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CLIMATIC DRIVERS OF SPATIO-TEMPORAL VARIATION IN PLANT COMMUNITIES IN HIGH-ANDEAN ECOSYSTEMS OF AYACUCHO AND HUANCAVELICA, PERU

HECTOR CHUQUILLANQUI [(1)], FIORELLA EDUARDO-PALOMINO[(2)] & REYNALDO LINARES-PALOMINO[(3]

[(1,3)] Smithsonian Conservation Biology Institute, Lima, Peru, hchuquillanqui@gmail.com
[(2)] Agricola ARZU, Puno, Peru.

ABSTRACT

Ecologists have explored the relationship between climate and vegetation at several spatial scales for decades. Ecosystems subjected to extreme climatic events (e.g. droughts), may experience strong changes in response to seasonality and environmental gradients, modifying the relative effects of climatic variables. In mountain ecosystems, such relationships had received less attention in comparison with other tropical biomes. Here we assessed how spatio-temporal variation in community composition correlates with climatic variables along a ~200 km transect in high-Andean ecosystems of Ayacucho and Huancavelica. We aimed to determine how climate shape plant grassland communities between 3800 – 4500 m a.s.l, as part of the Biodiversity Monitoring and Assessment Program (BMAP). We used species composition data from 10 sites with annual records of plant cover from 2013 to 2016. We extracted monthly precipitation and temperature records from "Peruvian Interpolated data of the SENAMHI's Climatological and hydrological Observations" (PISCO), and derived 20 variables based on precipitation, potential evapotranspiration (PET) and temperature for each site and year. In addition, we gathered soil data from four 10 cm depth samples at each site. We performed a multivariate constrained model, through Redundancy Analysis (RDA), with climate and soil data to determine the best explanatory variables. To avoid collinearity we checked for Variance Inflation Factor (VIF) and developed a model selection procedure to find the most parsimonious models. Finally we build a global model with selected variables and performed a Variance partitioning analysis to assess the contribution of climate and soil components. We found a major contribution of temperature and precipitation, explaining 21% and 14% of the variance, respectively. Precipitation variables that accounted for seasonality where retained in the RDA with 4% to 8% of explained variance. Variables of PET explained between 6% and 9% of the variance, while temperature explained between 3% to 12%. Soil variables accounted 25% of variance, with variables ranging from 3% to 8%. Variance partitioning showed that climate variables accounted for 21% of explained variance, while soil 8%. Together, soil and climate explained 36% of plant composition changes. Our results show how climate variability, coupled with substrate characterization, correlates with plant communities changes across the Andes. Moreover, we highlight the relevance of seasonality to explain those changes, which in turn can improve the predictability of vegetation changes and address potential impacts due to "El Niño" or extreme cold events in high-Andean ecosystems.

Keywords: Andes, vegetation, species turnover, climatic gradient.