

WINTER HOMING BEHAVIOR OF THE CHICKADEE

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MOST tests of homing behavior in wild birds have been made during the breeding season when the breeding territory, mate, or nest constitutes a "motive" or "stimulus" for return. To what extent does the homing behavior pattern operate in winter and do home range, food, or other factors serve as a stimulus? Also, is homing to be correlated with the degree of migratory behavior; that is, are winter resident species more likely to return than permanent resident species or vice versa?

In Europe, Hilprecht (1935) found that only one out of 1,027 birds of several species returned when transferred 126-282 miles in winter; thirty-three were found still at the point of release in July. Wenkel (1935) obtained only a small percentage of returns from English Sparrows, titmice, nuthatches, and woodpeckers released at distances of 2-4 miles. In this country, Sumner and Cobb (1928) have obtained some interesting results with winter birds. Very few returns were obtained from distances of 20-30 miles, but 16-34% of the migratory Gambel's and Golden-crowned Sparrows (*Zonotrichia leucophrys gambeli* and *Z. coronata*) returned when removed 2-3 miles from their winter feeding ranges. On the other hand, no returns were obtained with Wren-tits (*Chamaea fasciata*), California Thrashers (*Toxostoma r. redivivum*), or Anthony's Towhees (*Pipilo fuscus senicula*), species believed to be permanent residents, when removed to the same distances. These experiments have two weaknesses which the authors pointed out in their paper: (1) birds were released after dark and mortality might have been considerable as a result; (2) birds had to be retrapped in order to be identified. However, the comparative behavior of migratory and resident species should be significant. Sumner (1938) further found that some Golden-crowned Sparrows remained at the point of release for some time, one was found there even the following winter.

From the above studies it would appear that the homing tendency in birds is less in winter, and perhaps less with non-migratory species than with migratory species. However, as Mayr (1937) has pointed out, it is important to distinguish between "homing sense" and "homing urge." This is particularly true in winter when the homing urge might be expected to be less. Consequently, there are really two distinct problems involved in the study of winter homing: (1) to determine whether there is a strong urge for immediate return, and (2) to determine from what distances and under what conditions birds are able to orient themselves and make a successful return. Probably the former should receive attention first; to measure the homing urge birds should be transported only

a short distance from their winter range in order to test their "desire" rather than their "ability" to return. If it appears that the birds tend to home to winter ranges, the next step would be to transport them a greater distance to determine the limits of their ability.

The Black-capped Chickadee (*Penthestes atricapillus*) is a good subject for experiments designed to clarify some of the above problems. Despite the ease of capture in winter, few homing experiments with this species have been reported. Of seven newly trapped birds released two miles from the place of capture in winter by Butts (1931) only one was known to return. Wallace (1941) moved four color-banded chickadees distances up to two miles in winter. Three of these returned, two within a day and one within a week; the individual which failed to return was believed to be injured. Another bird, unbanded at the time of capture, moved three-fourths of a mile and released at a feeding station by Wallace (personal correspondence) did not return to its former locality but remained at the point of release and even returned there the following winter.

Preliminary experiments with short distance homing were undertaken during the late winter of 1940 on the Edmund Niles Huyck Preserve, Rensselaerville, N. Y. as a part of an intensive year-around study of the chickadee (Odum, in press). It was desired particularly to find out if chickadees in winter have a strong enough attachment for a winter feeding range to return to it when transferred to another equally favorable area. While the number of birds used in these experiments was not large enough to be particularly significant, the results are presented in this paper in order to point out the manifold possibilities of such experiments and to stress the precautions necessary for accurate results.

