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Feasibility and optimisation of fly elimination by adult mass trapping and larval treatment : a stage-structured metapopulation approach

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This work explores optimal strategies for the elimination of a fly population through adult mass trapping and larval treatment. Building on the results of [1] for (single-stage) metapopulation models with logistic growth, we extend here the analysis to a structured model that distinguishes between larvae, females and males. Linear migration of adults between patches is included, and the dynamic in each patch is inspired by the model in [2, 3].

Under appropriate conditions, we derive a condition that guarantees either elimination in all patches or convergence to a unique positive equilibrium.

Then, additional larval and adult mortality terms are introduced in a subset of 'controllable' patches, where intervention is allowed. We show that the feasibility of population elimination is determined by an algebraic property on the Jacobian at the origin of a so-called residual system. When elimination is feasible, the successful strategies that minimise a suitable treatment effort are analysed and compared with those established for the simpler logistic model considered in [1].

References

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