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SHORT COMMUNICATION

Artificial nests predation in an Amazon-Cerrado transition

Predação de ninho artificial em transição de Amazônia e Cerrado

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Abstract

Edge effects in artificial nest predation are the focus of many researches in different scales and landscapes. We conducted an experiment to evaluate whether there is an edge effect on predation rates in forest fragments in the Amazon-Cerrado transition. In addition, we verified whether there is an influence of protected and disturbed areas on nest predation. Within a region where natural landscapes are continuously replaced by agriculture, especially for production of soybean, we found that predation was significantly higher in edge areas than in the fragment core. However, there was no difference in these rates between protected and disturbed sites. With the increasing fragmentation process, and consequently the creation of more edge habitats, several terrestrial bird species might be extinct. We need to understand the factors that are the cause for this edge effect on nest predation in order to develop conservation strategies for threatened species.

Keywords: Amazon Forest, disturbed areas, landscape, conservation areas, soybean matrix.

Resumo

O efeito de borda na predação de ninhos artificiais é o foco de várias pesquisas em diferentes escalas e paisagens. Conduzimos um experimento para avaliar se existe algum efeito da borda na predação em fragmentos florestais na transição entre o Cerrado e Amazônia. Adicionalmente, verificamos se existe alguma diferença neste efeito para áreas protegidas e perturbadas. Em uma região onde a paisagem natural está continuamente sendo transformada em plantações, especialmente a soja, verificamos que a predação de ninhos artificiais é significativamente maior na borda do que no interior do fragmento. No entanto, não houve diferença entre os fragmentos preservado e perturbado. Com o aumento do processo de fragmentação, e com a consequente criação de mais habitats de borda, várias espécies de aves terrestres podem se tornar extintas. É necessário entender os fatores responsáveis por esse efeito de borda na predação de ninhos para que sejam desenvolvidas estratégias de conservação para espécies ameaçadas.

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Palavras-chave: Floresta Amazônica, áreas perturbadas, paisagem, áreas conservadas, cultivo de soja.

Urbanization, cattle herding and agriculture have a key role on habitat fragmentation processes (Duca *et al*., 2001). This fragmentation related directly with an increase in edge areas, which may have diverse implications on biological characteristics of local species. Distribution, reproduction and abundance might change between the edge and interior fragments (Vetter *et al*., 2013), affecting the persistence of several species. The alteration of biotic (e.g., predator-prey cycles) and physical (e.g., microclime) characteristics of the local environment is the main driver of the changes on natural communities in fragment's edges (Murcia, 1995).

Previous studies with invertebrates (Vasconcelos, 1998), amphibians (Marsh and Pearmann, 1997; Schlaepfer and Gavin, 2001), reptiles (Schlaepfer and Gavin, 2001) and birds (Melo and Marini, 1997; Duca *et al*., 2001;

França and Marini, 2009) investigated the existence of an edge effect and its shape in relation to the biotic characteristics of the affected fauna. If an edge effect is present, the comprehension of how a species responds on a local scale is important for the development of conservational efforts that take in consideration the population dynamics in the fragment (França and Marini, 2009).

For birds, the application of artificial nest experiments is common in order to measure reproduction success in different contexts, including edge effects in which one would expect a higher predation rate on eggs nearer the fragment's edge. According to Borges (2008), this effect is based on three mechanisms: (i) The border might have a higher nest density, due to the loss of suitable nesting areas; (ii) a facilitation of nest detection by predators in the edge since a lower plant density in this area; and (iii) the diminished alternative resources available for predators in edges. However, the results of several experimental studies are debatable. Melo and Marini (1997) tested for an effect of fragment size and edge distance on egg predation in forested areas of Central Brazil, finding no relation whatsoever. This was a similar result with that of another study made by França and Marini (2009) in the Cerrado biome, applying the same methods. On the other hand, Tabarelli and Mantovani (1997) found an edge effect on egg predation in Southeastern Brazil, the same conclusion by Marini *et al*. (1995) in Central Brazil.

The habitat integrity can affect the dynamic of predator/prey, causing high values of predation in disturbed areas. Sorace and Gustin (2009) reported a paradox in predation dynamics for disturbed and conserved areas. In disturbed areas, the homogenization process of the habitat and the reduction in number of specialist species can create a safe zone for many generalist species (Gering and Blair, 1999). On the other hand, the facility in access to food and territory can attract many predators to the disturbed areas (Chance and Walsh, 2006).

Therefore, this present study tested the hypothesis that (i) there is a higher predation rates near the border than on the fragment's core, and (ii) nest predation is higher in a disturbed area than on a protected region.

We conducted this study on an experimental area, with a total area of 100 ha, located in the *Tanguro* farm, at the municipality of Querência, Mato Grosso State, Brazil (Figure 1). For the study, we divided this area into two smaller experimental sites with 50 ha each, adjacent one to another, effectively considering each half of the total area as a different site. The outermost limits of the sites are at coordinates 13°05'01"S, 13°04'52" W; 13°05'02"S, 52°22'47"W; 13°04'26"S, 52°22'47"W and 13°04'28"S, 52°23'43"W. This region is part of a long-term study conducted by the Amazon Research

Figure 1. Location of the Tanguro farm in the state of Mato Grosso, Central Brazil.

