HOMING OF INEXPERIENCED PINTAILS

By William J. Hamilton III

Recent advances in the analysis of orienting cues used by migrating and homing birds have stemmed largely from experimental studies. Experiments have been of four basic types: (1) release of flying birds, either hand reared or wild caught (Matthews, 1955; Bellrose, 1958; in press; Kramer, 1957), (2) confining a bird in a circular test cage and measuring the directional component of seasonal migratory restlessness (Kramer, 1952, 1957 for diurnal movement; Sauer, 1957, 1961 and Sauer and Sauer, 1959, 1960; Hamilton, in press A, B; Mewaldt, 1960 for nocturnal activity), (3) training birds to respond to a reward in a particular compass direction and testing accuracy of choice under various natural and experimental conditions (Kramer, 1952; Hoffman, 1955; Hamilton, in press, C) or (4) free release of pinioned birds away from a home area (Hamilton and Hammond, 1960). All of these methods have provided valuable insight into the orienting cues involved.

This study deals with the application of method (1) to hand-reared Pintails (*Anas acuta*). The use of flying hand-reared birds in orientation experiments has been restricted due to the problems involved in rearing sufficient numbers of experimental birds. Kramer (1957), however, had good success using a home loft as a goal for inexperienced hand-reared pigeons. He observed a highly oriented initial homeward orientation but only a small part of the released birds returned.

METHODS

During May, 1956, Pintail eggs were gathered on the farm land and prairie fields near the Delta Marsh in south-central Manitoba, Canada. Additional eggs were provided by Bernie Gallop of the Canadian Wildlife Service from central Saskatchewan. All eggs were hatched in the incubators at the Delta Waterfowl Research Station in late May and early June and the ducklings were reared in heated rooms lighted by uncovered glass windows. In late June the birds were shifted to a large outdoor flight cage, measuring 20 x 8 x 5 meters high. The bottom of this cage was flooded by the marsh. By late July some of the birds were trying their wings and by the first of August some individuals could make flights covering several turns of the aviary. Breezes passing through the wire mesh often allowed the birds to hover several seconds facing into the wind so that the flying ability of the birds developed well within the cage.

On August 9, at 1830, two birds were released near Oakland, Manitoba, six miles south of the flight cage. Both flew well when released and after several minutes disappeared from sight. One of these two birds was recaptured the following morning as it attempted to reenter the flight cage. Releases were continued throughout the remainder of August, 1956.

Release sites. Original plans called for the use of release sites to the south, east and west of Delta. A northerly release site was impractical because of the large Lake Manitoba extending in that direction. The easterly and westerly areas proved generally unsatisfactory, however, because of the difficulty in finding suitable open areas away from water. Sites with even a small stock pond nearby proved inadequate because of the attraction of the water to passing birds. By contrast, the flat open prairie, mostly cultivated land, to the southeast of the home aviary provided more suitable release sites. Three were selected 8.3, 31.0 and 75.0 miles from the aviary (tab. 1). At all three of these sites there was unobstructed visibility in all directions for at least two miles.

TABLE I

Release sites in Manitoba, Canada, used in homing experiments. Home is a large flight cage at Delta, Manitoba.

Nearest Village	*Approximate Location of Release Site from Village*	*True Azimuth of Home*	*Distance to Home*
High Bluff	5 mi. N., 2 mi. E.	320°	8.3 miles
Elie	2 mi. S., 2 mi. E.	310°	31.0 miles
St. Jean Baptiste	3 mi. E., 1 mi. N.	340°	75.0 miles

Method of Release. When a release was to be made, up to 10 birds were taken from the flight cage and loaded into a large artificially lighted and ventilated light-proof crate. The drive to the St. Jean Baptiste release site took just over two hours, the trip to the nearer sites under one hour.

One by one the birds were thrown high into the air and followed with a spotting scope mounted on a bracket surmounting a large compass. One observer followed the bird with the telescope while an assistant noted the azimuth indicated by the mounted telescope at 10 second intervals and recorded the observer's estimate of the distance from instrument to bird. This permitted an approximate plot of the course of the bird although considerable inaccuracy must be allowed for in the observer's estimation of distance. Most low-flying birds were lost behind horizon features at about two miles. Some of the highest fliers were in sight for more than three miles. With two similar instruments (see Griffin and Goldsmith, 1955) a much more accurate track can be plotted by triangulation. Without such a refinement it is probably not justifiable to calculate final headings from the terminal portion of tracks such as are plotted in figure 1. The initial orientation heading presented in subsequent diagrams is therefore based on the direction from the observer to the bird when the bird was last seen.

