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Can the cut-burn strategy eradicate a wood-boring beetle infestation?

We propose a mathematical model for an infestation of a wooded area by a beetle species in which the larva develop deep in the wood of living trees. Due to the difficulties of detection, we presume that only a certain proportion of infested trees will be detected and that detection, if it happens, will occur only after some delay which could be long. An infested tree once detected is immediately cut down and burned. The model is stage structured and contains a second time delay, the development time of the beetle from egg to adult. There is a delicate interplay between the two time delays due to the possibility in one case for a larva to mature even in a tree destined for destruction. We present conditions sufficient for infestation eradication and discuss the significance of the conditions particularly in terms of the proportion of infested trees that need to be detected and removed. If the infestation is successfully eradicated there are always a number of trees that completely escape infestation and we compute lower bounds and an approximation for this number. Finally, we present the results of some numerical simulations.

This is a joint work with Stephen Gourley.