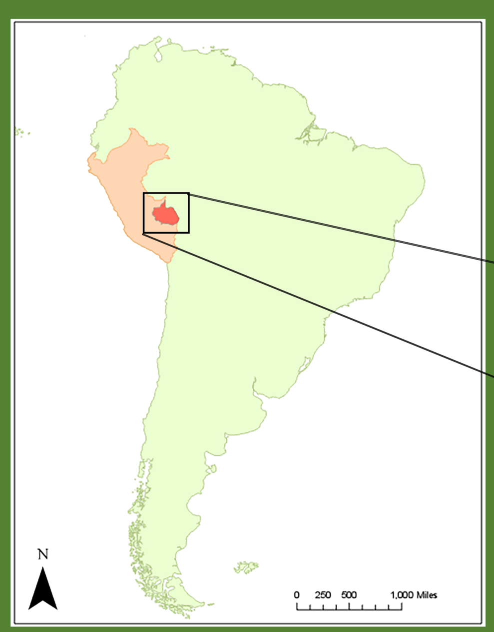
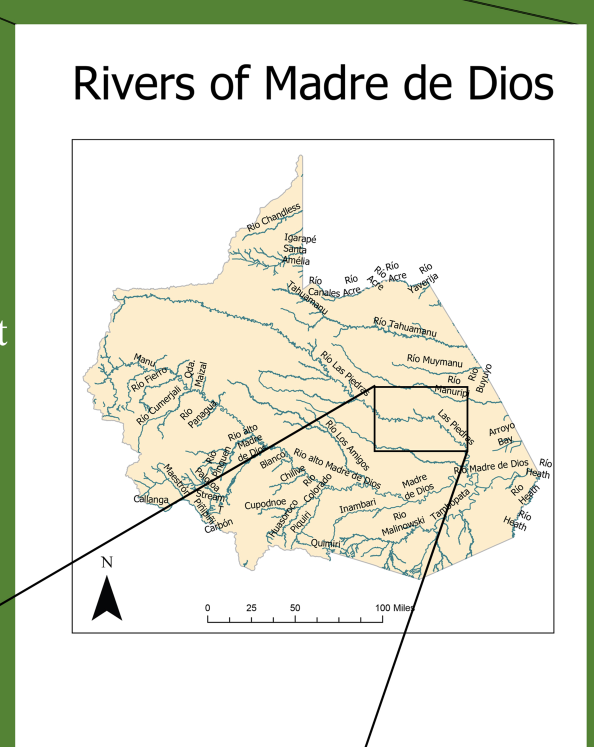
Bertholletia excelsa show seasonal growth rings, enabling dendrochronological analysis correlating growth rate with climatic events

Figure 1. High-resolution scan of Brazil nut tree core (Bertholletia excelsa). Bark (left) to pith (right), shows the pattern of seasonal precipitation “rings” from wet to dry season. The black area shows the “start” of the year when the tree begins putting on secondary growth, beginning sometime in November-December when precipitation is high, and the orange area shows the “end” of the year when the tree greatly slows its secondary growth, occurring sometime in April-May when precipitation is low.



