EFFECT OF GALLINULE PRESENCE ON JACANA AGGRESSION

SALLY W. DICKINSON AND DANIELLE L. POULIN

Abstract. Northern Jacanas (*Jacana spinosa*), Purple Gallinules (*Porphyrula martinica*) and Common Gallinules (*Gallinula chloropus*) share the same habitat in Laguna Palo Verde marsh in Guanacaste Province, Costa Rica. Because gallinules sometimes feed upon jacana eggs and young, we predicted that jacanas would become more aggressive towards gallinules as the relative number of gallinules increased. At low jacana abundances, we found that interpecific aggression was positively correlated with gallinule abundances, while at high jacana abundances, interspecific aggression was negatively correlated with gallinule abundance. We also found that intraspecific aggression among jacanas increased with jacana abundance. These findings suggest that at low jacana densities, jacanas respond more often to the presence of gallinules, but at higher jacana densities, jacanas respond more often to conspecifics. It appears that jacanas feel most threatened by gallinules where there are fewer jacanas around. Research during the height of the jacana breeding season would provide further insight into gallinule-jacana interactions.

Key Words: Gallinula chloropus, *interspecific aggression, intraspecific aggression,* Jacana spinosa, *nest predation,* Porphyrula martinica

INTRODUCTION

The Northern Jacana (*Jacana spinosa*), Purple Gallinule (*Porphyrula martinica*) and Common Gallinule (*Gallinula chloropus*) are all abundant within the Palo Verde wetlands. Gallinules are known to eat jacana eggs and young (Stiles and Skutch 1995), and adult jacanas defend chicks against predators such as gallinules by raising their wings in display and vocalizing loudly (Jenni 1983). Jacana aggression towards conspecifics is also common (Stiles and Skutch 1995). Adult male jacanas defend small mating and foraging territories, while adult females defend larger territories that encompass the territories of up to four males. The jacana system is a classic example of polyandrous mating (Jenni 1983).

We studied jacana-gallinule interactions in a tropical marsh in Costa Rica. We hypothesized that gallinules should have more influence on jacana aggression than jacana conspecifics. Four predictions followed from our hypothesis. (1) Interspecific jacana aggression should increase as gallinule abundance increases. (2) When few jacanas are present, interspecific jacana aggression should be more pronounced than when many jacanas are present; Because at low jacana abundance, jacanas will not have to direct much aggression towards conspecifics, they can direct more aggression towards gallinules. (3) Intraspecific jacana aggression should increase as jacana abundance increases. (4) When few gallinules are present, jacanas should direct more aggression intraspecifically than when many gallinules are present. Our study was conducted in a tropical marsh in early January, near the end of the Jacana breeding period (Jenni 1983), so we presumed that territories would still be in effect and that Jacanas would still have some young to defend from Gallinules.

METHODS

Research was conducted in the Laguna Palo Verde marsh in Palo Verde National Park , Guanacaste, Costa Rica on 13 and 14 January 1998. The study site was located at the end of the air strip, west of the OTS field station. It consisted of the fenced-in marsh area extending ~88 m from the shore to a patch of *Thalia*. We visually subdivided the site into four plots (each ~ 40 x 88 m). All plots had similar habitat structure, which was a mix of water hyacinth (*Eichhornia crassipes*), water lilies (*Nymphaea* spp.) and mimosa plants (*Neptunia plena*).

In each plot, we counted the number of jacanas and gallinules, including any juveniles. We then counted the number of aggressive interactions between jacanas and gallinules and among jacana conspecifics during 15 min periods. Attacks, chases and displacements that occurred within the plot were considered aggressive behaviors. We recounted the number of individuals in the plot at the end of each 15 min trial. Each plot was observed in late morning (10:00-12:00) and in early afternoon (13:00-15:00) on both days, yielding a total of 16 observation periods. Data were analyzed using regression models to test for relationships between gallunule and jacana abundances and interactions.

RESULTS

The number of aggressive interactions between jacanas tended to increase with increasing jacana abundance ($F_{1, 14} = 4.57$, $p = 0.050$; fig 1). There was no simple relationship between gallinule abundance and intraspecific jacana aggression ($F_{1, 14} = 0.24$, $p = 0.63$). More complex models including any combination of jacana abundance, gallinule abundance, and their interaction (gallinule abundance X jacana abundance), did not reveal any relationships beyond the simple linear model in Figure 1.

