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Recovery of forest biodiversity and carbon stocks following degradation and natural regeneration in the Amazon

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Forest conservation policies and incentives typically account only for forest cover, and do not incorporate measures of species composition and the overall conservation status of such forests. Even the basic definition of forests in global negotiations (e.g. the Clean Development Mechanism) is inadequate, considering only total forest area, canopy cover and tree height. This oversimplified perspective is worrying because severely degraded and newly regenerated areas are often afforded the same status as pristine forests, despite having a much lower environmental value in terms of carbon, biodiversity and other important ecosystem services. Here we present a detailed assessment of the depletion and recovery of carbon stocks and faunal and floral biodiversity following a range of historical disturbances and land-use abandonment in two regions of Eastern Amazon – Paragominas and Santarém – encompassing approximately 3 million hectares. We used a nested sampling methodology (250 forest plots distributed in 36 catchments across a gradient of cumulative deforestation in the two regions). We aimed to evaluate 1) the timing of pixel-scale degradation events as well as past forest loss for a 22-year period (1988-2010); 2) the relative value of varyingly degraded and regenerating forests in terms of above-ground carbon stocks and the diversity of trees, birds and dung beetles. We present depletion and recovery curves for carbon and biodiversity across forests in different stages of degradation and forest regeneration following land agricultural abandonment, and show that these are both highly variable across each study region and exhibit marked spatial discontinuities at local scales. We interpret our results with regard to the implementation of different policy options, including the relative value of different REDD+ activities (e.g. avoiding degradation vs. enhancement of carbon stocks) and alternative measures for compliance with Brazilian legislation for forest conservation on private lands (e.g. off-farm offsets vs. on-farm restoration).