

Modelling the evolution of asexuals: PDE, integro-differential and stochastic approaches

Lionel Roques¹, Jimmy Garnier², Marie-Eve Gil^{1,3}, François Hamel³, Florian Lavigne^{1,3,4}, Guillaume Martin⁴

¹ BioSP - INRA - Avignon

² LAMA - CNRS - Chambéry

³ I2M - Aix-Marseille University

⁴ ISEM - CNRS - Montpellier

The genetic adaptation of asexual organisms to a previously unfavorable niche underlies a wide range of biological processes, such as biological invasions by alien organisms, host shifts in pathogens or the emergence of resistance to pesticides or antibiotics. We develop here several PDE approaches (integro-differential equations, nonlocal equations on generating functions and free boundary approaches) to follow the dynamics of the fitness distribution in an asexual population, under the effects of selection and mutation. Using these approaches, we explore the behavior of the fitness distribution under different types of assumptions on the fitness effects of mutations (beneficial, deleterious, fitness-dependent, anisotropic). We compare our results with empirical results given by stochastic individual-based simulations of Wright-Fisher type models.

References

- [1] M-E GIL, F HAMEL, G MARTIN AND L ROQUES, *Dynamics of fitness distributions in the presence of a phenotypic optimum: an integro-differential approach*, Nonlinearity, (2019), in press
- [2] L ROQUES, J GARNIER AND G MARTIN, *Beneficial mutation-selection dynamics in finite asexual populations: a free boundary approach*, Scientific Reports, 7 (2017), Article number: 17838

- [3] M-E GIL, F HAMEL, G MARTIN AND L ROQUES, *Mathematical properties of a class of integro-differential models from population genetics*, SIAM J. Appl. Math., 77 (2017), pp. 1536-1561
- [4] G MARTIN AND L ROQUES, *The Non-stationary Dynamics of Fitness Distributions: Asexual Model with Epistasis and Standing Variation*, Genetics, 204 (2016), 1541-1558