In contrast to the case for intraspecific interactions, there were no simple relationships bettween either jacana abundance or gallinule abundance and frequency of interspecific interactions ($p > 0.30$, $r^2 < 0.07$). However, a more complex response surface that included jacana abundance, gallinule abundance, and their interaction explained 33% of the variation in interspecific interactions (Table 1). The model indicates a very strong interaction between jacana abundance and gallinule abundance. Interspecific interactions increased with increasing gallinule abundance at low jacana abundance (< 6 jacanas), were unaffected by gallinule abundance at intermediate jacana abundace (6-12 jacanas), and actually decreased with increasing gallinule abundance at high jacana abundance (>12 jacanas) (Fig 2).

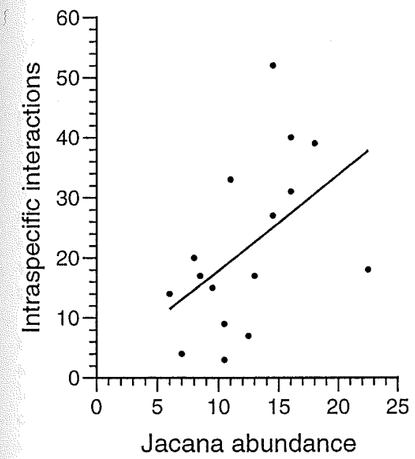

FIG. 1. Number of intraspecific aggressive interactions among jacanas as a function of jacana density: $Y=1.91+1.59X$, $r^2=0.25$.

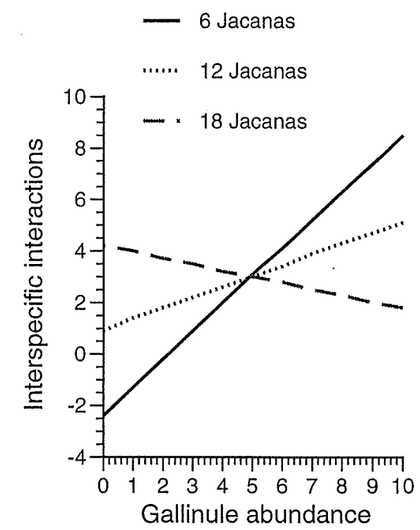

FIG. 2. Interspecific aggression on plots containing small, medium and high numbers of jacanas as gallinule abundance increases (see Table 1).

TABLE 1. Response surface modle describing the effects of gallinule abundance (*Gall*) and jacana abundance (*Jacan*) on frequency of jacana interactions with gallinules (*Y*). Model is of the form: $Y= ß_0 + ß_1*Gall + ß_2*Jacan + ß_3*(Gall*Jacan)$. Table shows estimated coefficients for $ß_0$, $ß_1$, $ß_2$ and $ß_3$ ($r^2 = 0.33$, n = 16). Figure 2 depicts the response surface.

Parameter	Coefficient	SE	P-value
Intercept	-5.66		
Gall	1.75	0.76	0.040
Jacan	0.55	0.29	0.077
Gall*Jacan	-0.111	0.05	0.057

DISCUSSION

As predicted, intraspecific jacana aggression increased with jacana abundance, probably due to competition among conspecifics for food, mating territories, and other resources. At low jacana abuncances, interspecific jacana aggression increased with the number of gallinules, indicating that at low jacana density, gallinules may pose more of a threat to jacanas than other jacanas. However, at high jacana abundances, interspecific jacana aggression decreased with number of gallinules present. There may be a critical number of jacanas where jacana conspecifics become more threatening than gallinules.

Other environmental factors may affect jacana aggression. Ungerer et al. (1998) found that jacana density differs in different types of habitat within the Palo Verde marsh. However, our study was within plot they defined as homogenous habitat. Jacanas were clumped within plots in many of our trials and gallinules were also sometimes clumped. It may be that jacana aggression should be measured in terms of the distance to the nearest gallinule rather than as an average over an entire study area. Perhaps individual jacanas are more aggressive when gallinules are nearby. Time of day can also influence jacana aggression (Hourdequin et al. 1996), but because all of our observations were conducted during the middle of the day, diurnal patterns were not a factor.

Another possibility is that at the time of our study all of the young jacanas were too large to be eaten by gallinules. Jacana and gallinule chicks were seen in the area at the time of our study (R. T. Holmes pers. comm.) which suggests that breeding by these marsh birds is possible early in the dry season. Future studies should be done in the wet season to determine if gallinules pose more of a threat to jacanas then. If so, we would predict higher rates of aggression by jacanas towards gallinules.

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