

The hidden role of host defense relaxation in MPB release: a lesson in real-world, low-density nonlinear dynamics

Barry J. Cooke

Canadian Forest Service, Edmonton AB, bcooke@nrcan.gc.ca

Abstract

Using actual recruitment data from the central Rocky Mountain region (MacQuarrie & Cooke 2011) and the southern interior of BC (Boone et al. 2011) I show that (1) the dynamics of relaxation release are a critical event influencing MPB eruption, and (2) this effect is not observable in operational Aerial Detection Survey (aka "red-top") data, but may only be observed under exacting circumstances. Observing this effect in the field requires early and aggressive ground monitoring in the absence of local immigration - circumstances which are atypical for most survey data. According to this model, relaxation release occurs when host defenses become critically impaired over entire landscapes, resulting in a "saddle-node bifurcation" which is the formal mathematical definition of "outbreak". Eruptive outbreaks may occur when either (i) the competition curve shifts significantly upward (higher component recruitment for all attack densities), or (ii) when the co-operation curve flexes non-linearly (higher component recruitment for low attack densities). When the two perturbations (vertical and nonlinear) occur simultaneously, as expected under sustained warm winter and dry summer conditions, outbreak is far more likely. This interpretation is consistent with early models of MPB eruptive dynamics, and suggests drought-caused relaxation in host defenses in the early 2000s may have been a contributing factor to the MPB outbreak in BC.

Notes: