EFFECT OF HABITAT ON THE DENSITY AND BEHAVIOR OF JACANAS IN A TROPICAL MARSH

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Abstract. *Jacana spinosa* is an abundant and conspicuous resident of tropical marshes. We quantified the abundance and behavior of a jacana population in Palo Verde, Costa Rica across habitats dominated by: (1) grasses-sedges, (2) water-lilies with considerable open water, and (3) floating mimosa with some open water. Scan samples indicated that jacana density was greater in plots with less open water and more vegetation. Focal samples revealed that rates of aggression and foraging were greatest in the site with intermediate vegetation cover, and were not correlated with bird density. The composition and/or dispersion of vegetation has important effects on jacana density and behavior.

Key Words: effect of density on aggression and foraging, intraspecific aggression, Jacana spinosa

INTRODUCTION

Jacana spinosa is a marsh-dwelling bird that is morphologically adapted to walking, feeding, and breeding on floating aquatic plants (Jenni 1983). Jacanas are abundant in tropical marshes where a variety of habitat types occur in close proximity to each other. Different habitat types often vary in the distribution and abundance of resources that can be used by birds. For example, Cook et al. (1993) found that snail density was significantly higher in heavy macrophyte cover than in open water habitat. It is likely that differences in abundance and types of floating vegetation in the marsh may affect the abundance of resources for jacanas, which will in turn influence their density and behavior.

We hypothesized that different habitat types within the marsh would be occupied by different densities of *J. spinosa*, and that jacana aggression and foraging would differ with jacana density and with habitat type. We predicted that intraspecific aggression would increase with jacana density thereby limiting the time for foraging behavior at high densities.

METHODS

We observed *J. spinosa* populations in three plots of different vegetation composition on the shore of the marsh at the Palo Verde National Park, near the OTS field station, Guanacaste, Costa Rica. Site 1 (3175 m^2) was covered by ~ 90% floating grass-sedge mats and 10% water-lilies *(Nymphea* sp.*)*. Site 2 (1450 m^2) was covered by ~ 65% floating mimosa *(Neptunia plena)* mixed with grass-sedge and water-lilies, 15% water-lilies, 15% grass-sedge, and 5% open water. Site 3 (4345 m^2) was covered by ~ 80% open water with scattered water-lilies and 20% mimosa mixed with water hyacinth *(Eichhornia crassipes)* .

We observed the birds during early morning (8:00 - 9:15) and late morning (10:30-11:45) on 10 - 11 January 1998. Every 15 minutes we scanned each site and counted the number of *J. spinosa* in each plot. Between scans, we conducted focal observations of a haphazardly chosen adult jacana, recording numbers of foraging acts and aggressive intraspecific interactions initiated and received by that focal individual. Twenty scans and at least 17 focal observations were made for each site. We rotated observers across sites to control for observer bias.

We analyzed density, foraging rate, and aggressive interactions with a two-way ANOVA that included site, sampling time, and site x time. Dependent variables satisfied assumptions of normality and homoscedasticity. We used the Tukey's test for multiple comparisons to assess differences between site and time. We used correlations to examine relationships between density, aggressive interactions, and foraging rates.

RESULTS

Jacana density varied among the habitats ($F_{2,54}$ = 43.3, P = 0.0001), with sites 1 and 2 having similar densities, both of which were significantly greater than that in site 3 (Fig. 1). There was no significant effect of time of day on bird density ($F_{1,54}$ = 0.10, P = 0.75), and there was no habitat x time interaction ($F_{2,54}$ = 0.503, P = 0.61).

Foraging rate varied among habitat types ($F_{2,48}$ = 3.24, P = 0.048; Fig. 1), with sites 1 and 2 having higher foraging rates than site 3. There was no effect of time of day on foraging rates ($F_{1,48}$ = 0.03, P = 0.86) and no site x time interaction ($F_{2,48}$ = 2.51, P = 0.09).

Aggressive behavior also varied among habitats ($F_{2,48}$ = 3.88, P = 0.027; Fig. 1). Birds at site 2 had the highest rate of aggressive interactions, especially early in the day. Overall, the rate of aggressive interactions was higher early in the morning ($F_{1,48}$ = 7.41, P = 0.009). Site x time interaction was not significant ($F_{2,48}$ = 1.70, P = 0.19).