Map 1. Locator map of South America, Peru, and the Department of Madre de Dios



Map 2. Map of the Department of Madre de Dios and its rivers

Map 3. Las Piedras River map and study sites for *Bertholletia excelsa*

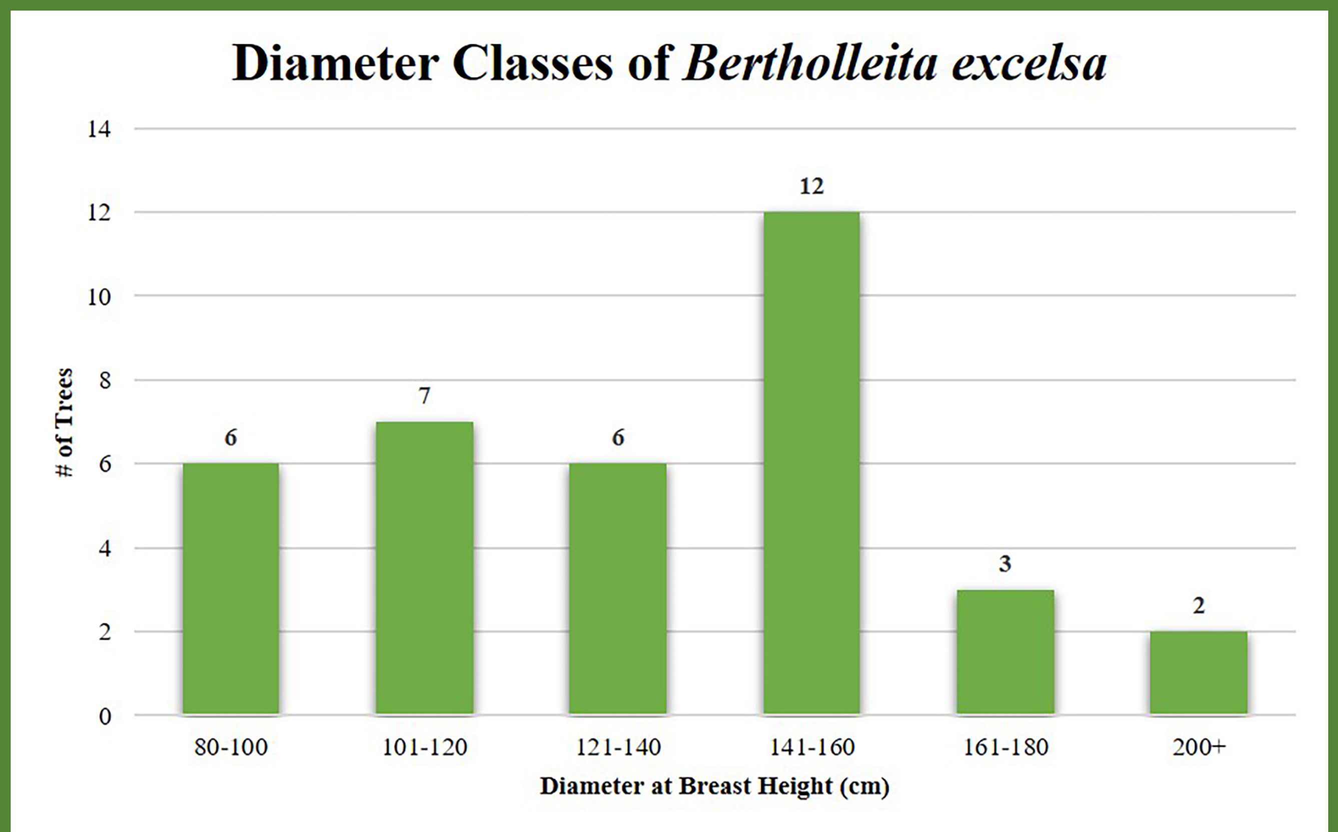


Figure 2. Diameter classes of Brazil nut tree (*Bertholletia excelsa*) in centimeters across the two sites in the Las Piedras River Watershed (n=36).

