FACTORS INFLUENCING THE OUTCOME OF BEHAVIORAL ENCOUNTERS IN *CTENOSAURA SIMILIS*

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Abstract: Ctenosaura similis exhibits territorial behavior, often resulting in conflicts between individuals. To assess whether individuals differ in their abilities to compete socially, we examined two factors thought to influence the outcomes of such encounters, body size and role as instigator/non-instigator. The "victor" of encounters was usually the larger individual and also the instigator. The instigator also tended to be the larger individual. Given that the victor of an encounter gains certain benefits (i.e., space or mates), we suggest that these factors may affect the fitness of individuals, and thus have evolutionary significance.

Key words: aggression, dominance, size, social interactions, territoriality

INTRODUCTION

Ctenosaurs (*Ctenosaura similis*), large territorial iguanid lizards, are common in Palo Verde National Park (Fitch and Hackforth-Jones 1983). Ctenosaurs sometimes display similar behavior in territorial and in courtship displays, often involving head-bobbing and species-specific postures (Savage 2002). During initial observations of ctenosaur groups, we witnessed multiple encounters between individuals. To investigate factors that may determine the outcome of these encounters, we tested the hypothesis that individuals differ in their abilities to compete socially. In areas of high ctenosaur density, territories may overlap and a social hierarchy may be established, generally with larger males dominating females and smaller males (Janzen 1983). Sex is difficult to determine in smaller individuals, so rather than differentiating between males and females, we first predicted that larger individuals would win encounters more often than smaller individuals. In many species, once an individual has established a territory, it is rarely ousted (Curtis and Barnes 1983). Based on this idea, we then predicted that non-instigators would win encounters more often, since we assumed that they would be the territory holders.

METHODS

We observed two groups of *C. similis* in Palo Verde National Park, one on the grounds of the Organization for Tropical Studies (OTS) field station and one approximately 1 km away, next to the park headquarters. Groups were observed from 0800 to 1600 on 14 January 2004. Encounters were defined as any observable interaction between two or more individuals. We noted the size and roles of the individuals involved and the outcomes of encounters. For multiple interactions between the same pair of individuals, only the first encounter was included in the analysis to avoid bias. We observed all encounters for their full duration, noting which individual was larger and which was the instigator. The instigator was defined as the individual that approached the stationary non-instigator. The victor was defined as the individual who did not move away from the location of the encounter.

Chi-squared tests were used to determine if the proportion of encounters that larger animals were victorious and the proportion of encounters that the non-instigators were victorious were significantly different from 0.5. In an attempt to differentiate between territorial and courtship behavior, we grouped the encounters

by speed of movement. Fast encounters were defined as encounters which involved running by one or both ctenosaurs. Slow encounters were defined as encounters which did not involve running.

Results

We observed three main types of encounters. A typical fast encounter involved one individual running towards another, with the other fleeing rapidly, sometimes pursued by the first. A second type of encounter, a type of slow encounter, involved an individual moving through an area, resulting in a nearby individual moving slowly away from the area. The third type, also a slow encounter, involved one individual, assumed to be a male, slowly approaching another, assumed to be a female, that would slowly move away, slowly pursued by the first; these encounters sometimes resulted in copulation events.

Overall, larger individuals were the winners more often (11 of 14 observed encounters) than smaller individuals ($c^2 = 4.57$, df = 1, P = 0.03), and the instigator won encounters more often (14 of 17) than the non-instigator ($c^2 = 7.12$, df = 1, P = 0.008). The larger individual was the instigator in every encounter (N = 13). Sample sizes differed since not all encounters involved a size difference or had a clear instigator.

Larger individuals and instigators won all of the fast encounters (N = 6). For slow encounters, the larger individual and the instigator still won more often (5 of 8 and 8 of 11, respectively), although results were not significant ($c^2 = 0.50$, df = 1, P = 0.48, and $c^2 = 2.27$, df = 1, P = 0.13, respectively).

Discussion

Our findings support the hypothesis that there exists a difference in *C. similis* individuals' abilities to compete socially: larger individuals and instigators won more encounters. Larger individuals appeared physically superior to smaller animals and would probably inflict injury upon another individual should actual fighting occur. For smaller individuals, selection may favor those that yield to larger, stronger individuals. Future studies could seek to demonstrate physical superiority of larger individuals, perhaps by assessing injuries afflicted in actual fighting and comparing them between larger and smaller individuals.

Our finding that the instigator would lose the encounter more often than the non-instigator was opposite of our prediction. We assumed that non-instigators would be the territory holders, since they would, by definition, remain stationary. However, this assumption appears to be incorrect, and in fact we guess the instigator was usually the territory holder. We did not consider that an individual may react to another individual in areas beyond its immediate surroundings, but within its presumed territory, and take chase. More needs to be known about the size and temporal stability of territories.

Since we found that the larger individual was always the instigator and also found that the larger individual won encounters more often, by extension, the instigator would win more often. Conflict, and movement in general, is energetically costly. Individuals may minimize activities involving movement, especially aggressive encounters, unless some benefit is gained. Since larger individuals are more likely to be victorious in encounters, they would be more likely than smaller individuals to instigate an encounter.

Victorious individuals must gain some benefit from winning encounters, such as territory, mates, or reduced competition for resources. Therefore, individuals that are large and aggressive, with these two traits probably

being linked, would have higher fitness.

Our results may have been confounded by the combination of mating and non-mating behaviors combined into one data set. In general, encounters classified as slow appeared to be courtship-based, because the two individuals remained in close proximity for long periods of time and several encounters of this type ended in copulation events. The ability to distinguish between sexes would be beneficial to future studies.

Future studies could investigate additional factors that may influence the outcome of encounters, such as health, sex, age, reproductive status, or aggression independent of size. We did not examine the magnitude of size differences. However, two similar-sized individuals may have a greater degree of escalation than two individuals of greatly disparate sizes. Further studies could also seek to confirm assumptions of the costs and benefits of encounters.

LITERATURE CITED

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