Releases of sterilizing males for mosquito population elimination: new insights from a bistable model

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Motivated by recent field experiments in French Polynesia, we aim at understanding the time dynamics of a mosquito population of genus *Aedes* exposed to artificial releases of sterilizing males. These males can be either sterilized by irradiation (SIT) or have a sterile crossing with wild females due to incompatible strains of *Wolbachia* (IIT). In both cases the released males sterilize the wild females they mate with and the target is population elimination.

Inspired by [1], we derive a minimalistic model to control mosquito population by SIT/IIT. Contrary to the previous models, it is bistable in general, allowing simultaneously for eradication of the population and for its survival. In addition, this control system is monotone in the sense of [2].

We consider different type of releases (constant, continuous, or periodic and instantaneous) and show necessary conditions to reach eradication in each case. We also derive the minimal application time below which eradication cannot occur. The key mathematical tool is the separatrix between the two basins of attraction in this bistable monotone system.

The applications of this work are two-fold: to help identifying key parameters (here, the mating probability and the duration of the egg compartment stand out both numerically and analytically), and to help designing release protocols.

References

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