Criteria for response. Only flights in which the bird was a mile or more from the release site when last seen are considered. Nor has any flight been tallied if the bird landed while still in sight, regardless of the distance it had flown. Many birds dropped into ditches or landed in nearby fields. Perhaps this is not surprising considering that this was the first opportunity that any of these birds had to make flights of distances greater than the length of the rearing pen. But such failures were probably not due to any lack of ability to fly well since several of these birds later returned to the home cage.

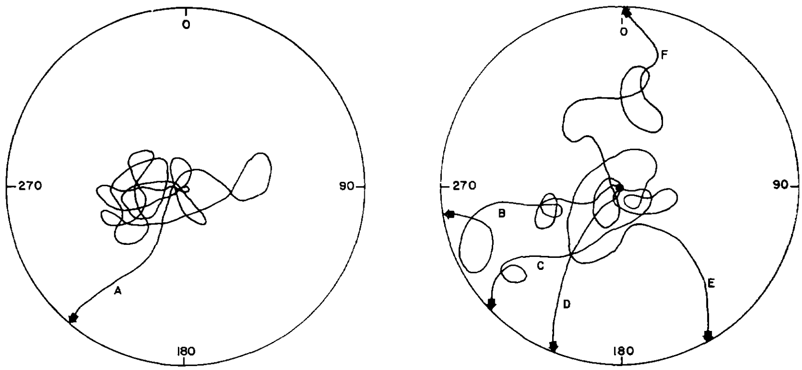

Figure 1. Tracks of Pintails on their maiden flight in unfamiliar areas. The diameter of each circle is four miles. The track in the lefthand circle is for a single bird, that to the right contains five superimposed courses. The point of release is the center of the circle; 0° is the home direction, not north.

The birds which responded to the first cover or potential cover, or water, require little discussion here, but it is of interest to note that recognition of appropriate ecological features was accomplished by these birds on their maiden flight.

RESULTS

Initial flight patterns provide considerable information concerning the orienting cues used. Six sample flight trails are plotted in figure 1. These patterns are typical in form of 120 such diagrams on which the following discussion is based.

A direct flight away from the release point to disappearance was rare (13 of 120 cases). Usually the bird made sweeping turns of ever increasing radius, sometimes initially very near the release point. Often as the bird was at the very limit of visibility it was making a sweep of great radius. This was more easily observed when the path of the sweep brought the bird back towards the observers. This terminal pattern is well illustrated by the latter part of the track of bird E, fig. 1.

The irregular flight patterns such as those illustrated in figure 1 contrast sharply with the highly oriented initial flight patterns of Mallards known to be using celestial cues (see fig. 5, Bellrose, 1958).

One of the surprising features of the release was the occasional return of a released bird *to the release site* some time after it had flown out of sight. When these birds returned they often headed directly for the observation instrument, turning aside only a few yards away and continuing in a fairly direct path out of sight in a new direction. Only one of these individuals could be positively distinguished from other individuals when it reappeared. This bird returned 14 minutes after its initial disappearance and departed 40° to the west of the initial disappearance direction. Several birds returned to the release point while still in sight, two landing only a few yards from the observer after having flown about some minutes in a circuitous manner near the observer.

TABLE II

Deviation from home of initial orientation performances by free-flying Pintails.

Release Site	*No.*	*Deviation from Home*	*Deviation from true north*	*Random*
High Bluff	11	63.3	72.3	90
Elie	29	46.1	34.6	90
St. Jean Baptiste	22	69.5	75.5	90

Direction of initial flight. The disappearance directions of the 56 birds which reached the prescribed criteria of flying a mile or more and not landing while still in sight are plotted in figure 3. Table II lists the average deviation of these vanishing points from home and true north. For each of these categories a random performance would have resulted in a 90° deviation. Such a test does not assess adequately the possible influence of the wind, however. If the data for wind (fig. 2) are divided into quartiles with sectors centered into and away from the wind, then 33 birds disappeared at points in these two sectors while 20 are in the neutral sectors. The wind data for the other three birds are missing. These data suggest a tendency to fly into or ride with the wind. If the wind were influential in directing the course in addition to some other orienting mechanism, then the full effect of the wind would be partly masked.

