GROUP FORAGING ACTIVITIES OF LARGE-FOOTED FINCHES

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Abstract: Foraging in species-specific groups should generally lead to reduced foraging success, as conspecifics compete for the same resources. However, many species consistently forage in groups. To help explain this paradox we observed the foraging and movement patterns of Large-footed Finch (*Pezopetes capitalis)* groups in Cerro de la Muerte, Costa Rica. We speculated that foraging in groups is an adaptation to aid foraging success by increasing the efficiency of prey discovery. This would require that resources be aggregated in space, which was supported by temporal aggregation of attacks. The optimal foraging model further predicted that attack rates by individual finches would increase with increasing group size and member proximity, and that groups would be relatively stable. As predicted, attack rate was higher (>2x) in finches within 60 cm of another finch. However, attack rates were not higher in larger groups. This suggests foraging benefits for finches in pairs, but no additional benefits for larger groups. Studies of group composition and movement verified that pairs tended to forage together, and detected 6 of 20 groups that included more than 2 adults.

Keywords: bird behavior, time allocation, social groups, Cuericí, Costa Rica, Cerro de la Muerte, resource aggregation

INTRODUCTION

Foraging in the vicinity of conspecifics should commonly diminish foraging success because of resource competition. Some organisms however, routinely forage in groups. One potential explanation is that the costs of increased competition are compensated by reduced risks of predation due to group vigilance. Grouping may also allow vigilance duties to be shared, allowing individuals within groups more time to forage.

Predation risks aside, there are probably some circumstances under which individuals within groups might acquire prey more efficiently than singletons. This is most likely if prey items are spatially aggregated and if there are emergent benefits from group foraging (e.g., if activities of one individual can flush prey items for a nearby individual).

We studied how grouping behavior affects the foraging of Large-footed Finches in Cerro de la Muerte, Costa Rica. These birds pair-bond throughout the year (Stiles and Skutch 1989), but are also reported to form larger groups. We evaluated three predictions derived from the hypothesis that group foraging by Large-footed Finches is an adaptation to enhance resource acquisition by individuals: (1) prey attack rates should increase with

increasing group size and member proximity; (2) the groups are expected to be reasonably stable while foraging and not just incidental fission-fusion encounters; and (3) prey attack rates will tend to be aggregated in time, indicating that prey are aggregated in space.

Of course, birds could forage in groups for reasons other than to increase foraging efficiency. For example, finches may forage in family groups, as parents tolerate competition from their offspring as a cost of reproduction. Also, pairs may remain together to ensure access to a mate throughout the year (Stiles and Skutch 1989). To evaluate these possibilities we tried to determine whether foraging groups commonly contained more than two adult birds, in which case they could not be family groups.

METHODS

On 1-2 February 2008, we observed 20 groups of *Pezopetes capitalis* near the Cuericí Biological Station in Cerro de la Muerte, Costa Rica. For each group, we recorded group size and recorded prey attack rates for as long as we could remain with the flock. To estimate prey attack rates, we followed a focal individual for as long as we could keep it in sight, continuously recording attacks as they happened. Attacks were defined as visible ground pecks. We recorded the number of attacks in 10 second intervals and scored the bird as being near or far from the nearest other finch (with "near" defined as within 60 cm). The duration of sustained observations on focal individuals ranged from 10 seconds to 8 minutes. When we lost sight of a focal bird, we switched to a different bird in the same flock, starting a new observation bout. When we lost a flock, we searched for a different flock and restarted the procedure.

For analyses, we calculated for each focal individual (n = 54) the average of attacks / 10 sec for all observations where the bird was near to another finch and all observations where the bird was far from the nearest finch. We square-root transformed the data to improve normality, then performed a one-tailed t-test of the hypothesis that attack rates were higher for birds that were near to another bird.

To assess resource dispersion, we performed a randomization test with our longest continuous observation of a focal individual. First we classified each 10-second time interval as 0 or 1 for low attack rates (< median) or high attack rates (> median), giving us a time series with an equal number of 0s and 1s. Then we calculated the frequency distribution of intervals (one or more 10-second periods) between each time of high attack rates and the nearest time of high attack rates. The test statistic was the median time

intervals between periods of high attack rates. We compared this test statistic from the empirical data to a frequency distribution of 10,000 such median intervals calculated with each 10 sec interval being randomly assigned as either high or low attack rates (following from the biological null hypothesis of random encounters of food items through time).

To record home ranges and foraging paths, we tracked nine additional groups using a GPS system during time-spans of 6 to 100 minutes on paths of 10 to 60 meters. We also recorded encounters between groups and the coordinates at which they occurred. We plotted waypoints to mark the beginning and end of sample groups, and used MapSource software to acquire and map the paths of finches.

RESULTS

We observed 20 flocks of between 2, 3, and 4 birds (n = 12, 2, and 4, respectively) for an average of 7 minutes per group. Each flock consisted only of adults (juveniles are easily distinguishable from adults by color and markings); 30% of groups that we observed contained more than 2 foraging adults.

Large-footed Finch attack rates were 2.29 times higher when they were near another finch ($t = 5.34$, $df = 88$, $P < 0.0001$; Fig. 1). Neither attack rate nor proportion of time near another finch were related to group size (Regression $F < 0.42$, $df = 1, 91$, $P > 0.52$). Ten second intervals with high attack frequency were nonrandomly aggregated in time (Fig. 2; $P = 0.0004$ from randomization test).

