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Mês de: Outubro 2010

BIOMATEMÁTICA

Dia 26 de Outubro (terça-feira), às 16h, na Sala B3-01

"Population Dispersal and Animal Movement: Statistical Mechanics of Non-identical Particles"

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Abstract:

Populations of ecological species do not remain fixed in space. Instead, their distribution evolves due to motion of individuals. A cornerstone for understanding mechanisms of dispersal is identification of factors affecting the shape of the dispersal curve, in particular, its rate of decay at large distance. A lower rate of decay – a "fat tail" – is known to result in a faster species spread, which is sometimes interpreted as superdiffusion. The standard random walk approach is widely believed to result in a dispersal curve with a 'thin' Gaussian tail, which is often at variance with field data. Here we show that the thin tail is more an artifact of an over-simplified description of the dispersing population rather than an immanent property of the random walk diffusion. Specifically, we show that a fat-tailed dispersal curve with either exponential or power law rate of decay arises naturally in a population of non-identical individuals, i.e. in a population with some inherent statistical structure. Our findings prove that, contrary to a widely spread opinion, a thick dispersal tail is not necessarily a fingerprint of Levy flights or superdiffusion as it is usually believed. Our theoretical results appear to be in a very good agreement with some available field data.

A good understanding of population dispersal is hardly possible without knowing what happens on the microscale, i.e. on the spatial/temporal scales of the individual movement. Correspondingly, we then proceed to the analysis of animal's individual paths. Movement paths are characterized by the distribution of the length and duration of bouts of continuous movements. Studies of different species have revealed that the distribution of bout durations often has a fat tail" which is well described by a power law, truncated at high values so that the distribution decays fast for long bouts. The relation between this pattern and the processes that cause it has remained poorly explored. Our attempt to reveal this relation is based on some tools statistical mechanics. Basing on the concept of "statistically structured populations" introduced in the first part of the talk, here we formulate an approach that allows us to describe data on bout duration within a unified framework and show that a truncated fat-tail in the bout distribution of animal movement is an immediate consequence of the inherent statistical variation of individual traits.

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