METHODS

The winter feeding ranges of chickadee flocks were determined on the Huyck Preserve and adjoining village of Rensselaerville, the aggregate area of which totals about 500 acres excluding ponds and lakes. Eight more or less distinct flocks occupied this area during the winter of 1940. In the homing experiments birds were transferred from flocks Nos. 1 and 2 located in the village (elev. 1,400 ft.) to the range of flock No. 8 located at Lincoln Pond (elev. 1,620 ft.) $1\frac{1}{2}$ to $1\frac{3}{4}$ miles northwest. While no birds of flocks 1 and 2 were known to come within a mile of the limits of flock range 8 during the winter, presumably the distance was not great enough to require a very marked homing ability of the part of the birds, since at other seasons they often travelled further. Birds of the three flocks were banded with colored bands at least a month previous to the transfer. All birds used in experiments were known to restrict their activity mainly to a range of known boundaries and

to be daily visitors to the trapping-feeding stations at the time of transfer. It is important to know as much as possible of the previous history of individuals. As every bander knows, certain individuals often visit stations once and are not seen again. With chickadees this is often due to the tendency of individuals to wander temporarily out of their feeding range into adjacent areas. If such birds were taken from their temporary range they might return to their customary one and hence escape detection. Only those individuals (which make up the bulk of the chickadee population) exhibiting a high degree of fixation in winter were used for experiments.

The birds were transferred in groups of three to eight, not more than five to a cage. They were captured between 10 and 12 in the morning and released between 1 and 2 in the afternoon. This allowed time for weight recovery in the morning following loss at night, and also gave plenty of time for feeding and acclimation at the place of release. While held captive and during transfer, birds were kept in dark cages to reduce the wastage of energy resulting from fright and struggling. Transfers were made on days when the weather was not abnormally severe. It is important in properly testing homing to release birds in good condition, especially in winter. Small birds such as chickadees are unable to survive even one night at low temperatures unless adequate food is obtained during the day.

Birds were released in flock range 8 at a feeding-trapping station identical in construction and food supply with those in ranges 1 and 2. As far as possible the behavior on release was followed. All birds in experiment 1 (see table I) flew north into the hemlock woods (in a direction opposite to their home range). The locally resident flock was in the vicinity at the time but the new birds were not observed to join them or come to the feeding station. In experiment 2 all three birds flew S. E. (in the direction of the home range) with much calling back and forth, then moved north along a hedgerow and were lost from view. The eight birds in experiment 3 scattered at first, but after much calling consolidated themselves as a flock and moved into the woods. Here they encountered the local flock and four individuals were observed to come to the feeding station in close association with the local birds. All birds in experiment 4 likewise flew north into the woods. The local flock was not present at the time, but 15 minutes later it appeared at the feeding station and with it three of the five released birds. These birds were watched until 5:30 P.M. when it was fairly certain that they went to roost with the local flock at the latter's customary place. Thus, the direction the birds took on release and whether they associated with the local birds was seemingly a matter of chance.

RESULTS

As shown in table I, five out of 21 releases or 19% returned the

following day within less than 24 hours; three additional birds returned within two days, two more within a week. Altogether, twelve birds or 57% were known to return by the time of the break-up of the winter flocks and commencement of breeding activities which took place this year between April 10-20. Seven birds were known to remain at the place of release the first day and two were observed there constantly for a month. Seven birds or 33% disappeared from the release point (one remained five days) but were not found to return. It seems unlikely that these birds perished; probably they wandered off in other directions and perhaps became associated with other flocks. The total of nine birds (see table I) which failed to return during the winter did not subsequently return during the breeding season. One, G-RB, mated with an unbanded bird and nested half a mile north of range 8. The other eight were not found within a one-mile radius covered in a study of breeding chickadees.

Perhaps more interesting is the fact that only two birds (A-YB and A-GR) of the twelve that returned subsequently nested immediately in or near the winter home ranges. Two birds (G-RG and A-BR) nested nearer the point of release than to the winter range. One other (A-RB) was located for the summer a mile away and the others could not be found, probably moving a greater distance.

TABLE I
SUMMARY OF HOMING BEHAVIOR

x = indicates return to the home range and continued occurrence there.
o = indicates observed at the point of release.