Across all observations foraging rate was positively correlated with aggression rate (r = 0.32, P = 0.017), but correlations between density and aggression and between density and foraging frequency were not significant (P > 0.10, N = 54). Analysis within sites revealed no significant correlations among these parameters (all r < 0.60, all p > 0.05).

DISCUSSION

As predicted, sites varying in composition and extent of vegetation cover differed in jacana density , feeding rates, and aggressive behaviors. Jacana density, however, did not appear to determine the variation among sites, as it did not correlate with rates of either foraging or aggressive interactions. Furthermore, aggression did not have the anticipated effect on foraging rate; instead the two behaviors showed a strong positive correlation. This result might be because increasing foraging activity increases contact between birds near territorial boundaries.

Site 3, a primarily open water habitat, had significantly smaller jacana densities probably due to reduced resource abundance or limited suitable foraging sites. Jacanas use floating vegetation as perches, feeding substrates (e.g. for insects and other invertebrates), and food (e.g., water-lily ovules) (Jenni 1983). The

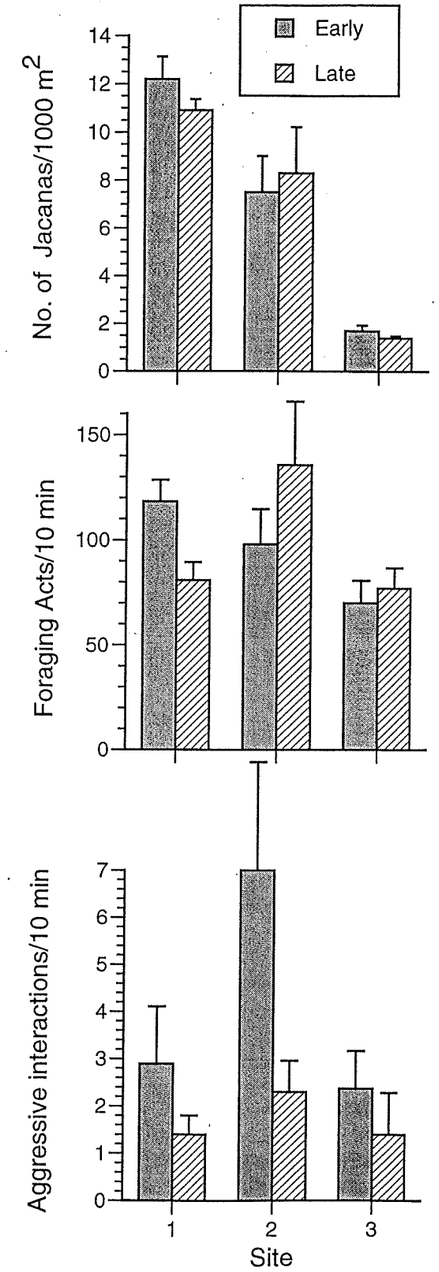

FIG. 1. *J. spinosa* density, foraging and aggressive behavior by site and time of day (mean ± 1 SE).

jacanas in site 3 also foraged at lower rates, suggesting lower food abundance than in other habitats. Thus an open water site with only scattered water-lilies appears to be poor Jacana habitat. Reduced rates of aggression in this site may be a consequence of increased territory size (and therefore reduced interactions) in resource poor habitats.

Sites 1 and 2 differed in the composition but not extent of vegetative cover. Sites 1 and 2 had higher densities of jacanas, and higher foraging rates, than the open water site and appear to represent better jacana habitat. Among these, the mimosa habitat (site 2)Interestingly site 2 had more aggressive interactions among jacanas than the grass-sedge site (site 1), perhaps because of higher "effective densities" (Jackson and Kopplin, 1996) in the mimosa site. Both vegetation and jacanas appeared to be relatively clumped within the mimosa site compared to the grass-sedge site.

Across sites, aggression rates were higher in the early morning than late morning, perhaps because jacanas reassert territories or compete for more valued sites or resources earlier in the morning. While rates of foraging did not differ significantly with time of day, we only measured foraging in morning sessions so we cannot predict how foraging rates might vary across the whole day. Jackson and Kopplin (1996) found that foraging rates varied significantly over the course of the day, and were highest in mid afternoon. It is also questionable to what extent foraging rate is a good measure of prey availability, as a jacana in a resource-poor environment may forage at a greater rate to compensate for the scarcity of prey. Another weakness of our study was the lack of replication of habitat patches within habitat types. Our understanding of jacanas would benefit from studies that include direct measures of prey availability, replication of sites, and the use of marked birds of known sex.

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