

Objective Indicators of Pasture Degradation from Spectral Mixed Model Analysis of Landsat Imagery

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Degradation of cattle pastures is a major concern for management and for understanding the future land cover/land use consequences of ongoing Amazonian deforestation. Unfortunately, "degradation" is not well defined and may have different meanings for ranchers, ecologists, and policy makers. The objective of this study is to quantify pasture degradation using objective scalars of photosynthetic vegetation (PV), non-photosynthetic vegetation (NPV), and exposed soil derived from spectral mixture analyses of Landsat imagery. The amount of exposed soil and NPV, such as senescent grass foliage, increases as pastures age and as the grasses become less productive. We employed a general, probabilistic spectral mixture model (AutoMCU) for decomposing satellite spectral reflectance measurements into sub-pixel estimates of PV, NPV, and bare soil covers at Fazenda Nova Vida in Rondonia and Fazenda Vitoria in Pará. These two ranches vary by size, age, soils, and management practices. The Nova Vida ranch had higher stocking densities, was more intensively managed, and had larger values of estimated exposed soil than did Fazenda Vitoria. The number of management "treatments" at Nova Vida, which included liming, herbiciding, and disking, was weakly, but significantly positively correlated with exposed soil and negatively correlated with PV across pasture management units. At both ranches, PV and NPV were strongly negatively correlated, and PV values were generally lower at the more intensively managed Nova Vida ranch. Although this analysis demonstrates that Nova Vida ranch shows signs of pasture degradation as defined by these objective criteria, it nevertheless has been maintained as a highly productive pasture system through intensive management and relatively high inputs. This remote sensing technique successfully reveals variation in objectively defined degradation indicators between and within ranches, but these degradation indicators do not necessarily imply reduced current cattle production.

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