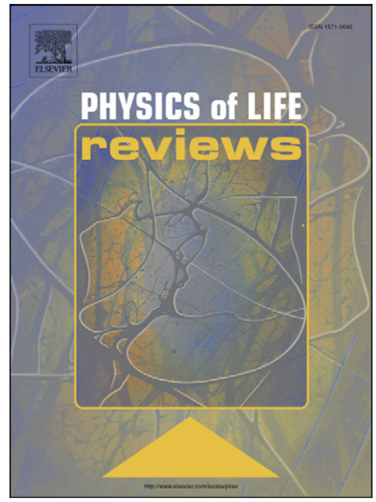
Accepted Manuscript

Make your trappings count: The mathematics of pest insect monitoring

Bernd Blasius



PII: S1571-0645(14)00064-5
DOI: 10.1016/j.plrev.2014.05.005
Reference: PLREV 493

To appear in: *Physics of Life Reviews*

Received date: 12 May 2014
Accepted date: 13 May 2014

Make your trappings count: the mathematics of pest insect monitoring

Comment on "Multiscale approach to pest insect monitoring: Random walks, pattern formation, synchronization, and networks" by Petrovskii et al.

Bernd Blasius

ICBM, University of Oldenburg, 26111 Oldenburg, Germany

Since the beginnings of agriculture the production of crops is characterized by an ongoing battle between farmers and pests [1]. Already during biblical times swarms of the desert locust, *Schistocerca gregaria*, were known as major pest that can devour a field of corn within an hour. Even today, harmful organisms have the potential to threaten food production worldwide. It is estimated that about 37% of all potential crops are destroyed by pests. Harmful insects alone destroy 13%, causing financial losses in the agricultural industry of millions of dollars each year [2-4]. These numbers emphasize the importance of pest insect monitoring as a crucial step of integrated pest management [1]. The main approach to gain information about infestation levels is based on trapping, which leads to the question of how to extrapolate the sparse population counts at singularly disposed traps to a spatial representation of the pest species distribution. In their review Petrovskii *et al.* provide a mathematical framework to tackle this problem [5]. Their analysis reveals that this seemingly inconspicuous problem gives rise to surprisingly deep mathematical challenges that touch several modern contemporary concepts of statistical physics and complex systems theory. The review does not aim for a collection of numerical recipes to support crop growers in the analysis of their trapping data. Instead the review identifies the relevant biological and physical processes that are involved in pest insect monitoring and it presents the mathematical techniques that are required to capture these processes.

To structure their review, Petrovskii *et al.* distinguish between three characteristic spatial scales, each requiring a distinct mathematical treatment [5]. The smallest spatial scale constitutes the single trap problem: How can we estimate the population abundance in the vicinity of a single trap and thereby reconcile the effects of population density with the movement of individual insects. The answer depends on our assumptions about the modes of animal movement – a fact which connects pest insect monitoring to movement ecology and random walk theory [6,7]. Thereby, the authors avoid entering the controversy of whether animals really perform Levy-walks, and propose the framework of time-dependent diffusion as a reasonable, practical approach to capture the trap counts of populations with fat-tailed step length distributions.