

Bayesian statistical models to evaluate the efficacy of traditional and innovative mosquito control interventions

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Background : A Bayesian regression approaches was developed to assess the efficacy of conventional (biological larvicide, larval exp1) and innovative (Wolbachia male release, adult exp2) mosquito control interventions, to optimize mosquito control management. We exploited the flexibility of the Bayesian approaches to analyze results of two field

Exp 1: Larval control- Evaluation of *Bacillus thuringiensis* subsp. *israelensis* and *Bacillus sphaericus* combination (Bti+Bs) against *Culex pipiens* in high vegetated ditches. Generalized Additive Mixed Model (GAMM) in Bayesian framework was developed to assess:

- Larvae/ pupae abundance in treated and control sites



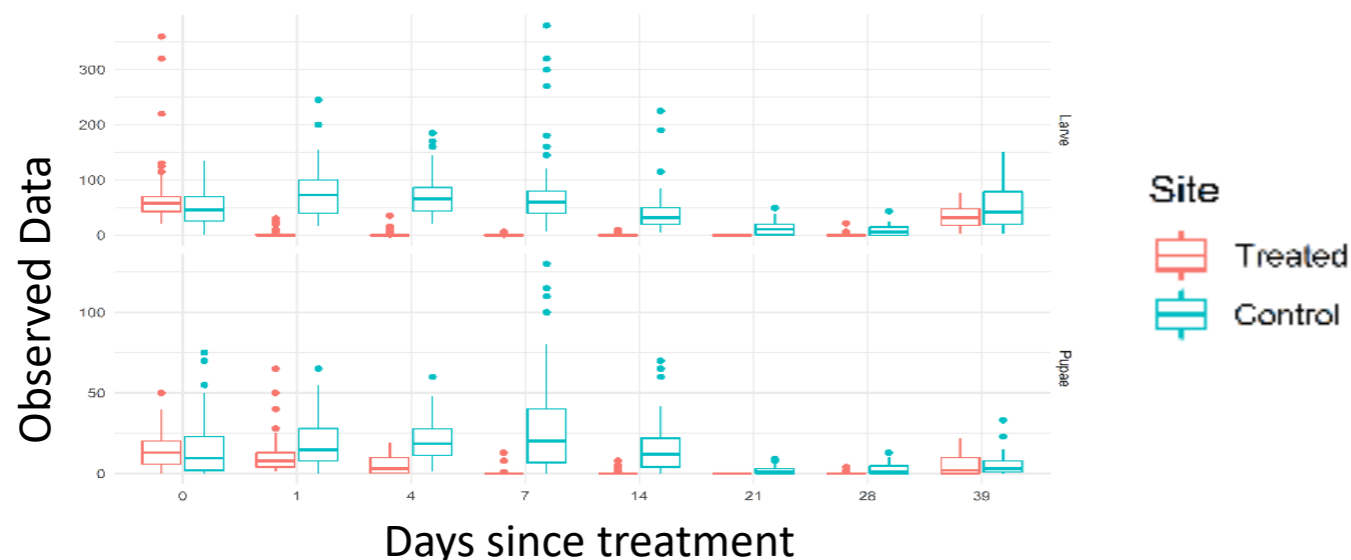
Exp2—Wolbachia suppression: Evidence of fertility reduction after release of *Aedes albopictus* males with manipulated Wolbachia infection in an Italian urban area. GAMM and Generalized Linear Model (GLM) in Bayesian framework were developed to assess:

- the eggs viable rate (p)
- wild females fertility rate (χ).



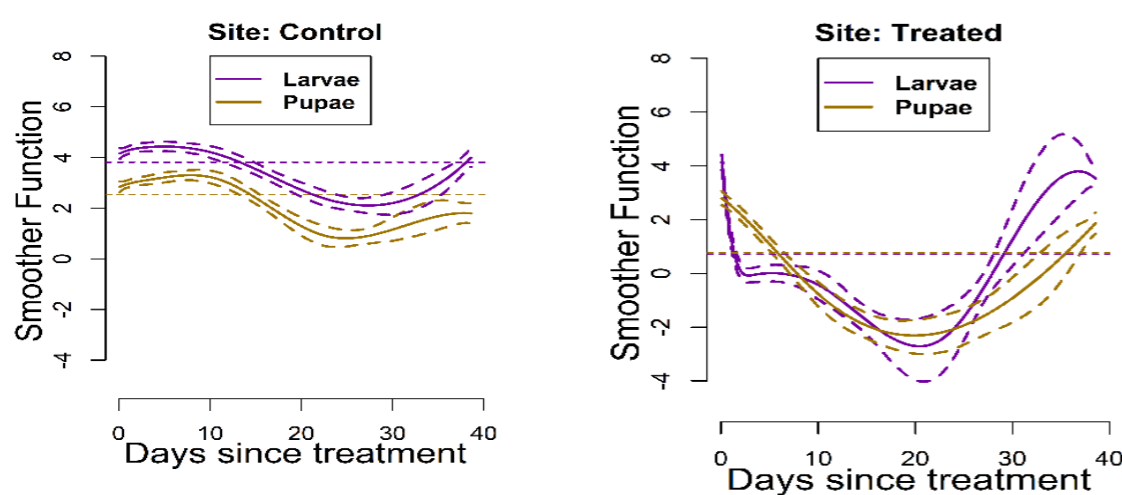
Results Exp1:

Figure 1: Observed larvae and pupae temporal dynamics in the treated and control site. Dots=outlier



In the ditches treated sites, a significantly **decrease in larval abundance** is observed **immediately** after the Bti+Bs application; the **decrease of pupae is delayed of 4 days**