Institute (*Instituto de Pesquisa Amazônica* – IPAM). The main vegetation formation in the study area is a Cerrado/Amazon transition forest with predominance of trees and lianas species (Balch *et al.*, 2011). The vegetation contains relatively low floristic diversity, showing an accentuated dominance of just nine species of trees (Brando *et al.*, 2012; Silvério *et al.*, 2013).

These sites are located next to a soybean plantation matrix. The first one is a preserved transitional forest with nearly no human disturbances. The second site is a disturbance-controlled site, subject to annual fires with human control since 2004, which allowed us to capture the effect of fire in this work.

This study was conducted in September, 2012, during an expedition to the Tanguro farm. We built 60 artificial nests from leaves and small branches located in the study area. The nests were made in order to mimic local ground-dwelling bird nests and were installed in the ground, next to the trees. In each artificial nest we placed three common quail, *Coturnix coturnix* (Linnaeus, 1758), eggs. The low cost and high market availability makes quail eggs perfect for this type of study.

In each of the two areas, we used 30 nests and 90 eggs. We created three transections, with 10 nests each, at different edge distance to verify the existence of an edge effect: an edge transect (0 m), an intermediary (100 m) and an interior one (250 m). All nests were spaced by 20 m from one to another. In each nest point, a red strip was put in a near tree, to facilitate our future nest detection, avoiding any counting errors. After four days, all nests were checked. We considered as a predation any damaged and/or missing eggs.

We considered each nest on each transect as a sample point. If a nest had any sign of predation we registered as “1” and, if not, as “0”. This produced a data frame consisted of ten points of presence or absence of predation for each transect.

We applied a Generalized Linear Model (GLM) to search for any difference in predation events between different distances and the two sites. For edge effects, we conducted the analysis using the sum of the results of both sites, thus increasing the sample and reliability of the test. For fragment type differences in predation, likewise, we grouped together all records from each fragment, not considering edge distance. We also tested for an interaction effect between these two variables when analyzed together.

We choose a Binomial Family Link for the analysis because the nature of the data is binary (0 or 1), so it is appropriate for this type of link. All analyses were performed in program R (R Development Core Team, 2014).

There were a total of 14 preyed nests. Eight nests were preyed in the preserved site (five in the edge and three in the core), and six in the disturbed site (three in the edge and two in the core).

We found a significant difference between the edge and the fragment core, indicating an edge effect ($F1=4.45$; $p=0.03$), with more nests preyed in edge fragments. No significant difference in bird egg predation was detected between the preserved and disturbed sites ($F1=1.63$; $p=0.20$). Likewise, there was no detectable interaction between the two variables ($F1=0.075$; $p=0.97$), suggesting that the edge effect holds the same form independently from the fragment type, and that the fragment had no influence in predation regardless of edge distance.

This study detected an edge effect in nest predation in the sampling area, without, however, any difference between the two study sites. A comprehensive review on edge effect conducted by Lahti (2001) found that, in 55 different studies, only 13 showed a significant edge effect on nest predation. The author points out that the main difference between these studies is the landscape context in which the fragments are inserted, with a higher probability of edge effects in nest predation occurring in disturbed and fragmented landscapes than in preserved ones. Here we find a greater number of nests preyed upon on the preserved site, rather than in the disturbed area, even though we found no significant difference between the two sampling sites, contrary to the results observed previously by Lahti (2001). However, we also consider that the absence of significant difference in predation between the preserved and disturbed may be related to the duration of the experiment.

We, however, found an edge effect for both sites. This might be due to an improved predator’s success in fragmented landscapes. As mentioned before, predators might have an facilitation of nest detection near the open edges in relation to the dense interior, and since the dynamics of other food sources might be compromised (Batalha and Martins, 2004), predators might create a specific search image (Tinbergen, 1960), facilitating nest detection.

The type of the matrix in which the fragment is inserted might also play an important role (Sandström, 1991; Donovan *et al.*, 1997; Bayne and Hobson, 2002). Agricultural lands should have a smaller edge effect, since alternative resources are available (Poulin and Villard, 2011). However, soybean plantations may attract several rodent species, which in turn increases the presence of rodent predators. These predators might prey on bird eggs near the edges of a fragment, creating the edge effect. The top-down regulation of nest predators are also affected in disturbed landscapes, since larger predators are more sensible to habitat change, increasing the density of their prey species – mostly nest predators (Schneider, 2001).

The correct detection of the causes of an edge effect in a determined area is essential for birds’ conservation efforts in fragmented areas, since nest predation is a key factor in regulating birds' population densities (Lahti, 2001). The increasing transformation of natural habitats to agricultural lands and its inherent fragmentation processes creates more edge habitats in disturbed landscapes. This may contribute for a change on population dynamics of many terrestrial birds, as seen in this study, driving some species to extinction. Experimental studies, that manipulate factors that might be the cause of edge effects, are needed in order to develop new strategies and conservation efforts for threatened species in fragmented habitats.

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