

RETURNS OF TRANSPLANTED PINE SISKINS RELEASED AS SINGLES OR IN FLOCKS

BY FRITZ L. KNOPF

The adaptive significance of flocking by birds was recently reviewed by Moriarty (1976). Outside the breeding season most birds that flock tend to roost communally also. This observation prompted Ward and Zahavi (1973) to speculate that roosts (and therefore flocks) primarily evolved as a mechanism for individual birds to gain information on the location of ephemerally patchy food resources, and secondarily for other functions such as enhancing predator detection and evasion.

Many biologists have captured, banded, transplanted, and released wild birds at distant sites. Most such efforts were to answer questions about how effectively birds orient toward and return to the capture site (e.g., Graue 1970, Matthews 1963, Mewaldt 1964), while some asked questions of ecological significance (Ralph and Mewaldt 1975, 1976). In 1978 I monitored the returns of experimentally relocated Pine Siskins (*Carduelis pinus*) that had been released as single birds or in a "flock" of 3 as a simple test of the information exchange function of flocking. The Pine Siskin is nomadic in winter, and was chosen specifically for this study to minimize bias attributable to previous experience of birds at a site, and to maximize the contribution of flock-derived input relative to the ability of individuals to return following relocation.

METHODS

I captured 168 Pine Siskins 14-31 January 1978 at a bait station located in a rural oak (*Quercus* spp.) savannah landscape approximately 13 km east of Stillwater, Oklahoma. Each was banded with U.S. Fish and Wildlife Service aluminum bands and transported to a release site. Twenty-four birds were released at each of 7 distance intervals: .5-1.0, 1.5-2.0, 2.5-3.0, 3.5-4.0, 4.5-5.0, 6.5-7.0, and 9.5-10.0 km. Releases were conducted in all compass directions from the capture site, with no more than one release/point/day. All birds were transported in individual-cell holding cages and transferred at the release site to a larger cage on which one entire side was hinged. Twelve birds were released individually (controls) and 12 were released in flocks ($n = 4$) of 3 birds each (treatments). Returns of birds were verified by reading band numbers at a window feeder daily and by recapturing efforts conducted three mornings/week, mid-January through February.

RESULTS

The technique for releasing flocks appeared effective. All 3 birds of flocks exited the release cage almost simultaneously. After release, birds in flocks frequently gave the *chlee-ip* call note (Peterson 1961). I visually followed birds until they disappeared, and never saw a bird leave one of these investigator-created flocks. In contrast, birds released singly did

TABLE 1. Percentage of returning Pine Siskins recorded each week for birds released either as singles or in flocks.

Days	Percentage returning birds	
	Released as singles (n = 41)	Released in flocks (n = 34)
1-7	66	73
8-14	10	12
15-21	16	9
22-28	8	6

not vocalize, and usually flew to a tree within the first 25 m and perched. Flock birds perched on 2 occasions and then only briefly before leaving as a flock.

Some birds returned to the capture site quickly. A single bird released at .5 km was recaptured 30 min later, whereas another single released at 4 km was recaptured in less than 2h. The average (\pm SE) number of days before birds were confirmed to be back at the capture site was 7.98 ± 1.3 days for birds released as singles and 6.71 ± 1.2 days for birds released in flocks. The mean resighting times were not significantly different ($t = .74, P > .05$). Single and flock birds also showed similar return patterns when returns were summarized by week (Table 1).

Of 84 birds released as singles or in flocks, 41 (48.8%) and 34 (40.5%) returned respectively. Although there were no significant differences in returns of the 2 groups at each release distance, single birds did have a higher overall return rate than flock birds (arcsin transformation, $t = 2.17, P < .05$; Sokal and Rohlf 1969:607). Comparison of returns by distance of release indicated that the greater return of singles was due solely to differences within the first 2 release distances (Table 2). The returns of single-released birds were higher at release distances ≤ 2 km. Returns of single-released and flock-released birds were identical (22 of 60, 36.7%) at distances exceeding 2 km.