Bellrose's recent discovery (1958) that Mallards fly to the north when released in open fields suggests that a fixed compass direction orientation mechanism may be significant in waterfowl orientation, at least under some circumstances. To test this hypothesis all data were plotted about true north (fig. 2, Table II). For the Elie release site these data actually provide a closer fit than the home direction (fig. 3) and for the other release sites the difference is not great. Without additional releases in other directions the type of orientation involved cannot be ascertained, and the possibility remains that the observed orientation was this kind of fixed direction flying

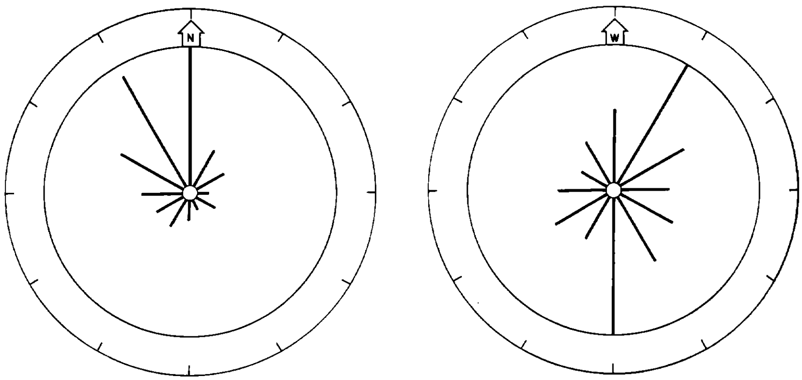

Figure 2. The disappearance directions in relation to north (N) is plotted in the lefthand circle; in the righthand circle the disappearance directions are plotted in relation to the wind (W). The results are grouped to the nearest 30 degree sector and the modal response is indicated by the longest radius. Other choices are indicated by radii fractionally proportional to this modal response.

rather than homing. Recently Bellrose (in press) tested Pintails in the same way and found a westerly or northwesterly trend characteristic of this species. This discovery tends to discourage the contention that a fixed direction mechanism is responsible for the noted orientation. The Pintails Bellrose worked with originate in the same breeding areas as those in this experiment.

During the course of the experiments it seemed that there was no significant initial orientation. This opinion was strengthened by the erratic courses generally witnessed. For this reason no attempt was made to provide a control under fully overcast skies. When the oriented trend emerged following analysis of preliminary results, other conditions discussed below prevented an adequate test under overcast conditions.

Return to the home aviary. Of the 56 birds which reached the prescribed criteria 15 were later recaptured as they attempted to reenter the flight pen (Table III). This includes 5 of the 10 birds from High Bluff,