Figure 2: Estimated non-linear smoothed curves of the time effect on the number of mosquito larvae (purple) and pupae (yellow) in in ditches treated with Bti+Bs (left) and in Control (right) sites

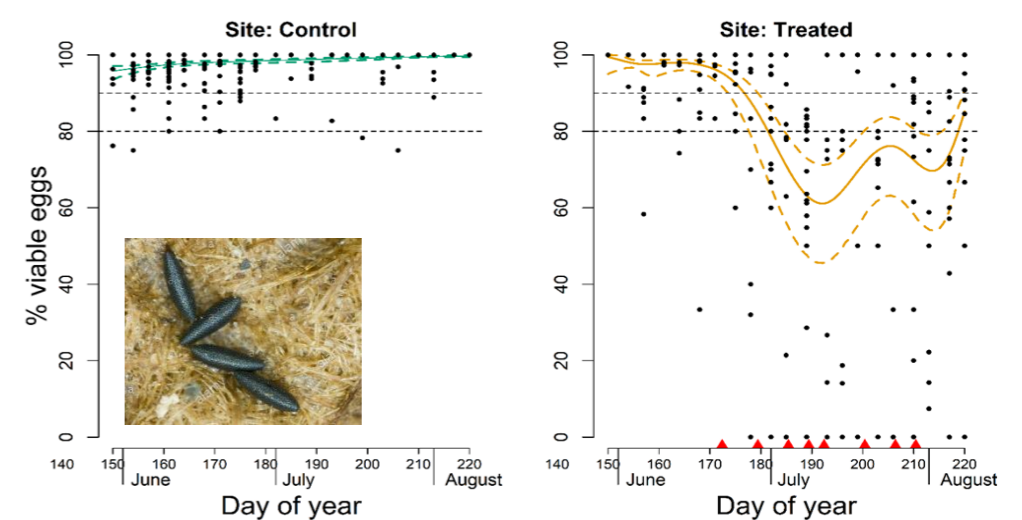


A reduction in larval abundance **24h post-treatments** (93%) with lack of living larvae up to **22 days** and high residual effect in pupae density up to **39 days** (84%);

Results Exp2:

the eggs viable rate (p)

Figure 3: Temporal dynamics of the proportion of viable *Aedes albopictus* eggs in treated and control sites in Rome (Italy) as estimated by GAMM. Dots=observed data



GAMM model predict a lower percentage (up to 35%) of viable eggs in treated than in control site

wild females fertility rate (χ).

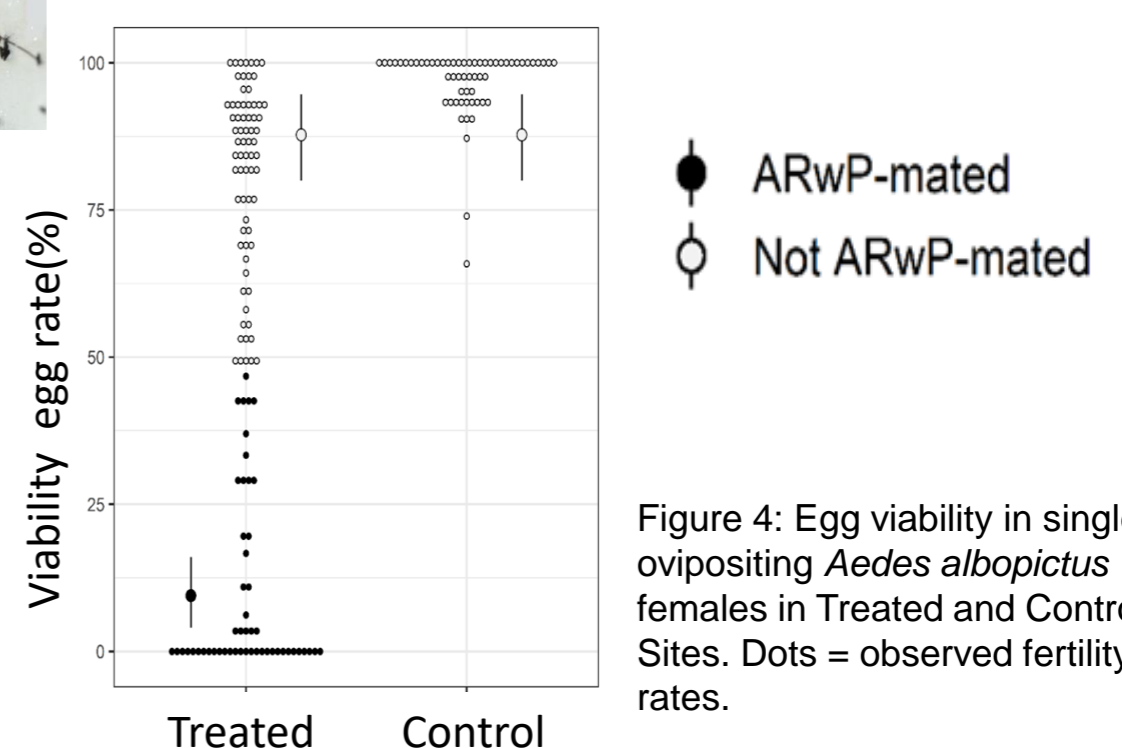


Figure 4: Egg viability in single ovipositing *Aedes albopictus* females in Treated and Control Sites. Dots = observed fertility rates.

GLM predict that the proportion of females classified as mated with ARwP males in the **treated site is 41.78%**

Discussion: Our results show how the application of **novel Bayesian regression** approaches to the evaluation of mosquito control intervention allows obtaining important quantitative results from field experiments, such as the comparison of the mosquito temporal pattern between treated and control sites and the estimation of the overtime mating exposure of wild females with released ARwP-males.