between either the territories offered by the males or where. The failure of one mating status of the males, and that unattached females remained unpaired after the shooting. In the first half an hour after the shooting took place, and later bred in the experimental area. It is most likely that these birds represent sur-

The results of this experiment provide evidence for the presence of some non-resident females within the study area. It is most likely that these birds represent surplus individuals which are present at the start of the breeding season, and that those females which became mates after the experimental removal of already-paired females had therefore not been paired previously elsewhere.

A close correlation has been found between song activity and several environmental factors (Slagsvold 1977). This study shows that song activity also depends on the mating status of the males, and that unattached females are readily able to assess the status of the males (cf. Krebs 1971, 1977; Krebs et al. 1978). The failure of one of the males to obtain a mate even after the removal of the original female suggests that females can discriminate between either the territories offered by the males or the males themselves (Searcy 1979). As suggested by Emlen & Oring (1977), we believe that polygyny has not evolved in our chaffinch population because defence of the food supply is difficult, as the territory is of only minor importance as a source of food (Saether, unpublished).

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information about an animal's ability to remember spatial locations, at least for short periods of time, is relevant to models of optimal foraging (e.g. Pyke et al. 1977).

Although birds' foraging behaviour has been studied (e.g. Smith 1974; Kamil 1978), to our knowledge experimental assessment of memory capacity for the spatial locations of food has been conducted only for rodents (e.g. Roberts 1979). Consequently, we undertook the present experiment to assess short-term memory for spatial location in one bird species. We tested adult female ring doves (Streptopelia risoria) in a variant of the radial-arm maze (Olton 1979).

Between daily testing sessions the doves were housed individually in stainless-steel cages with ad libitum access to water and granite grit. The birds were maintained at 90% of free-feeding weight by food obtained in the maze and post-testing supplementary feedings. The cylindrical-shaped central area of the maze, constructed of wire mesh, was 82 cm in diameter and 73 cm tall. A mesh screen covered top and bottom. Fourteen cardboard tubes (8 cm in diameter, 14 cm long) served as 'arms' of the maze; these extended through holes cut in the mesh so that the entire length of the tube was external to the central area. The tubes were mounted around the perimeter of the maze forming two parallel levels of seven arms, spaced in such a way that the distance between adjacent arms, both within and between levels, was equal (30 cm). A T-shaped perch was attached to the entrance of each tube; the distal end of each tube contained a food cup mounted in front of a mesh barrier.

At the start of each day's session 0.5 g of budgie mix was placed in the food cup in each tube. Each bird was allowed to make 14 choices (defined as landing on a perch) and was then removed from the maze. The birds were trained for 125 sessions, at which time performance was asymptotic.

The birds flew between perches (birds 1, 2, and 3) or from perch to floor to perch (bird 4) and invariably entered the tube and consumed the food after landing on a perch. The birds generally took about 10 min to make their 14 choices.

A 'correct' choice was defined as selection of a tube containing food: percentage of correct choices for the last 20 days are shown in Fig. 1a. The birds chose more correct tubes than would be expected had choices been random (chance level for a 14-arm maze is 64.5% ; see Spetch & Wilkie 1980). Consequently, tube selection was probably better than chance even on the last 20 days of training. Chance level of correct choice is 64.5%. In both panels, data from individual birds are shown as unconnected points; the group means are shown as connected points.

Two reasons, however, make it unlikely that this factor contributed greatly to the birds' performance in the present study. First, the extended training (over 100 tests) provided ample opportunity for the birds to learn that there was no replacement of food in an arm within a test period. Second, ring doves should be less predisposed to revisit depleted food sites than would, say, an insectivorous species, because their food, seeds, does not move between locations. Moreover, substantial recruitment to the prey population usually occurs only during one period of year; during the rest of the year the food is simply depleted. Accordingly, ring doves are good subjects for studies of memory for spatial location. Comparisons of ring doves with other bird species, particularly those with different diets, in regard to spatial memory tasks would also be of interest.

![Fig. 1. (a) Percentage of correct arm choices during the last 20 days of training. Chance level of correct choice is 64.5%. (b) Transformed probability of a correct arm choice for the second through fourteenth choices. Scores are based on the last 20 days of training. In both panels, data from individual birds are shown as unconnected points; the group means are shown as connected points.](image-url)
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'Territorial Song' as a Flocking Signal in Red-Winged Blackbirds

It has been reported that birds sometimes deliver 'territorial advertisement song' outside of the breeding season (Nottebohm 1975). While several studies have shown that song plays an important role in territorial defence, no functional explanation has yet been proposed for pre- and/or post-breeding-season song behaviour. I have commonly observed adult male red-winged blackbirds (Agelaius phoeniceus) singing at fall and spring roosts, as well as sometimes while feeding in flocks or resting on temporary perches at these times of the year (also see Orians & Christman 1968). Since redwings aggregate in large numbers before and after breeding, I hypothesized that redwing song outside the breeding season may facilitate group formation and cohesion during roosting and foraging. To test this hypothesis I investigated whether post-breeding-season blackbirds were attracted to playback of male territorial song.

During the breeding season, playback of conspecific song to territorial redwings evoked a strongly aggressive response (Brenowitz 1980; in press). Females and juvenile males failed to show any consistent, oriented response to playback. Spectrographic analysis indicates that songs produced by males outside the breeding season are identical to those sung by redwings defending territories. In the present set of experiments conducted in an upland field near Ithaca, N.Y., from 23 August to 8 September 1980, I compared the responses of redwings to playback of full song of a conspecific territorial male with those to presentation of the song of a territorial male song sparrow (Melospiza melodia). The songs of both species were recorded at the study site with a Sennheiser MKII 415TE condenser microphone and a Nagra IV-D recorder at 19 cm/s during the breeding season of 1980.

Preliminary observations indicated that there was a regular flight of redwings, both singly and in groups, over the study site at heights of 30 m or more for about the first 2 h following dawn. After the sun rose above the horizon, playback of either the redwing or sparrow song was initiated, but only when no redwings were visible at the time on the study site or in the air space above. Each signal was played repeatedly at intervals of 3.5 s for 30 min from the Nagra recorder to a Nagra DH speaker-amplifier mounted 1.5 m above the ground at one end of the study field. Maximum root-mean-square sound pressure level of playback for both signals was set at 100 dB 1 m from the speaker, which is equivalent to the pressure level that would result from three redwings each singing at a sound pressure level of 88 dB at 1 m and overlapping in time of song delivery. The mean maximum root-mean-square sound pressure level of 36 songs recorded at the study field from one redwing was 91.3 dB at 1 m (se = 0.21, range = 89-94). Both signals were presented sequentially every day, but order of presentation was reversed each day.

During the 30-min playback period, I recorded the number of redwings that landed on perches within 50 m of the speaker (designated as the census area) and the times of arrival and departure for each individual or group of blackbirds, as well as the sex and age class of each bird. Females, males hatched in 1980, males hatched in 1979 (first year, P > 0.05, Mann-Whitney U test in both cases)...

These data strongly suggest that song outside the breeding season in redwings plays an important role in the...