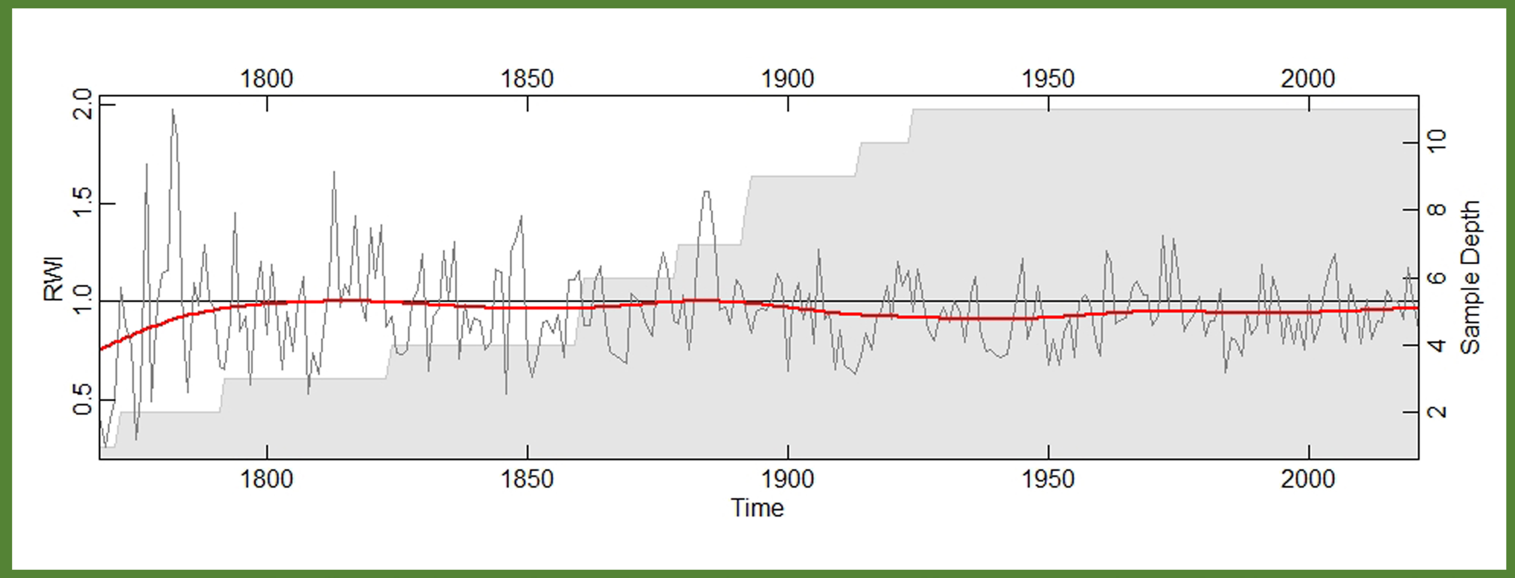
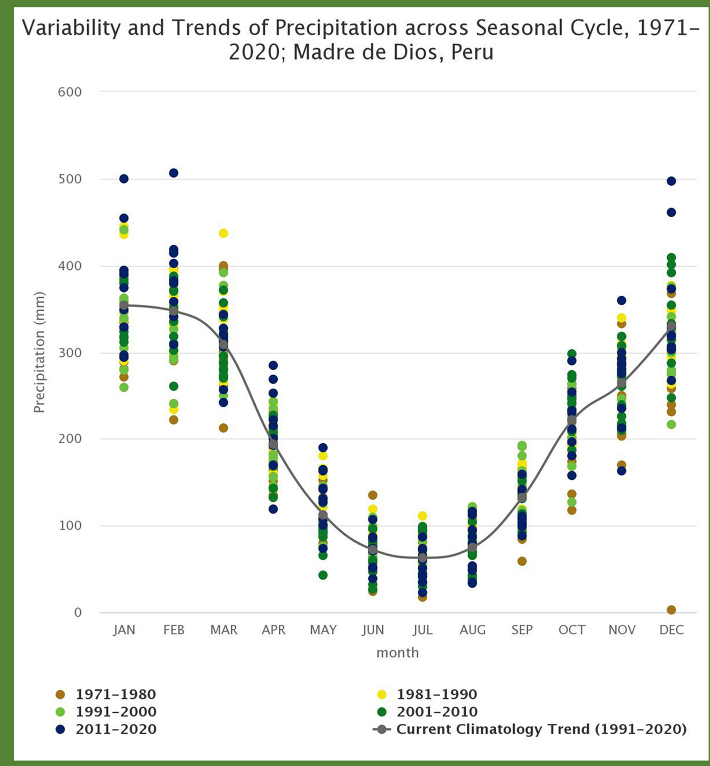


Figure 3. Standardized chronology from about 6 Brazil nut trees (*Bertholletia excelsa*) from Las Piedras River Watershed 2021. The gray field represents sample depth over time.