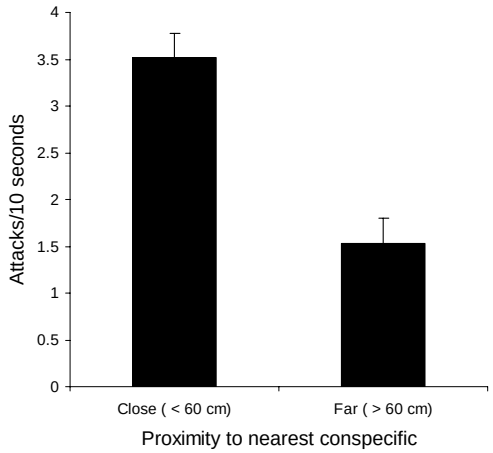

Figure 1. Mean attack rate (± 1 SE) for Large-footed Finch groups when one or more group members were near and far from nearest group member in Cerro de la Muerte, Costa Rica.

We were able to track the movements of nine flocks of Large-footed Finch for 2 to 65 minutes. Based on the GPS tracks (Fig. 3), they had a median foraging path of 30 meters for approximately 17 minutes, giving an average speed of 1.7 meters per minute. Flock movements involved frequent turning, rather than linear progress through the landscape (Fig. 3). Two of 9 group paths directly overlapped.

Our observations showed a surprising inconsistency in the nature of group encounters. Six

aggressive interactions between foraging groups resulted in individuals or pairs relinquishing foraging ground. In contrast, 5 groups merged and foraged together.

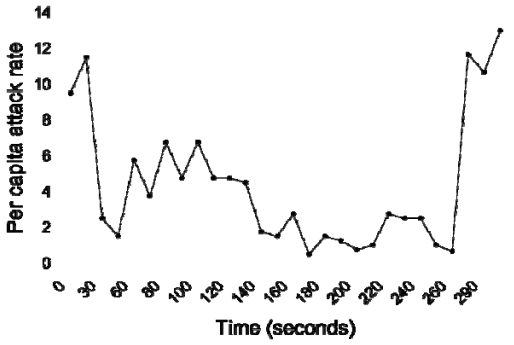

Figure 2. Number of attacks per 10 sec period by a Large-footed Finch that was observed continuously for 290 seconds at Cerro de la Muerte, Costa Rica.

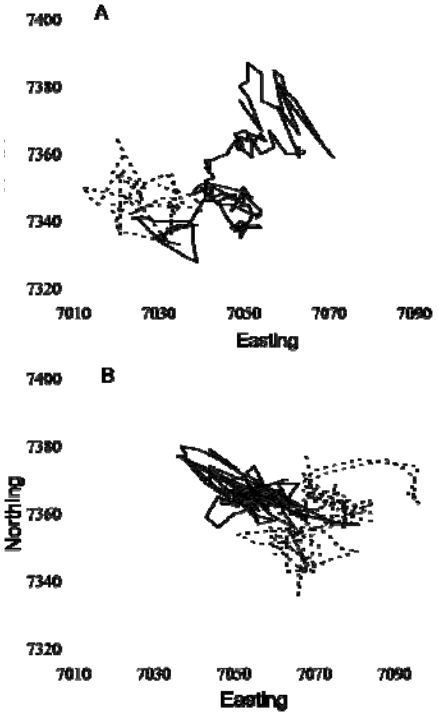

Figure 3. Foraging paths of Large-footed Finch groups at Cerro de la Muerte, Costa Rica. **A** two groups on 1 Feb, 2008; **B** two groups in same area on 2 Feb, 2008.

DISCUSSION

Large-footed Finches employ powerful double-scratches to expose seeds and insects in ground litter (Stiles and Skutch 1989), which may also be exploited by a near neighbor. Attack rates, which are presumably related to resource acquisition rates, averaged more than twice as high for birds that were within 60 cm of a foraging conspecific. This supported the hypothesis of increased foraging efficiency in groups. However, time spent in close proximity did not change with group size. Thus, it is beneficial to forage in a group, but groups of 4 are not obviously better than groups of 2 or 3.

The hypothesis that groups are favored by birds and not just accidental was further supported by our tracking data, which illustrated the stability of finch pairs. Though groups merged and broke apart with considerable fluidity, pairs stayed together throughout. We guess that the stable hunting pairs are also reproductive mates. So it is likely that there are benefits for them being together that go beyond impacts on foraging success.

Groups of all sizes showed aggregation of attacks in time, which indicated an aggregated dispersion of resources in space. This aggregation may also explain variation in the nature of group interactions. Aggregated resources may support larger groups of

finches, and eliminate the need to defend resources. Conversely, foraging in areas of local scarcity could explain the occurrence of aggressive behavior. In these areas, more intense competition for resources could encourage aggression between groups.

Regardless of resources, finches may benefit from being in larger groups if they decrease time spent being vigilant and increase time spent foraging. We did not collect data on predation or vigilance, so cannot support or refute this hypothesis. The possibility that finches form groups based on kinship and parental care is refuted by the absence of juveniles in larger groups, but juveniles might be a part of foraging groups at other times or places.

The erratic paths of finch foraging may increase efficiency of resource location by allowing finches to cover the most ground possible. Our tracking maps indicated that the finches have relatively small home-ranges, suggesting that there is a large arthropod community present in the leaf litter at Cuerici, and that the replacement rate of prey is relatively high.

The high speed of finch foraging suggests that it is efficient for finches to cover more ground rather than to be very thorough in their foraging. This hypothesis is consistent with optimal foraging theory for patchy resources (Fig. 2) that are relatively easy for foragers to move among. It is also supported by the increased foraging success in groups. Apparently, individual finches do not scour prey from within patches of high food abundance. Their relatively small home ranges would be beneficial if they can become familiar with the local spatial patterns of prey availability.

LITERATURE CITED

Stiles, G.F. and A.F. Skutch. 1989. A Guide to the Birds of Costa Rica. Cornell University Press, Ithaca, New York.