Does nest defense behavior vary with differences in landscape features in four species of shrub-nesting birds?

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Summary

This study focused on if landscape features around the nest affect levels of anti-predator behavior in different shrub-land birds. Adult behavior was recorded on day 7 post-hatch, when chicks were remover as part of another study. The species studied are American Robins (AMRO), Gray Catbirds (GRCA), Northern Cardinals (NOCA) and Brown Thrashers (BRTH). The behavior between the different landscapes of AMROs and GRCAs was not significantly different. This shows that the energy difference is not significant enough to deter protective behavior. However, the NOCAs in less developed areas had a significantly more aggressive behavior. Also, the BRTHs had a significantly higher behavior score in lower percent grassland/shrub-land areas. This may be due to predation risk and perceived quality of the habitat. Variation in their habitat influenced their behavior.

Introduction

Avian reproductive investment can be reflected in the level of nest-defensive behaviors that adult birds exhibit in response to an attempted predation event. Aspects of the nesting habitat may influence parental investment decisions.

Habitat value in each area may change due to predation risk and resource availability. The predation risk in higher developed areas is higher than lower developed areas due to higher amounts of small sized mammalian predators[1]. Also mortality rates are higher in higher developed areas due to automobile and building collision[2] pollutants[3], and disease transmission[4]. Resource availability in higher developed areas are higher due to anthropogenic effects such as bird feeders and ornamental landscapes. This increases their survival especially for overwintering birds[5]

Differences in aggression between species in similar habitats can be due to species diet and species predation risks. Species differ in their food requirements. AMROs, BRTHs, and GRCAs rely heavily on insects while NOCAs rely mostly on seeds. Also, species have different predation risks. In higher developed areas, AMROs and GRCAs have a higher survival rate where as NOCAs have a lower survival rate[6]. The increase in canopy cover in GRCAs and NOCAs had a negative effect on nest survival where canopy cover had no effect on AMROs[6].

Grassland/shrub-land habitat is characterized as a combination of long-stemmed grasses and shrubby vegetation that is presumed to provide high quality nestling habitat for the four focal species.

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Hypothesis

Anti-predator behavior will be different between species of shrub-land birds

If landscape features change then the anti-predator behavior for each species will change.

Methods

From May 5th to July 31st, active shrub-land bird nests were found and monitored at seven locations around Central Illinois. Once located nests were checked every three days until chicks reached seven days of age or the nest failed. On day seven, chicks were removed from the nest as part of another study, and at the time of the first chick removal, adult behavior was recorded. As one person went to collect the nestlings, another person recorded the behavior of the adults. The behavior was categorized by the distance the adult was from the nest (Table 1). We calculated the proportion of the landscape that was developed (human structures) and grassland/shrub-land within 500 meters of the nest using the USDA NRCS geospatial data gateway in GIS.

Behavior Score	Distance Away
6	Touching
5	>1m
4	1-3m
3	3-5m
2	5-10m
1	>10m
0	not present

Table 1. Distance of Bird from nest compared to Behavior Score.

Male Northern Cardinal (NOCA) At Middle Fork River Forest Preserve on July 20, 2015

Gray Catbird (GRCA)

American Robin chick, age 7 days at Kennekuk County Park on May 27, 2015

Statistical Analyses

We ran a Tukey-Kramer test comparing mean aggression scores to examine whether the four species differ in their level of aggression. To assess whether landscape type was related to nest defense, we ran logistic regressions for each species individually. Before doing so, we ran simple linear models to examine whether date and number of chicks in the nest were important variables to include as covariates. We found no support for date, but did find a significant positive effect of number of chicks (P=0.035). We included number of chicks as a covariate in each model, and ran models with proportion of developed habitat within 500m radius of the nest and proportion grassland/shrub-land habitat within a 500m radius of the nest. For species in which landscape features were significant, we ran simple linear regression using behavior as a continuous variable to allow for easy visual interpretation of the results.

Results

A total of 88 nests were observed for this study. Of the 88, there were 26 American Robins, 23 Brown Thrashers, 23 Gray Catbirds, and 16 Northern Cardinals.