Experiment	Individual ¹	Sex ²	Days After Release							End Week	3rd Week	4th Week
			1	2	3	4	5	6	7			
Experiment 1, February 26 from Flock 1	A-G	♂ ^(w)	..	..	..	..	..	..	..	..	..	..
	A-B	♂ ^(w)	..	..	..	..	..	..	..	..	..	..
	A-YG	♀ ^(w)	..	..	..	..	..	..	..	..	..	..
	A-YB	♀	x	x	x	x	x	x	x	x	x	x
	A-GR	♂	x	x	x	x	x	x	x	x	x	x
Experiment 2, March 1, from Flock 2	G-GY	?	..	x	x	x	x	x	x	x	..	..
	G-BI	?	..	..	..	..	..	..	..	..	..	..
	G-BY	?	..	..	..	..	..	..	..	..	x	x
Experiment 3, March 8, from Flock 2	G-RG	♀	o	..	..	x	x	x	x	x	x	x
	G-Y	♂ ^(w)	x	x	x	x	x	x	x	x	x	x
	G-R	?	..	..	..	..	..	..	..	..	..	..
	G-B	?	..	..	..	o	..	o	..	o	o	o
	G-RB	♂	o	..	o	o	..	o	..	o	o	o
	G-BR	♀	o	..	o	..	x	x	x	x	x	x
	G-YR	?	o	..	o	..	o	..	..	..	..	..
G-YB	?	..	..	..	..	..	..	..	..	..	..
Experiment 4, March 12, from Flock 1	A-BR	♂	x	x	x	x	x	x	x	x	x	x
	A-GY	♀ ^(w)	o	x	x	x	x	x	x	x	x	x
	A-RB	♂	x	x	x	x	x	x	x	x	x	x
	A-YBY	♀ ^(w)	o	x	x	x	x	x	x	x	x	x
	A-YB	♀	o	..	x	x	x	x	x	x	x	x

¹Designated by color band combination, i.e., G-RG = green band on one leg and red and green band on the other. A = Aluminum band.

²Sex determined by wing measurements is indicated by (w); otherwise sex determined more certainly by subsequent breeding behavior.

DISCUSSION

Food is certainly an important consideration in winter homing behavior. On release, many of the birds were observed to start feeding immediately. This is understandable since starvation for even two to three hours empties the digestive canal, and nearly continuous feeding is necessary to supply the increased metabolic rate coincident with low temperatures, and particularly to build up reserve energy (as indicated by weight, for instance) for the starvation period at night. No birds were known to return the afternoon of release. Eight birds were known to avail themselves of the feeding station at the point of release. Thus, the first impulse on release was to obtain food. However, the fact that five out of eight birds which were observed to use the abundant food of the feeding station, later deserted this station and returned to the home stations, indicates that food is not the motivating force that brings about return, although an abundant supply of food might suppress the urge to return for longer or shorter periods. Therefore, some of the birds apparently returned to the home area as such and not to a mere supply of food.

The fact that most of the returning birds did not subsequently use the winter area as a breeding territory but moved away varying distances would indicate that there is a definite tendency among some individuals to home to the winter feeding range as such. The case of G-RG was especially interesting. This bird returned to its winter home area (range 2) and was seen constantly there for a month. During April it moved northwest and eventually nested very near range 8 (point of release) mating with a bird which was a winter member of flock 8!

Homing seems to be an individual behavior response in the chickadee and not a flock behavior pattern which is perhaps the most interesting result. Thus, although birds known to be associated together in a flock in the home territory were released in groups and were observed to remain together on release at least for a time, they did not in any case return as a flock. In groups 3 and 4, for instance, some birds were known to return immediately while others from the same flock remained at the point of release for longer or shorter periods.

If homing to a winter range is an individual matter the question arises as to why certain individuals showed such a definite tendency to come back and others apparently little or no tendency. Although the chickadee is conventionally considered to be a permanent resident species there is considerable evidence to indicate that a portion of the population in the northeast is migratory, or at least the population of a given area may show marked seasonal changes (Wallace, 1941; Odum in press). However, the breeding birds seem to be largely resident (Butts, 1931). There is, thus, the possi-

bility that homing may be correlated with the migratory status or the age of the individual. Six out of 11 birds which showed a homing behavior nested in the vicinity (one mile radius) during the subsequent spring and summer, while only one out of 9 birds which failed to home could be found in the same area during the breeding season. These latter individuals might well have been immatures or migrants from distant areas which had no strong attachments for the area of the flock from which they were removed. It is equally possible, however, that some birds had the "urge" to return but were unable to do so because of unfamiliarity with the region. Many more data are needed before a conclusion can be reached on this important point.

