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BEHAVIOR OF *JACANA SPINOSA* AS A FUNCTION OF NEIGHBORING DENSITY

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Abstract. We examined whether northern jacana (*Jacana spinosa*) behavior patterns differed depending upon their conspecific density in a tropical marsh. Jacana began each day highly aggregated, but dispersed for the day and remained scattered until night when they reconverged. Preening and eating increased during mid-afternoon while agonistic behavior was highest near dusk. With time of day held constant, scattered jacana (<3 birds/ 2 m2) tended to spend more time feeding and preening, and less time in agonistic behavior than clumped jacana (>3 birds/ 2 m2). There were no significant difference between clumped or scattered jacana for either stationary activities or walking/flying.

Key words: Jacana spinosa, *density-dependent, agonistic behavior, behavioral time budgets*

INTRODUCTION

Preliminary studies (Hourdequin et al. 1996) suggested that the frequency of agonistic behavior in jacana changed throughout the day. At the same time, jacana at Palo Verde tend to be clumped at sunrise and sunset and scattered during the day. Thus, we hypothesized that *J. spinosa* behavior varies over the day as a result of changes in the local density of conspecifics. Specifically, we predicted that (1) agonistic behavior would be higher in clumped jacana due to the close proximity of the birds and overlapping breeding territories; (2) feeding time would be similar between scattered and clumped jacana since feeding takes up the majority of jacana activity; (3) preening and still activities would be higher for scattered jacana since less time is taken up by agonistic behavior; and (4) walking/flying would be higher for clumped individuals because of resource depletion by high density groups.

METHODS

Our sampling protocol was designed to separate the effects of local density and time of day on jacana behavior. We observed jacana behavior on 11-12 January 1996 at the marsh observation tower south of the Estacion Biologica at Palo Verde at sunrise (05:30-06:30), midday (12:30-13:30), and sunset (16:45-17:45). Every five minutes the observer haphazardly chose a bird to follow for a five minute interval using focal animal sampling. Behaviors were classified into five categories: feeding, agonistic interactions, preening, still, and moving. A jacana was considered to be feeding when it was pecking at the ground with or without movement. Aggressive interactions consisted of display, running/flying attack, or fleeing. Preening consisted of bathing or preening. Moving was defined as walking without feeding, or flying without aggression. Jacana not engaged in any other behavior were classified as still. The number of birds within a 1 m2 radius of the focal individual was recorded at 0, 2.5, and 5 minutes. Jacana with an average of more than 3 neighbors were considered to be at a high density, while those with < 3 neighbors at a low density. Data were analyzed using a three-way ANOVA model that included density, time, and day. Afternoon and evening observations were pooled since there were almost no high density jacana in the afternoon (n = 30 over two days) or low density jacana in the evening (n = 30 over two days).

RESULTS

Each evening, the group of ≈ 70 jacana were aggregated within a 0.7 hectare plot, but dispersed shortly after sunrise coincident with an increase in aggressive interactions. Jacana were scattered throughout the marsh in the afternoon, but were aggregated at sunset when jacana activity declined. There were marked differences between clumped and scattered jacanas in the amount of time spent in feeding, preening, and agonistic behaviors (Figure 1; Table 1). Scattered birds spent significantly more time feeding and preening than clumped birds, and significantly less time in agonistic behavior. There were no significant differences between clumped and scattered jacana for

Table 1. Summary from ANOVA's testing for the effects of density, time, and day on jacana behaviors at the Palo Verde National Park, Costa Rica.

Source	df	F Statistics				
		E	A	P	M	S
Time	1	8.30**	5.60*	6.50*	0.33	0.00
Day	1	0.81	2.77	0.16	1.85	0.88
Density	1	4.81*	11.38**	4.59*	0.87	3.22
Time x Day	1	0.70	2.30	0.56	0.73	2.34
Time x Density	1	0.88	12.31***	1.34	0.03	0.50
Day x Density	1	0.06	0.06	0.61	0.23	0.00
Time x Day x Density	1	1.94	0.08	0.03	1.8	2.10
Error	52					

* P < 0.05; ** P < 0.01; ***P < 0.001
E=Eating; A=Agonistic; P=Preening; M=Moving; S=Still

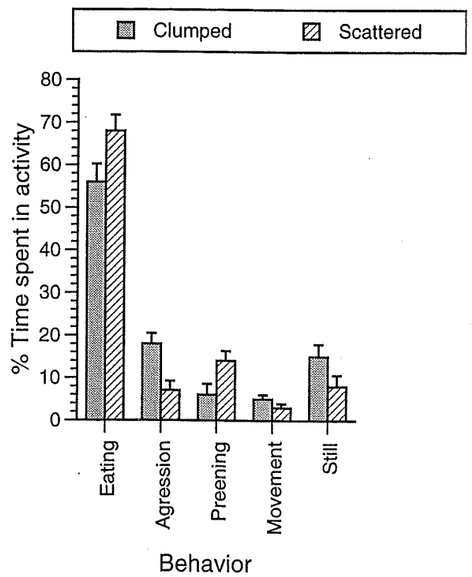

Figure 1. Activity budgets of scattered and clumped northern jacana (mean ± SE, n = 60).

movement or still behavior (Table 1). Eating and preening increased during mid-afternoon while agonistic behavior increased in the evening (Table 1). There was a significant Time x Density interaction for agonistic behavior. In both morning and afternoon, clumped birds spent more time in agonistic behavior than solitary birds, but the difference between clumped and solitary was slightly more in the afternoon(x ± SE = 11.2 ± 1.4 vs. 8.5 ± 1.1% in the morning compared with 41.0 ± 5.3 vs. 32.7 ± 4.3% in the afternoon).

Discussion

Jacana dispersion patterns range from clumped to over-dispersed on a predictable diurnal schedule. As the day progresses, poor foraging sites may cause jacana to disperse and seek out better resource sites. Any clumping behavior during the day may be due to clumped resources, while at night, jacana probably clump for protection.

Agonistic behavior was more prevalent in clumped versus scattered individuals, presumably because of increased likelihood of territory invasion.

Feeding was the most common behavior of jacana. Contrary to our prediction, scattered birds spent more time feeding than clumped birds. Scattered jacana may feed more because less time is consumed by agonistic behaviors.

Preening was most common in solitary birds during the afternoon. This might be because solitary birds, which are partly relieved from agonistic interactions, have more time for preening, or because preening is a low cost activity that can be performed during the hottest time of the day.

We expected that clumped jacana would move around more because at high densities they may clump at high resource sites and thus rapidly deplete resources. In fact, we found no significant difference in stationary activities or movement at the different densities.

Our study focused on jacana behavior during the non-breeding season. It would be useful to compare behavior changes associated with neighboring density

during the breeding season. An examination of variation between sexes could offer further insight into the behavioral dynamics of jacanas.

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