Analytic Summary of a Peer Reviewed IMRAD Article

Article: Light and thermal niches of ground-foraging Amazonian insectivorous birds

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Introduction

This study focused on insectivorous birds in the Amazon rainforest. Most birds in the tropics are insectivores, a group that is highly sensitive to disturbance and that can be used to indicate change in rainforests. Ground foraging (terrestrial) species are some of the most sensitive to disturbance. The aim of this study was to investigate why these species go extinct in damaged rainforests. Specifically, the microhabitat hypothesis was explored as an explanation for the decline of these birds. The microclimate hypothesis states that small forest patches become too hot, bright, and dry when they become isolated, creating an intolerable environment for specialized bird species. This hypothesis has gained attention recently due to declines in the populations of terrestrial insectivorous bird species in both degraded and intact forests. Climate change is causing the Amazon rainforest to becoming hotter, brighter, and drier, potentially driving these bird populations to become increasingly vulnerable. Previous studies have shown that insectivorous birds respond to changing microclimates by moving out of intolerable microclimates. However, it is not certain how vulnerable insectivorous birds are to changes in microclimates and where these birds are found under the changing climate regime. The researchers hypothesized that insectivorous bird species will avoid bright, warm conditions and instead occupy low-light and low-temperature niches. They also hypothesized that these light and thermal niches will be partitioned among insectivorous bird species. Lastly, they hypothesized that the most vulnerable species will prefer the coolest and dimmest microclimate.

Methods

The study was performed between 2017 and 2019 in the central Amazon rain forest in Brazil. This rainforest consists of layered canopy with open understory. The Amazon is both hot and humid year-round, and the climate cycle consists of a wet season and a dry season. In order to perform the study, the researchers selected 10 species of insectivorous birds to capture and tag. Target-netting was used to capture individual birds. The birds were captured during the dry season each year. When a bird was captured, it was immediately measured and tagged. Body temperature was also measured. When a bird was first captured, a microclimate logger was attached to the bird that measured light intensity every 5 minutes and temperature every 15 minutes. Forest loggers were also placed in a range of areas throughout the forest. Later, the loggers were recovered, and light and temperature data were analyzed.

Results

The terrestrial insectivorous birds were found to mainly inhabit dim niches. The thermal and brightness niches did appear to be partitioned between the species. However, changes in light and temperature did not seem to correlate to the abundance trends of the species. The species with the lowest populations, or the most vulnerable species, did not appear to necessarily prefer the coolest and dimmest microclimates.

Discussion

The hypotheses that insectivorous bird species would live in low-light and low-temperature niches and that these light and thermal niches would be partitioned among insectivorous bird species were supported. However, the hypothesis that the most vulnerable species would prefer the coolest and dimmest microclimate was not supported.

These results were interpreted as a selection for low light and low temperature microhabitats as well as small-scale habitat partitioning. Light was determined to be a crucial environmental factor that can structure avian niche partitioning. The results for temperature were more complex, but still relatively partitioned among the species. The least sensitive species of the 10 bird species also occupied a high temperature niche. The physiological ability of this species to withstand high temperatures may contribute to its tolerance for forest fragmentation.

Birds were assumed to perform active cooling by bathing in the late afternoon, potentially as a method of behavioral thermoregulation. Reduced opportunities for bathing could impact their populations as the increasingly hot dry season reduces bathing opportunities in the future.

In regard to the unsupported hypothesis that vulnerable species will inhabit cool, dim niches, only one species followed the expectation that its high vulnerability would lead to selection for dim, cool niches. Since only one species displayed this expectation, there was not enough evidence to conclude that vulnerable species would prefer this type of niche space.

These results were considered to be evidence for the microclimate hypothesis as an explanation for the loss of terrestrial insectivorous birds in degraded habitats. Climate change may cause these birds to become increasingly vulnerable to extinction in both degraded and intact habitats.

Article Analysis

Is the topic of the paper somewhat original?

The topic of the paper is relatively original. There have been previous studies on this topic in different countries, but several of them have results that conflict with the microclimate hypothesis. Based on the previous studies, it appears that there is a lot of variation between species and locality in terms of microhabitat tolerance. When this study was conducted, the microhabitat hypothesis was already relatively controversial, so the results of this study add to the support for the hypothesis without necessarily fully confirming it as the explanation for the loss of bird species.

Is one of the authors a statistician, or is a statistician's contribution acknowledged?

None of the four listed authors are statisticians. All of them are in the fields of ecology or conservation biology. However, statistics is generally a critical aspect of ecology that is taught with experience in the field. Two of the authors are graduate students with several papers published each. The last listed author is a highly experienced professor in conservation biology at Louisiana State University who appears to have many years of experience with both statistics and visualizing data.

What was the aim of the study? What hypothesis did the researchers test? Are the conclusions reached (assuming they are valid) important to you and others (explain)?

The aim of the study was to investigate the microclimate hypothesis as an explanation for the loss of terrestrial insectivorous bird species in rainforests. The researchers hypothesized that insectivorous bird species would avoid bright, warm conditions and instead occupy low-light and

low-temperature niches. They also hypothesized that these light and thermal niches would be partitioned among insectivorous bird species. Lastly, they hypothesized that the most vulnerable species would prefer the coolest and dimmest microclimate. While the conclusions do not support all three hypotheses, they do still support the microclimate hypothesis. These results are important to the field of ecology, climate change science, and conservation biology because they provide further evidence that climate change can negatively impact vulnerable species in both degraded and intact habitats.

Were enough data obtained to reach valid conclusions?

There was significant data to reach the conclusions that the paper made. Out of the birds tagged, all species had between four and thirteen individuals, except for one species that only had one tagged individual. For avian research, this is a reasonable amount of birds to tag and collect data from. It can be incredibly difficult to catch birds, especially cryptic species with low population numbers. However, it could be argued that the species with only one bird should have been disregarded, as data from one individual is not sufficient to make generalizations about an entire species.

Are the results plausible?

The results of this study are plausible. Birds can be highly sensitive, especially insectivorous birds that are small and vulnerable to stress and predation. It may be difficult to attribute the results entirely to microclimate, as there are many potential confounding variables that could also influence these species preference for dim, cool niches. For example, the birds may prefer dim areas due to a decreased risk of predation by being less visible to predators. The microhabitat

niche partitioning does appear to be driven by light and temperature conditions, which is also a reasonable conclusion as competitive interactions between species will generally result in reduced niche overlap.

Have the authors discussed possible limitations of the study?

The limitations of the study were discussed. Limitations in the ability of temperature loggers were addressed, as the data used to calculate temperature included both raw temperature from the tagged loggers on the birds, air temperature on the forest floor, and species-specific body temperature. This method of temperature logging may not be the most accurate measurement of the microhabitat the birds are occupying at a given time. The other main limitation of the study was the relatively low numbers of tagged individuals for several species.

Do the study's findings have practical importance, regardless of whether they have statistical significance?

Yes, this study does have practical importance. The support for the microclimate hypothesis will add to the growing base of literature documenting the effects of climate change on species loss. This study will be crucial for any future conservation of terrestrial insectivorous bird species and may serve as further argument against habitat degradation in areas where vulnerable species reside.