Quantifying the survival uncertainty of Wolbachia-infected mosquitoes in a spatial model

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This talk concerns a spatially distributed model for the spread of Wolbachia-infected mosquitoes in an Aedes aegypti population and its success as far as non-extinction probabilities are concerned. More precisely, we obtain lower bounds so as to quantify the success probability of spatial spread of the introduced population according to a mathematical model. The underlying framework is based on existing nonlinear reaction-diffusion models.

Artificial releases of Wolbachia-infected Aedes mosquitoes have been under study in the past years for fighting vector-borne diseases such as dengue, chikungunya and zika. Several strains of this bacterium cause cytoplasmic incompatibility (CI) and can also affect their host's fecundity or lifespan, while highly reducing vector competence for the main arboviruses.

We measure the success of a field release by the sustained rate of Wolbachia infection it achieves (usually 1 - invasion - or 0 - extinction). Space plays a crucial role in the choice of the release protocol and the problem contains many uncertainties, on estimating biological parameters of the native population or of the introduced individuals as well as on assessing the population distribution after a release. We obtain both theoretical and numerical lower bounds for the probability of release success and give new quantitative results concerning the one (space) dimensional case.

This is joint work with Nicolas Vauchelet and Martin Strugarek (Paris).