Predicting significant beech seed-fall events from national climate and elevation surfaces across New Zealand

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Predicting large beech seed-fall events is of considerable interest to conservation managers in New Zealand because such events can trigger rodent irruptions. Annual beech seed-fall data from a national trap network across New Zealand were modeled using mixed effects models with a binomial error structure. Seed-fall thresholds and candidate models containing climatic and geographic variables were based on findings from previous studies. Climate and geographic parameters were derived from the NIWA Virtual Climate Station Network (VCSN) and the Landcare 15 m Digital Elevation Model (DEM).
For summer temperature, we found mean daily maximum gave better fit than mean daily average or mean daily minimum across all beech species and seed-fall thresholds tested. We found models that specified an interaction between the two previous summer's temperatures had greater support than previously published models. The best fitting model incorporated a summer temperature two years prior to seed-fall, summer temperature and rainfall one year prior to seed-fall, the mean annual temperature for the previous five years, rainfall and frosts during flowering in the season of seed-fall as well as the geographic location. The best fitting model can be calculated three months before seed-fall begins. However, a similar model without climate variables during flowering gave acceptable fit and can be calculated 13 months before seed fall-begins, which has greater utility from a conservation management perspective. Models can be projected spatially and this allows predictions to be made across New Zealand beech forests without installing monitoring data at every site.