JSM 2022 – Conference submission

Session Type: Contributed

Session Subtype:

Abstract Title: Quantifying post-wildfire revegetation using satellite data and statistical models: challenges and opportunities.

Abstract Text:

Understanding ecological process that drives vegetation and population recovery after wildfires is difficult due to inherent heterogeneity associated with natural landscapes. However, efficient land management and conservation planning will require predictions of natural regeneration defined in the management-relevant boundaries of space and time. Remote sensing presents an opportunity to quantify rates of revegetation across arbitrary extents of the landscape without laborious data collection in the field. In our study we focus on quantifying revegetation rate within a 1988 wildfire in western Utah, Beryl wildfire. Using a remote sensing data product that approximates population abundance at a 30m resolution, we apply two contrasting statistical models to quantify annual change in population abundance. First, we fit a conventional autoregressive integrated moving average model (ARIMA) to spatially-averaged trajectories of annual change quantifying site-level recovery. Second, we fit a Beverton-Holt ecological growth model for single-species population dynamics to the same dataset to estimate ecologically relevant parameters: an in intrinsic population growth rate and the strength of density dependence. Our data represented pixel-level trajectories based from the National Land Cover Database (30 m^2) within the Beryl wildfire spanning 30 years of population recovery (N = 13,327 \* 30 years). Based on the ARIMA model, …. Similarly, the Beverton-Holt model fit to the satellite data showed a good fit with the parameters falling within the range of those observed directly in the field. [some summary]. We conclude that although both models showed a good fit to the data, the Beverton-Holt growth model embeds mechanistical relationships within populations such as density-dependence, a process that traditionally requires laborious field or experimental data. In both model, the nature of satellite data presented a challenge with respect to statistical model fitting. First, satellite observations include an inherent source of measurement error that could represent a source of bias in the parameter estimates. An explicit handling of the observation error in a form of hierarchical relationships in the model present a promising solution to account for the noise in the satellite data. Secondly, the big data challenge is relevant to our study as well, where a single wildfire with its time-series of recovery contained 399,810 data points. With an increasing availability of the data, including higher-resolution imagery and denser time-series, efficient computational routines for statistical inference at large scales will be necessary. The next steps in our analysis will include an addition of a mechanistic relationship between individual patches (i.e., pixels) that will account for the dispersal and diffusion of exiting populations in space and time. Satellite-based remote sensing data provides an unprecedented opportunity to quantify ecological dynamics that can further inform decision-making at the level of local land management.

Abstract Keywords:

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