We found that BRTHs and GRCAs were significantly more aggressive in defense of their nests than AMROs and NOCAs (Fig. 1).

We found no effect of habitat on the behavior of AMROs ($p>0.23$) or GRCAs, although there was a nonsignificant trend for GRCAs to behave less aggressively in landscapes with higher proportion of grassland/shrub-land ($p=0.06$). For BRTHs we found a significant negative effect of grassland/shrub-land on aggression scores (Chi Sq = 4.92, $p=0.027$), but no effect of developed habitat (Chi Sq = 2.13, $p=0.144$), whereas for NOCAs we found a significant negative effect of proportion developed habitat (Chi Sq = 5.75, $p=0.017$), but no effect of grassland/shrub-land habitat (Chi Sq = 0.52, $p=0.47$).

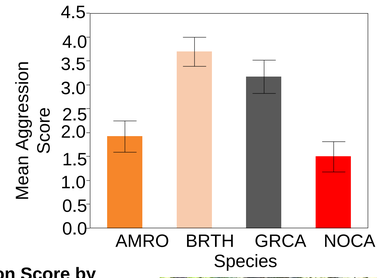

Figure 1. Average aggression scores for AMROs, BRTHs, GRCAs, and NOCAs

NOCA Aggression Score by Proportion Developed Habitat

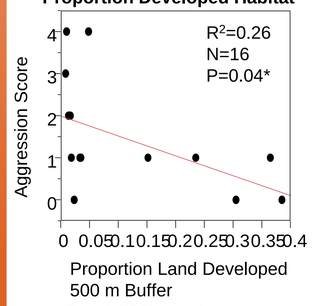

Figure 2. NOCA aggression score by proportion developed habitat

Brown Thrasher (BRTH) at the University of Illinois Pollinatrium on April 26, 2015

American Robin (AMRO)

BRTH Aggression Score by Proportion Grassland/Shrub-land Habitat

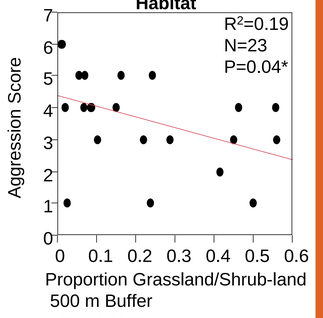

Figure 3. BRTH aggression score by proportion grassland/shrub-land habitat

Discussion

Between Species Differences

AMROs and NOCAs have a significantly lower overall behavior score than GRCAs and BRTHs. These species aggression difference may be due to differences in food requirement or predation risk. BRTH and GRCA nests may be more likely to be depredated by predators that the adults could successfully drive away compared to AMRO and NOCAs. Or it may be that GRCAs and BRTHs have shorter nesting periods, and therefore value each nest more highly than NOCAs and AMROs which have longer nesting periods and are therefore willing to take on greater risk to themselves. BRTH and GRCAs are in the same family (Mimidae) so they may exhibit similar behavior because they are phylogenetically closely related.

Landscape features and nest defense behavior

Previous research has demonstrated that NOCAs in highly developed areas experience higher rates of nest-predation compared to NOCAs nesting in less developed areas[7]. Adult NOCAs in more developed areas may invest less in each nest attempt, and therefore exhibit reduced nest-defensive behaviors compared to NOCAs nesting in less developed areas. In place of nest defense, birds in high proportional developed land may invest more in replacement clutches

Overall, the aggression is based upon the investment in the eggs. NOCAs in lower developed areas put more investment into their current eggs while NOCAs in lesser developed areas put more investment in keeping themselves alive to produce in the future.

BRTH's behavior was significantly higher in low percentage grassland area due to their perceived level of quality of the habitat. BRTHs in these lower quality nestling habitats may have to invest more energy for their offspring to survive. GRCA had an almost significant correlation between high anti-predator behavior and low percentage grassland area. This may be genetically influenced since GRCAs and BRTHs are from the same family.

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