Behavioral response of wrens (Troglodytidae) to familiar and unfamiliar predator playbacks

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Abstract

Predator-prey interactions are important for determining fitness, especially including a prey species' ability to distinguish a predator from a non-predator. In this study, I investigated how three wren species: the Plain Wren (*Thryothorus modestus*), the House Wren (*Troglodytes musculus*) and the Rufus-and-white Wren (*Thryothorus rutilus*) respond to familiar and unfamiliar predatory calls. The test subjects responded with higher warning call frequency to the predatory calls than the control ($p<0.05$). Wrens responded to the two predatory birds with similar call frequency, though there were varied responses in approach behavior. The fact that wrens respond to unknown predators similarly to known predators implies that a combination of both genetic inheritance and learning affects predatory birdcall recognition in wrens.

Resumen

Las interacciones depredador-presa son importantes para determinar la supervivencia de las especies, especialmente en la habilidad de las especies para distinguir entre organismos depredadores o no depredadores. En este estudio, investigue la habilidad de tres especies de soterrey: *Thryothorus modestus*, *Troglodytes musculus* y *Thryothorus rutilus* de responder a cantos conocidos y desconocidos para las especies. Encontré que estas especies responden cantando con mas frecuencia a cantos de depredadores que a los cantos de tipo control ($p<0.05$). Las especies de soterreys responden de manera similar a las dos especies de aves depredadoras, sin embargo tuvieron respuestas variadas en el comportamiento de acercarse al estimulo. El hecho de que estas especies respondieron de manera similar a depredadores conocidos y no conocidos puede explicarse a que tanto las características heredadas y los procesos de aprendizaje afectan el reconocimiento de los cantos de los depredadores en los soterreys.

Introduction

Predator-prey interactions have a major influence on species fitness. The ability of a prey species to recognize threats from potential predators and respond accordingly is essential to survival. There is a wide spectrum of defense mechanisms that animals employ to avoid and flee from predators. These behaviors are classified in two groups: the anti-detection, where they are able to hide from their predators and the anti-capture, where they use behaviors to avoid death after being threatened by a predator (Alcock 1984).

Animals must first be able to distinguish an actual predatory threat with various cues, in order to determine when to use defense mechanisms appropriately. Animals' abilities to distinguish these cues have been studied in terms of: visual cues (Waggett 2007), olfactory cues (Zhao et al. 2006), and auditory cues (Johnson et al. 2003). One study in Costa Rica showed that 32 species of birds have the ability to distinguish between threatening and non-threatening species' auditory calls. They responded 75% of the time to raptor calls, while only 10% of the time to a non-threatening species call

(Elahi 2000). Another study has shown how Western American Crows can distinguish between a familiar predator, the Red-Shouldered Hawk calls, and an unfamiliar species, the Madagascar Harrier Hawk calls, with which they have not had previous exposure (Houser and Caffrey 1994). Although, the ability to determine threat is well studied, the actual mechanisms of learning and heredity are often overlooked.

I explored if there were trends in how wrens respond to familiar and unfamiliar predatory calls. I expected wrens to react more strongly to predator calls than a non-predator call, the control, because having the ability to determine an auditory threat would imply higher fitness.

I also questioned if wrens were able to distinguish between familiar and unfamiliar predator calls. Wrens were expected to respond by calling and advancing more in response to an unknown predator. Typically wrens respond to a known predator by giving a few warning calls and then hiding. It is expected that they will respond with less caution to the unfamiliar calls because they have not learned them to be actual threats.