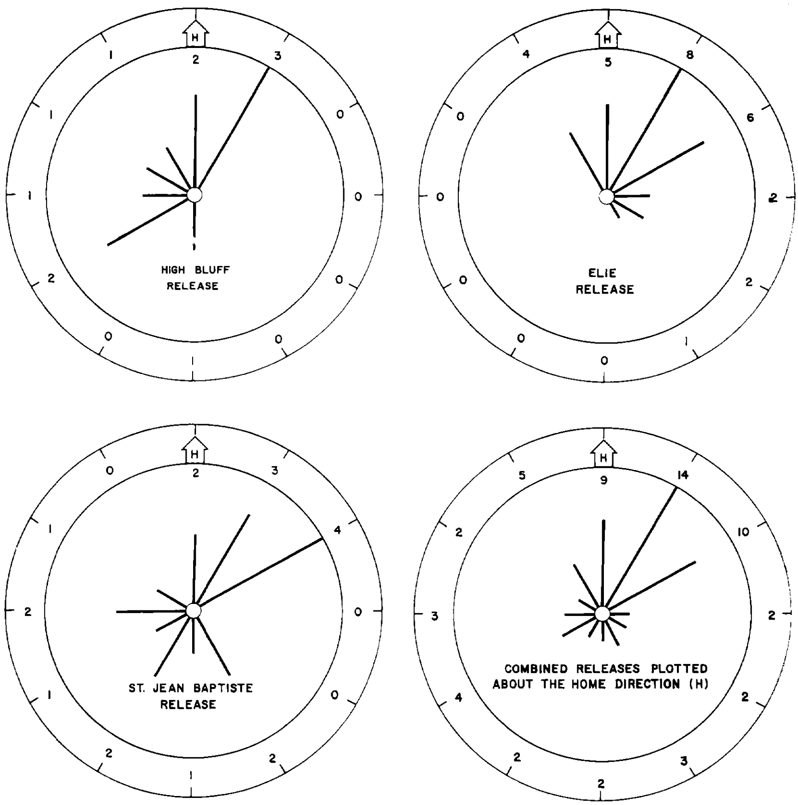

Figure 3. These are choices of Pintails at individual release sites and all release sites taken together in relation to home (H). The length of radii is designated as in Figure 2. The actual number of choices in each sector is indicated between the outer concentric circles.

TABLE III
Initial orientation and homing time of birds homing successfully

Release Site	*Homing Time (hrs.)*	*True Initial Flight Azimuth*	*Deviation from Home*
High Bluff	6 hrs. 13 min.	335	15° right
High Bluff	5 hrs. 50 min.	300	20° left
High Bluff	76 hrs. 10 min.	125	165° right
High Bluff	75 hrs. 50 min.	290	30° left
High Bluff	14 hrs. 55 min.	005	45° right
Elie	22 hrs. 45 min.	295	15° left
Elie	25 hrs. 12 min.	335	25° right
Elie	11 hrs. 57 min.	255	55° left
Elie	1464 hrs. 00 min.	005	55° right
Elie	3 hrs. 45 min.	200	110° left
Elie	119 hrs. 03 min.	065	115° right
Elie	500 hrs. 00 min.	310	correct
Elie	no record	070	120° right
Elie	18 hrs. 45 min.	225	85° left
St. Jean Baptiste	71 hrs. 58 min.	045	65° right

9 of 28 from Elie and one of 18 from St. Jean Baptiste (fig. 3). All listed return times are maximum times. Most of these birds were probably in the area several hours before they were captured, but since the birds were marked only with aluminum bands it was impossible to identify individuals before they were recaptured and handled. Several additional birds returned to the general vicinity of the home cage but could not be recaptured.

DISCUSSION

Motivation. Reports of homing experiments seldom provide any discussion of the stimuli motivating the released animal to return home. Such an omission is particularly disconcerting when we recall that we are attempting to resolve, at least in part, the seasonal phenomenon of migration. The mere event of initial orientation and subsequent homing is usually taken as *prima facie* evidence of a motivating influence. While this assumption is surely correct, it ignores variation in the strength of the stimuli which may help clarify seasonal and geographical differences in orientation performance. Furthermore, adequate analysis of motivation may facilitate interpretation of the adaptive advantage and selective influences involved in the evolution and maintenance of the highly adaptive behavior we are investigating.

The experiments described above were carried out largely before the fall migration through Delta was under way. This factor, combined with the fact that the home cage did not lie in the path of a predicted migratory route away from the release site, suggests that the homing behavior observed must have had a basis other than the natural migration of this population.

There seem to be at least two distinct possibilities which might make a homing behavior appropriate at this season. A constant food supply was continually available to the caged birds. When suddenly subjected to the novel environment of the release site, new sources of nourishment may not be easily located and hunger may spur the bird homeward. Also the stable and familiar social system of the home flight cage may temporarily remain a strong attraction to any displaced bird. Whenever a bird escaped through the wire of the cage it soon attempted to return, breasting the wire and moving back and forth along the outside of the cage. At the local "home", therefore, the familiar social situation may be a particularly important factor to a gregarious bird such as the Pintail.

In the last week of August the birds in the flight cage became increasingly restless and the amount of flight activity in the cage increased sharply. At this time, several of the birds escaped from a gap near the top of the cage. The behavior of these birds contrasted sharply with that of earlier escapes. On gaining freedom they hesitated momentarily and then flew off and were never recovered. This change in behavior may have resulted from increasing wildness due to the daily disturbance as birds were gathered for release or it may have been a seasonal change in behavior reflecting the onset of the migratory or dispersal phase of the species. No releases were made after the development of this behavior so that birds used in the tests that are presented here are presumably homogeneous in motivation to return to the home site.