Fifty percent of all singles and 43% of the flock birds returned from distances of 5 km or less. Return rates were lower for both single ($t = 4.0, P < .05$) and flock ($t = 4.1, P < .05$) birds at release sites exceeding 5 km (Table 2). This pattern held also when I compared the number of flocks returning as represented by the return of at least one individual from a released flock.

DISCUSSION

The Pine Siskin is a "rare winter visitant" in Payne County, Oklahoma (Baumgartner and Howell 1948) becoming extremely abundant in some years (Sutton 1967). No siskins were recorded at my feeder in January-February of 1976, 1977, or 1979. During 1978 siskins were abundant to the point of being considered a "plague" on the southcentral plains

TABLE 2. Number of displaced Pine Siskins returning to the capture site relative to distance of relocation. Also presented are the number of flocks returning (as evidenced by the return of at least one flock member). Twenty-four birds were released at each distance: 12 singly and 12 in flocks ($n = 4$) of 3 birds each.

Distance of release (km)	Individuals		Flocks
	Released singly (%)	Released in flocks (%)	
0.5-1.0	12 (100)	7 (58)	4
1.5-2.0	7 (58)	5 (42)	3
2.5-3.0	6 (50)	4 (33)	3
3.5-4.0	8 (66)	8 (66)	4
4.5-5.0	4 (33)	7 (58)	4
6.5-7.0	2 (17)	2 (17)	2
9.5-10.0	2 (17)	1 (08)	1
Total returning	41 (48.8)	34 (40.5)	21

(Williams 1978:372). From these observations I assumed that, unlike some sparrows (Ralph and Mewaldt 1976), both adult and immature siskins were unfamiliar with the area as a wintering locale. The poor return rates of all birds at distances exceeding 5 km support this assumption.

The best data supporting the information function of flocking behavior have been from an experimental study of captive *Quelea* (DeGroot 1980). Field support (Krebs 1974, and others) has remained inferential. Loman and Tamm (1980) experimentally placed new food resources (carrion) in the vicinity of corvid (*Corvus cornix* and *C. corax*) roosts, and then monitored the response of birds. The number of birds at a site increased during the first day, but not thereafter. The authors attributed the first day increases to the concept of foraging by "local enhancement" (Hinde 1961), a behavioral attraction of a bird to other birds already feeding at a site, and concluded that the information center may be working but is difficult to test.

By my field test I tried to detect whether birds in flocks can share information. I hypothesized no difference in the return rates of individuals released in the treatments (as flocks) and controls (as individuals). Further, I predicted that birds could potentially share information on either their (1) geographic location after displacement in relation to the food source at the capture site, or (2) knowledge of how to find a new food source. Greater returns of individuals released in flocks would support the first prediction, and decreased returns of flock birds, the alternative prediction.

The pattern of returns observed for relocated siskins tends to indicate that flock birds do share information and, because they don't return, are more efficient in finding new food resources. However, simpler explanations are available as all differences between single- and flock-

bird returns occurred within 2 km of the capture site. Single birds may have had a greater tendency to join a flock, and at close release distances the nearest flock to join was more likely at the capture site. Also, the effective range of "local enhancement" foraging may have been 2 km for siskins, and single birds may respond more to the presence of other birds when locating food than birds already in a flock. Based upon the observed return patterns and these alternative explanations, I conclude that there were no real differences in the ability of single and flock birds to return to the known food resource (capture site). I found no indication that flock birds shared information relative to either their geographic location or their combined abilities to locate new food resources.

SUMMARY

Individual Pine Siskins were transplanted and released as singles or in flocks at distances up to 10 km in northcentral Oklahoma. At distances of 2 km or less, birds released as singles returned to the capture site better than birds released in flocks. Single and flock birds returned at identical rates from releases farther than 2 km. Two kilometers appeared to be the effective distance at which siskins were capable of locating either a flock to join or food resources by the concept of "local enhancement." I found no evidence that siskins in flocks were more capable than individual birds in returning to a known food source, or in locating a new resource.

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Department of Zoology, Oklahoma State University, Stillwater, Oklahoma 74074.
Present address: Denver Wildlife Research Center, 1300 Blue Spruce Drive,
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