Methods

Study Site and Bird Species

The study took place in the San Luis, Costa Rica. Study sites included Projecto Bella La Finca, the road to the San Luis Research Station, along La Trocha, and Xinia Araya's farm. The three wren species in this study, Plain Wren (*Thryothorus modestus*), the House Wren (*Troglodytes musculus*) and the Rufus-and-white Wren (*Thryothorus rutilus*), are commonly found foraging in this undergrowth of non-forested areas (Garrigues and Dean 2007). Given the nature of the territory preferences of wrens, most of the study sites were thick shrubs or secondary forest edges. The two predator calls used were: the Mottled Owl (*Ciccaba virgata*), which is fairly common in the San Luis area, and the Spectacled Owl (*Pulsatrix perspicillata*), which is not found in the area (Fogden 1993). The control species used was the Great Kiskadee (*Pitangus suophuratus*), common in San Luis, but not a direct threat to wrens (Stiles and Skutch 1989).

Sampling Methods and Analysis

Each wren was watched for two-minutes to determine calling behavior. Each individual was then given the same 18-minute stimuli series: the Mottled Owl for four-minutes, two-minutes of silence, the Great Kiskadee for four-minutes, two-minutes of silence, and then the Spectacled Owl for four-minutes. During each of the three stimuli periods the number of calls were recorded. Wren calls are varied so each call, no matter the type, was counted as equivalent to one call. Whether or not the bird approached the stimuli was also recorded. An approach behavior was if the bird obviously moved toward the stimuli in an investigative manor. The calls used for the stimuli were from the "Birds of Costa Rica" album and played using an iPod with portable JBL iPod speakers. The call response data were then analyzed by using a Friedman's test and the number of wrens that approached were analyzed with a goodness of fit test.

Results

A total of 24 different wren individuals were studied. The wrens were able to differentiate between the owl predator calls and the control (f=12.72, p=0.001, df=2;Fig 1). They responded more frequently in response to the owl calls, and they approached the predator stimuli more often than the control (Fig 2). The wrens approached more often towards the Mottled Owl than the other two stimuli (Fig 2) but had similar responses in call frequency averages (Fig. 1).

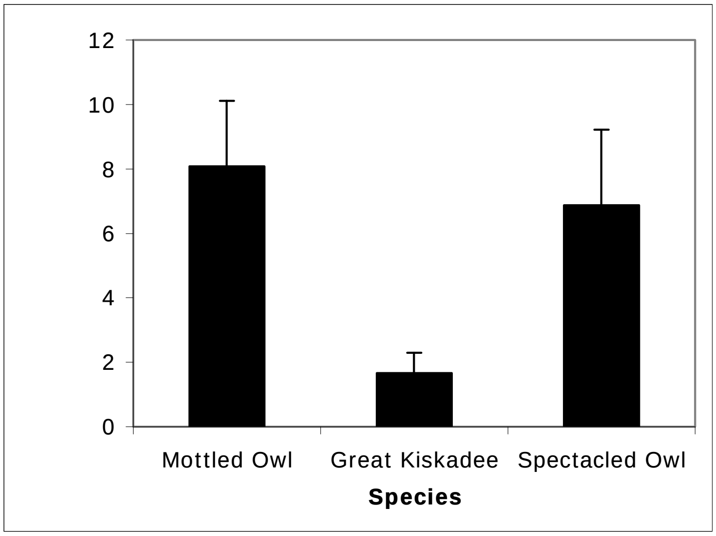

FIGURE 1. Average call response frequency of Troglodytidae family to three stimuli: the familiar predator (Mottled Owl), the control (Great Kiskadee), and the unfamiliar predator Spectacled Owl (f=12.72, p=0.001, df=2).

