C. Ciências Biológicas - 5. Ecologia - 3. Ecologia Terrestre

ABOVEGROUND NET PRIMARY PRODUCTIVITY IN TROPICAL FOREST REGROWTH INCREASES FOLLOWING WETTER DRY-SEASONS

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INTRODUÇÃO:

Net primary productivity (NPP) is often considered the best integrative measure of resource effects on ecosystem processes. Improved understanding of temporal shifts in NPP may aid predictions of ecosystem response to ongoing climate and land-use changes.

Observational and manipulative experiments suggest that moisture availability may be an important control over aboveground NPP (ANPP) in tropical forests. At old-growth forest sites in the Brazilian Amazon, higher diameter growth rates are associated with wetter periods. Soil moisture depletion during a partial throughfall exclusion experiment reduced ANPP in an old-growth Amazonian forest. Prolonged droughts can result in higher tree mortality in tropical forests, increasing forest susceptibility to fire. Analogous data from both observational and manipulative studies are lacking for tropical forest regrowth.

Our primary objective was to investigate the response of ANPP to inter-annual variability in dry-season precipitation and experimentally increased dry-season moisture availability during a four-year irrigation study. We hypothesized that ANPP would be positively correlated with dry-season precipitation, and that dry-season irrigation would increase ANPP.

METODOLOGIA:

This study was conducted at the *Universidade Federal Rural da Amazônia* field station (Castanhal, Pará, Brazil). The number of dry months (rainfall < 100 mm month^{-1}) during the experimental period varied from 2 to 5 per year. The soils are classified as Distrophic Yellow Latosol Stony Phase I. The stand under study was

plots (20 m x 20 m) were established in August 1999. There were 4 replicate plots for the irrigation treatment and 4 control plots. Irrigation was applied at a rate of 5 mm day^{-1} during the dry seasons of 2001 to 2005.

We estimated ANPP as the sum of annual increases in aboveground biomass (AGB) of trees (DBH ≥ 1 cm) and fine litterfall between 2001 and 2005. AGB was estimated with allometric equations based on diameter measurements. Fine litterfall was collected weekly in each of three 1 m x 1 m screen litter traps in the plots. Aboveground biomass increment (AGBI) was calculated for each plot as follows: ABGI = (Σ increments of surviving trees) + (Σ increment(s) of ingrowth).

We ran linear regression analysis between ANPP and rainfall. We analyzed the effects of year, treatment, and year-by-treatment interaction on ANPP using a repeated measures analysis.

RESULTADOS:

ANPP ranged from (mean ± standard error) 12.3 ± 0.5 to 16.6 ± 2.1 Mg ha^{-1} yr^{-1} in the control plots, increasing with annual and dry-season rainfall, with particularly marked responses to previous year total and dry-season rainfall; the effect of dry season irrigation on ANPP was additive. Year and treatment effects on ANPP were significant ($P = 0.034$ and $P = 0.026$, respectively), and the year-by-treatment interaction was marginally significant ($P = 0.059$). For the annual periods from July 2002 to July 2003, and July 2003 to July 2004, ANPP was significantly higher in irrigated plots than in control plots, largely due to the effect of dry-season irrigation on aboveground biomass increment. Litterfall was marginally affected by date only, whereas aboveground biomass increment, which mostly results from stemwood increment, was significantly affected by date and marginally affected by treatment.

CONCLUSÕES:

Increased ANPP in response to wetter, previous-year dry-seasons suggests that tropical forest regrowth may be sensitive to rainfall seasonality. Our results also indicate a lag effect of the influence of dry-season precipitation on ANPP, probably due to rainfall controls on bud preformation, storage of reserves under favorable conditions, and long-term water table storage. The lack of ANPP response to irrigation during the first year of treatment supports the lag effect, as does the absence of a significant treatment response in 2004-2005, following the weak dry season of 2003-2004.

Predicted climate change for the Amazon region may include more frequent and severe dry seasons in response to global warming, deforestation, and more frequent El Niño episodes. Our results indicate that the potential of forest regrowth to sequester C will decrease under that projected scenario. Slower rates of regrowth also translate into longer periods of enhanced stand susceptibility to fire. Even when the rate of deliberate conversion of forest to agricultural use declines, as it did in 2005, avoiding future forest degradation and loss in the region will depend, in part, upon maintaining the rainfall regimes that are needed to support rapid forest regrowth.

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