

Spatio-temporal dynamics of bumblebees foraging under predation risk

Rainer Klages

Queen Mary University of London, School of Mathematical Sciences,

An interesting topic of recent biophysical research is to understand the foraging dynamics of organisms by means of statistical data analysis and stochastic modeling. In my talk I will discuss a laboratory experiment in which 3D flight paths of bumblebees searching for nectar in an artificial carpet of flowers have been recorded [1]. In one phase of the experiment, some of the flowers have been randomly equipped with artificial spiders modeling predation risk. Statistical data analysis of the bumblebee trajectories yields a spatial mixture of two different Gaussian velocity distributions, which reflects how bumblebees access the food sources and perform far away foraging flights, respectively [2]. Surprisingly, the threat posed by the spiders does not show up in a change of the velocity distributions but only as a difference in the velocity correlation functions. Our analysis thus shows that the bumblebees adjust their flight patterns spatially to the environment and temporally to the predation risk. We qualitatively reproduce these findings from a simple stochastic Langevin equation, which includes a repulsive interaction between bumblebee and spider. For the foraging flights without spider interaction only, we construct a second, more detailed Langevin-type model from experimental data analysis within the framework of correlated random walks [3].

This is joint work together with F.Lenz, T.C.Ings, L.Chittka, and A.V.Chechkin.

[1] T.C.Ings, L.Chittka, *Curr. Biol.* **18**, 1520 (2008)

[2] F.Lenz, T.Ings, L.Chittka, A.V.Chechkin, R.Klages, *Phys. Rev. Lett.* **108**, 098103 (2012)

[3] F.Lenz, A.V.Chechkin, R.Klages, *Constructing a stochastic model of bumblebee flights from experimental data*, to be submitted