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BL403: Ecology Lab
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Assessment of Bird Diversity in the Andes of Peru at Low and High Elevations

Introduction

There are many factors that influence the biodiversity of a given region. This includes the abiotic factors of the area, such as temperature and elevation, as well as interactions between the various biotic factors (Wardle, 2006; Marins et al. 2016). Some areas of the world are known as biodiversity hotspots because the abiotic and biotic factors contribute to a high level of biodiversity (Convertino et al. 2015).

One of these biodiversity hotspots is the Andes Mountain Range in South America. The plant diversity and the diversity of vertebrates and invertebrates in the Andes are all very high, which is why it is considered a hotspot (Kattan et al., 2004; Pennington et al., 2010; Lourenço & Ythier, 2013; Lujan et al., 2013; Novillo & Ojeda, 2014).

Even though the Andes is known as a biodiversity hotspot, I would like to know how abiotic factors influence biodiversity in the Andes, specifically elevation. The question that I would like to answer is, "Is the diversity of bird species in the Andes of Peru different between areas of high elevation and areas of low elevation?" I am going to use bird census data from Oswald et al., 2015 taken from the Dryad Digital Repository to assess bird diversity at low and high elevations. My hypothesis is that there will be a higher diversity in the lower elevation area because the conditions at higher elevations aren't suitable for as many species as the conditions at lower elevations. I created a rarefaction curve and calculated the Chao1 index to estimate the species richness of both areas and compare them.

Methods

The census data in this study were collected on each side of the Andes in Peru, specifically in four dry forest areas: two areas in the Tumbesian dry forest and two areas in the Marañón Valley. They took point counts of the bird species along the elevational gradient, but excluded the area above 2500 m due to a difference in vegetation that occurs at that altitude. They completed a total of 411 point counts, and they were taken at least 200 m apart and lasted for ten minutes, and they included birds in their visual and auditory field (Oswald et al., 2015).

To classify species, they used the classification from Remsen et al., 2015. They also took data about the latitude and longitude and environment type, but I will only be using the species abundances as it relates to elevation to examine biodiversity. I separated the data in Excel first by the Remsen et al. classification of the species and then by the elevation in which they were found. I considered elevations of less than 1000m to be "low elevation" and elevations greater than 1000m to be "high elevation". I calculated the abundances of each species for each category and entered that data into EcoSim. I used EcoSim to run 1000 simulations and generate the data for my rarefaction curve. I used Excel to plot the data. In addition to the rarefaction curve, I used the Chao1 Index to estimate the total species richness of each area to see if there was a difference between the two elevations.

Results

The observed species richness in the low elevation area was higher than the observed species richness in the high elevation area (Table 1). Even though the shapes of the rarefaction curves for the low and high elevation areas are similar (Figure 1), it shows that the data taken from the high elevation site do not fall within the 95% confidence interval for the low elevation site. The Chao1 estimator for the low elevation site gave a total species richness estimate of 233.2 and a total species richness estimate of 190.6 for the high elevation site (Table 1).

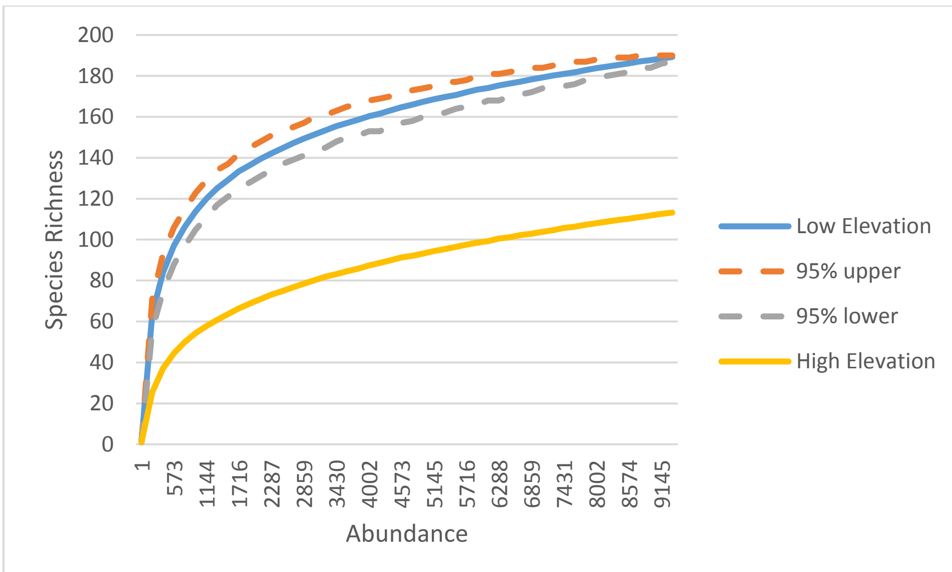

Figure 1. Richness of bird species in Peru at low elevations (<1000m) and high elevations (>1000m). The dashed lines represent the 95% confidence interval for the low elevation data.

Table 1. Data used to calculate the Chao1 estimate for the low elevation and high elevation areas.

	Species observed	Number of singlets	Number of doublets	Chao1 estimate
Low elevation	190	36	15	233.2
High elevation	114	35	8	190.6

Discussion

The results supported my hypothesis because they were in the same direction as my hypothesis. The observed species richness for the low elevation site was higher than the high elevation site, and the rarefaction curve showed that the low elevation site had an overall higher diversity than the high elevation site. The estimates given by the Chao1 estimator also show that the low elevation site has a higher estimated species richness than the high elevation site. Both results support the idea that there is a higher bird diversity in the low elevation area than the high elevation area.

These results are congruous with other studies done about bird diversity along elevational gradients. Species richness of birds is known to decrease as elevation increases (Dehling et al., 2014; Katuwal et al., 2016). This could be because plant diversity also is influenced by elevation, and less plants available to the birds would lead to a lower diversity of birds, or it could be due to abiotic factors such as the temperature change between low and high elevations or geographical barriers.

In this study, it appears that the main driver of the difference in biodiversity is the abiotic factors. However, this study specifically is limited to areas of the Andes in Peru and it is unclear if this same pattern can be seen across the entire mountain range. Additionally, it would be interesting to know if other global biodiversity hotspots have the same elevation-bird diversity relationship. Regardless of the mechanism for this difference, it appears that an elevational gradient does influence the diversity of bird species across environmentally disparate regions.

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