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Empirical analyses of predictors of deforestation in the Brazilian Amazon

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Brazil's portion of the Amazon basin represents 40% of the world's remaining tropical forests and provides environmental services that are important both locally and globally. Concern about the future of Amazonian forests is growing as both the extent and rate of primary forest destruction increase. However, the region's development is also a concern for Brazil as the Legal Amazon region covers 58% of its national territory but houses only 11% of its population and in 1999 contributed just 4% of its GDP. The development-conservation dilemma in the Brazilian Amazon is critical to both Brazil and the international community. Here we combine spatially-explicit information on various biophysical, demographic and infrastructural factors in Amazonia with satellite data on deforestation to evaluate the relative importance of each factor to deforestation. A sampling grid was overlaid on distributions of Amazonian roads, highways, rural and urban populations, soils, dry season length and annual rainfall. Data on deforestation and each predictor variable were extracted for every 50 km by 50 km grid cell, and the relationships among deforestation and predictor variables were examined using a sub sample of grid cells. In order to test the sensitivity of results to alternative sampling methodologies, we stratified sampling first on deforestation, and then on each predictor variable in turn. For each stratification, 10 random samples of 120 grid cells were selected. We found highways to be the strongest predictors of deforestation under both stratification regimes. Roads were stronger predictors of deforestation when sampling was stratified to include a full range of road densities. Population density, annual rainfall and dry season length were also important predictors, with more densely populated areas that receive less rainfall and have longer dry seasons more likely to be deforested. In order to assess the consistency of our results with studies conducted at different spatial and temporal scales, we conducted a thorough review of previous empirical studies of the drivers of deforestation in the Brazilian Amazon. Our results, in concert with those of previous studies, send a clear message to planners: roads and highways are key drivers of the deforestation process. These factors are also the most amenable to policymaking. The time to make decisions concerning roads and highways is before they are built, as once forests are accessible a veritable Pandora's Box of exploitative activities is opened.