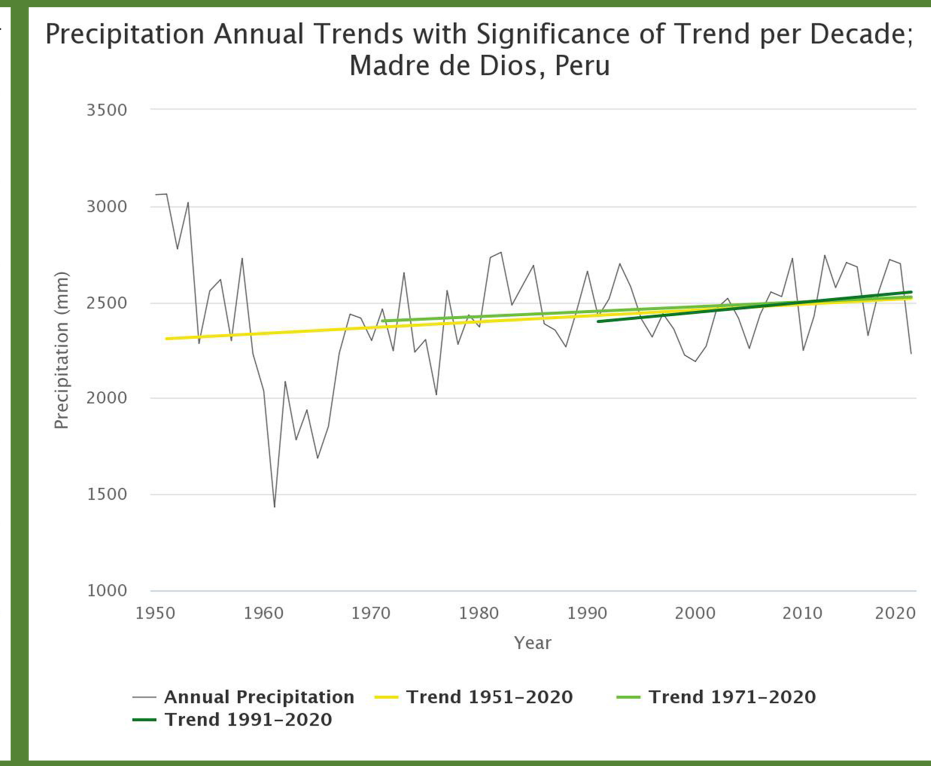


Figure 4. Annual precipitation in millimeters for the Madre de Dios department 1951-2020. Trend lines across three decades show approximately little variation in annual precipitation, with the expectation of a drought event occurring in the 1960s. Annual precipitation data provided from the World Bank Knowledge Portal.

Figure 5. Seasonal precipitation variability in millimeters throughout one year (January-December) from 1971-2020. Each bot represents a decade since 1971. There is a distinct “dry” season between April and October when precipitation is relatively low, and a distinct “wet” season between November and March when precipitation is relatively high. Annual precipitation data provided from the World Bank Knowledge Portal.

Radford University Tree Ring Lab

Growth-Climate Relations of *Bertholletia excelsa* growing in Southeastern Perú

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Background

Brazil nut trees (*Bertholletia excelsa*) are a dominate, widely dispersed tree species throughout the Amazon Basin. Brazil nut trees provide importance ecological and economic services to the Amazon Basin. In addition to their nuts being harvest due to high global demand, Brazil nut trees are a pillar in Amazonian rainforest ecosystems by regulating the amount of light entering the understory and supporting many animal species as a principle food source. Despite these significant services to rainforest communities, little is understood about these trees’ ability to form annual rings. Without a concrete ability to read tree rings, broader estimation of historical precipitation and temperature events become more difficult to study.

Annual tree rings in temperate-deciduous forests are formed by seasonal change via change in temperature (summer to winter). Tropical forests experience climatic variability via precipitation change (wet to dry seasons). Recognizing this difference in how forests respond to climatic phenomena becomes a central detail when analyzing tropical tree species’ growth rings. Early studies suggest that tropical species tree rings are formed via seasonal precipitation variability. The expression and length of Brazil nut tree rings are traced through distinct ring patterns rather than ring distance which is traditionally applied to temperate-deciduous forests.

Methods

Approximately 36 Brazil nut trees were sampled at two sites in the Las Piedras River Watershed, Madre de Dios, Perú. Tree core samples (two cores per tree) were collected using a 5mm diameter increment borer at breast height (1.3m above ground) from trees that showed no visual signs of rot or extensive damage. Tree cores were then prepared for scanning by sanding each with increasing sandpaper grit until seasonal rings were visible. For complete crossdating, each core was dated in Coorecorder and Cdendro software. Additionally, statistical analysis and correlation were evaluated using R Studio and packages like Dendrochronology Program Library in R (*dplR*) and treeclim.

Discussion

We found that the tree growth shows a common pattern despite the difficulty of defining ring boundaries. The chronology shows a decline in growth in the 1960s and we see in the climatic data that there was a drought at this time. As of now we can not definitely say that growth is affected by precipitation; however, there is some evidence to support this claim. We have another 29 trees to date and process. This study is ongoing and will require further research.

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