A Novel Approach to Evaluation of Pest Insect Abundance in the Presence of Noise

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Abstract

Evaluation of pest abundance is an important task of integrated pest management. It has recently been shown that evaluation of pest population size from discrete sampling data can be done by using the ideas of numerical integration. Numerical integration of the pest population density function is a computational technique that readily gives us an estimate of the pest population size, where the accuracy of the estimate depends on the number of traps installed in the agricultural field to collect the data. However, in a standard mathematical problem of numerical integration it is assumed that the data are precise, so that the random error is zero when the data are collected. This assumption does not hold in ecological applications. An inherent random error is often present in field measurements and therefore it may strongly affect the accuracy of evaluation. In our paper, we offer a novel approach to evaluate the pest insect population size under the assumption that the data about the pest population include a random error. The evaluation is not based on statistical methods but is done using a spatially discrete method of numerical integration where the data obtained by trapping as in pest insect monitoring are converted to values of the population density. It will be discussed in the paper how the accuracy of evaluation differs from the case where the same evaluation method is employed to handle precise data. We also consider how the accuracy of the pest insect abundance evaluation can be affected by noise when the data available from trapping are sparse. In particular we show that, contrary to intuitive expectations, noise does not have any considerable impact on the accuracy of evaluation when the number of traps is small as is conventional in ecological applications.