STATISTICAL MECHANICS OF INDIVIDUAL ANIMAL MOVEMENT

Paulo F.C. Tilles[1], and Sergei Petrovskii[2]*

[1]Universidade Estadual de Londrina, Londrina, Parana, Brazil
[2]Department of Mathematics, University of Leicester, Leicester, UK

paulotilles@hotmail.com, sp237@le.ac.uk3 (*corresponding author)

ABSTRACT

Understanding mechanisms that affects the rate of animal dispersal has long been a major issue in movement ecology [1]. Over the last two decades, a special attention has been paid to the phenomena that are broadly referred to as long-distance "fat-tailed" dispersal and/or super-diffusive spread, i.e. where the dispersal rate is higher than the diffusive spread described by the Brownian motion. One way to explain the faster spread is to denounce the Brownian motion altogether changing it to Levy flights and Levy walks [2]. In my talk, I will discuss alternative approaches to this problem. I will argue that there is a variety of mechanisms that can result in a super-diffusive spread and/or fat-tailed dispersal kernel even if individual animals perform the Brownian motion [3, 4]. I will also show that a super-diffusive movement arises naturally as a result of the behavioral response of the moving animal to external signals or environmental clues [5, 6].

References

[1] Turchin, P. (1998). Quantitative analysis of movement, Sinauer, Sunderland.

[2] Viswanathan, G., et al. (2011). The physics of foraging: an introduction to random searches and biological encounters. CUP, Cambridge.

[3] Petrovskii, S.V, Morozov, A.Y. (2009). Dispersal in a statistically structured population: fat tails revisited. *Amer. Nat.*; **173**, pp.278-289.

[4] Petrovskii, S.V, Mashanova, A., Jansen, V.A.A. (2011). Variation in individual walking behavior creates the impression of a Levy flight. *Proc. Natl. Acad. Sci. USA*; **108**, pp.8704-8707

[5] Tilles, P.F.C., Petrovskii, S.V. (2015). Statistical mechanics of animal movement: animals's decision-making can result in superdiffusive spread. *Ecol. Compl.*; **22**, pp.86-92.

[6] Tilles, P.F.C., Petrovskii, S.V. (2016). How animals move along? Exactly solvable model of superdiffusive spread resulting from animals decision making. *J. Math. Biol.*; in press.