In flock 1 the dominance order or "peck order" was known. There was no correlation with return and the position in this "social order." A-B, A-GR, and A-RB were individuals high in the dominance ranking, two of which returned. Likewise, A-YG, A-GY, and A-YBY were low ranking birds, two of which returned. The behavior of released birds when they came in contact with the individuals of local flock 8 was interesting. Released birds which spent the first day at the feeding station with flock 8 were relegated to a low position in the combined flock even though some individuals may have been dominant in their own flocks. The strangers were clearly on the defensive. During the first day no introduced bird was observed to displace a resident bird at the feeding station and nearly all of the resident individuals were observed to displace them. However, there was no attempt to drive the strangers from the vicinity, that is, no group territorial behavior. After several days the three birds which remained (G-B, G-RB, G-YR) were observed to displace some of the resident birds apparently finding their proper level in the combined flock.

The case of A-YB, was interesting since this individual was transported twice and returned both times. Although this individual should have been well acquainted with the route after the first return, it took three days to return the second time and was the slowest of group 4 to return (see table I).

SUMMARY

Twenty-one color-banded chickadees released $1\frac{1}{2}$ to $1\frac{3}{4}$ miles from their winter feeding ranges behaved in three different ways. Twelve or 57% returned (5 or 19% within 24 hours, the rest within a week), 2 were observed constantly at the point of release for a month, one later breeding in the vicinity, and 7 (33%) disappeared from the area where released (one remained 5 days) but did not return and were not seen again in the study area (1 mile radius) even during the following spring and summer.

Thus, return was an individual response and not a flock behavior

pattern, some individuals of a given winter flock showing a strong tendency to return, others no tendency. It is not certain whether this can be correlated with the migratory or seasonal status, or possibly with the age of the individual.

Food does not seem to constitute a stimulus for return since of 8 birds observed to use the feeder at the release point, 5 later deserted this station and returned to home stations. Food, however, may be an important influencing factor.

Return was to a winter area and not a breeding territory since most of the returning birds (all but 2) did not subsequently nest immediately within the winter feeding range. Six of the 12 returning birds, however, were found nesting in the study area, the others were not seen after the breakup of winter flocks.

Many birds, when released, were observed to join the flock residing in the area. The introduced birds were relegated to a low position in the dominance order, at least at first, but the resident birds made no attempt to drive the strangers from the vicinity.

To obtain the most useful data on winter homing in this species the following precautions are stressed: (1) Birds should be banded or marked so that identification is possible without recapture. (2) Close observation at the point of release is as important as at the point of capture. (3) It is desirable to know as much as possible about the previous history of the individual being tested. (4) Birds should not be kept captive any longer than absolutely necessary and should be released in plenty of time for feeding before nightfall. Only birds in good condition can be expected to behave in a normal way.

LITERATURE CITED

- BUTTS, WILBER K. 1931. A Study of the Chickadee and White-breasted Nuthatch by Means of Marked Individuals. II. The Chickadee. *Bird-Banding*, 2: 1-26.
- HILPRECHT, A. 1935. Heimfinderversuche mit Wintervögeln. *Der Vogelzug*, 6: 188-196.
- MAYR, ERNST. 1937. The Homing of Birds. *Bird-Lore*, 39: 5-13.
- ODUM, EUGENE P. (in press) The Annual Cycle of the Black-capped Chickadee. *The Auk*.
- SUMNER, E. L. and J. L. COBB. 1928. Further Experiments in Removing Birds from Places of Banding. *Condor*, 30: 317-319.
- SUMNER, E. L. 1938, "Homing Instinct" in the Golden-crowned Sparrow. *Condor*, 40: 127-128.
- WALLACE, GEORGE J. 1941. Winter Studies of Color-banded Chickadees. *Bird-Banding*, 12: 49-67.
- WENKEL, F. 1935. Verfrachtungen an Sperlingen, Meisen, und Mittelspecht. *Der Vogelzug*, 6: 200-210.
- Biological Research Division, Edmund Niles Huyck Preserve, Rensselaerville, New York.