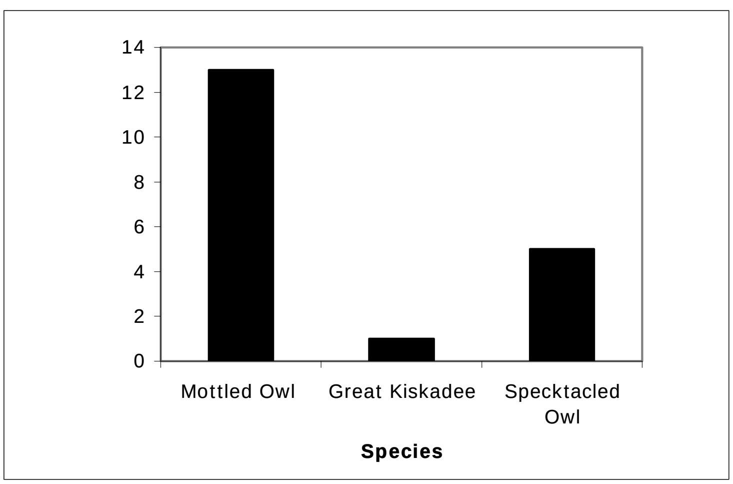

FIGURE 2. Number of Troglodytidae individuals out of a total sample size (n=24) that advanced toward the stimuli during each of the four-minute stimuli play periods (x^2=11.7886, df=2, p=0.0028).

Discussion

Wrens are able to distinguish between predator and non-predator calls, which show that they have the ability to determine whether or not calls are threatening. For this reason, being able to distinguish the difference between birdcalls improves bird fitness (Goth and Hauber 2004); this should also hold true for the ability of a bird to identify predator calls from non-predator calls.

These data also show that there is no difference in response to familiar and unfamiliar predator stimuli. This data could suggest that a combination of factors play into predator-specific recognition in wrens. It is possible that there is a common sound characteristic in both owl calls that wrens interpret as threatening. One study showed that the mechanics of birdcalls of similar species are constrained to a similar vocal range (Podos 2004). The two owls, in my study, are phylogenically similar, and so they may have both inherited a call that is interpreted similarly by wrens. Another study has found that closely related birds have similar neural anatomy that controls the calling function, which would be another reason that owls could sound alike to the wrens (Striedter 1993). Therefore, there may be some similar characteristics, due to mechanics and neural functions, which identify the owls as like-predators. Another possibility is that the interpretation of familiar and unfamiliar owl calls as threatening is innate, given that there was no exposure time to learn the unfamiliar call. A study done on predator-naïve adult Great Tits found that they were able to recognize predators innately (Kullberg and Lind 2002). Although, further research is needed to determine if wrens have the same innate abilities as Great Tits and if these owls have similar call characteristics, it is plausible that wrens have the innate knowledge of what a threatening predator call should sound like.

Furthermore, these results could show that inheritance is important in determining threatening calls based on prey-predator range overlap. The three wrens in this study have population ranges that overlap with the unfamiliar predator. If there is gene flow between each population of wren with and without the presence of that predator, it is possible that the ability to determine the unfamiliar predator as threatening was carried into the San Luis population from another gene pool. Therefore, though the unfamiliar owl is not present in this population, these wrens are still able to identify the call as a potential threat.

The data of the total amount of approaches toward stimuli shows that most wrens approach the familiar predator, less approach the unfamiliar predator, and even less approach the control. This trend does not support the initial prediction, which stated that more wrens would approach the unfamiliar predator call. The explanation for this could be that the perceived threat of the unfamiliar predator call was greater than that of the familiar call. Since these wrens have not learned the consequences of approaching the unfamiliar call, they could be more cautious to approach. It is also possible wrens are willing to approach the familiar predator call more often because they have learned the associated threat of this predator.

Several things may have influenced the accuracy of the data, including the small sample size. In response to the stimulus, wrens exhibited a wide variety of call types, each type being considered equal to the others. A future study should include call type and quantity, which would insure more precise data. Lastly, the three wren species were considered one group and interspecies variation may have caused greater range of results. Studying wren species individually would allow for more accurate species-specific results and behavioral cues.

Further research should include a larger sample size that is based on individual species. More predator calls could also be used to find larger amounts of data. Predator species should be chosen from a variety of families to reveal stronger data. The unfamiliar predator species should have a non-overlapping range as the prey species to eliminate gene flow as a variable in the study.

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