The potential of Capture Mark Recapture models for the study of life-history traits of mosquitoes

Through a capture-mark-recapture (CMR) longitudinal experiment, we aim to evaluate the adaptation of mosquito vectors to environmental modifications associated with global change. It is important to evaluate their life-history traits change, influencing vectorial capacity, in order to predict more accurately the epidemiological consequences of niche expansions. The procedure uses environmental DNA to identify individually mosquito larvae. This raises two difficulties for the analysis which are the misidentifications due to poor eDNA and the small recapture rate due to the cumbersomeness of the protocol coupled with big population size.

To deal with the misidentifications, we examine the latent multinomial model (LMM) developed by Link et al (2011) and extended in Schofield & Bonner (2015) and in Bonner et al (2016). It uses latent histories in which the misidentifications are known. We evaluated the model on different scenarios. Simulations were made to understand the limits of the model and to define an efficient fieldwork protocol. The lack of information with few recaptures being the main problem we have to deal with, we are working on adding information through informative priors and through the observation of the different larvae stages in the data.

For capture rates between 0.1 and 0.4, identification rates between 0.8 and 0.9, and 5 to 9 sampling occasions, we showed that the biases of the model estimates are sensitive to the capture rate and to the number of sampling occasion. The biases tend to be reduced when the identification rate is increased. There is a better decrease of the bias by augmenting the capture effort or the number of occasions rather than the identification effort. All these considerations will help in designing an efficient fieldwork, taking into account the biology of mosquitoes.