Orienting cues. From the home cage a resting bird could see only the small pond at the Delta decoy. A bird flying near the top of the cage would be able to view much of Cadham Bay, a large open body of water approximately two miles in diameter on the Delta Marsh. Vegetation at the edge of this marsh limited further visibility. A direct view of Lake Manitoba to the north was blocked by a large building. Several other structures on the station grounds were visible and might have provided familiar cues to any homing bird. If the birds searched actively for an open body of water or wandered randomly until they sighted such a feature and then responded to it, some of them might have been attracted to the general area of the home aviary. The Delta Marsh, however, covers a broad area extending many miles along the southern edge of Lake Manitoba so that the general features of Cadham Bay could not provide sufficient orienting cues alone. Furthermore, a similar marsh is situated at the south end of Lake Winnipeg about 100 miles to the east. This marsh was actually closer to the St. Jean Baptiste release site than the Delta Marsh and the Elie release site was equidistant between the two. The final cues directing the birds to the loft must have been features of the cage or the surrounding structures. Another factor which might conceivably have facilitated gathering on the marsh is the movement of other birds in the area which at this season make periodic flights to the open land south of the marsh for feeding. These considerations lead to the following summary of possible orienting cues during the homing process.

1. The initial orientation process may have been guided by celestial cues, resulting in the adoption of either a fixed compass course (Type II orientation, Griffin, 1952) or navigation (Type III orientation, Griffin, *op cit.*). The experiments discussed here lend no conclusive support to this contention but neither do they suggest an alternative.

2. During the initial orientation process the bird quickly learns the physical features of the novel terrain to which it has been subjected. This information allows the bird to return to the precise point of initial release. This conclusion suggests a usable mechanism in developing a search pattern. The initiation of a new course the second time these birds disappeared suggests that a mechanical search pattern may have been involved in the initial orientation process.

3. The recognition of the goal may include general features of the home topography such as large masses of water but probably also includes recognition of local structures or the home cage.

SUMMARY

Experiments with free-flying birds made use of captive hand-reared Pintails. When the birds were old enough to fly well they were released at distances up to 75 miles from the home flight cage. Initial orientation, flight pattern and homing success of these inexperienced birds were used as measures of orientation capacity. The initial orientation of the 56 individuals which flew a mile or more showed a slight tendency to move in the direction of the home loft. Of these 56 birds 15 were recaptured at the home loft and others probably returned. The pattern of the initial flight was often circuitous. Occasionally birds returned to the release site some time after being released. There is some possibility that the homing response is based on methodical search and the recognition of familiar areas but celestial orientation cannot be ruled out.

These experiments were undertaken to obtain information about the cues guiding the natural migration of waterfowl. The simplest interpretation of the cues guiding these movements would seem to be that these inexperienced birds maintained a fixed direction based on celestial cues. Responses to the terrestrial environment probably account for local attraction to suitable habitats and the winter breeding location, but it is not necessary to invoke such responses to explain fully the directional aspect of migration of inexperienced birds.

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TEN YEARS AND 10,000 BIRDS (concluded)

By H. ELLIOTT McCLURE

Black-headed Grosbeak, *Pheucticus melanocephalus.* A total of 36 were banded, three of which repeated in the same season. They were all captured at Hart Park and one was retaken there 385 days after banding, and a second 955 days after banding. They were caught with Rogers 8-cell traps using grain or peanut hearts as bait. Since this species is a summer resident only, its first and last appearance in the traps is of some interest. In 1946, '47 and '49, first birds were taken between June 19 and 29th. In 1948 and 1950 they were first taken on April 29. Latest individuals were captured between August 7 and 20, 1947, '48 and '49.

House Finch, *Carpodacus mexicanus.* In Kern County, the House Finch appeared to be three-brooded, but loss of nests through environmental pressures and those from which young were fledged were quickly replaced by new construction. This activity obscured the presence of definite broods of young. The bulk of young of the first brood was fledged around May 20, second brood June 30, and third about the last week of July.