An individual-based model for sex-pheromone-oriented flight patterns of male moths

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Controlling a lepidopterous pest by mass-trapping of males is not likely to damage the natural environments and has been regarded to have great potential in IPM (Insect Pest Management), though there are only a few examples of success under a range of allowable levels. It has been argued that the immigration of males from outer areas will diminish the efficacy of the control [1, 4]. If the rate of trap catches is smaller than the rate of remaining males near the traps, the proportion of mated females will not effectively decrease even if many males are killed by traps [2]. It will be difficult to handle such problems analytically, since it is deeply associated with the interactions between the flight patterns of individual males and pheromone flowing structure (pheromone plume).

Thus an individual-based model was constructed [6] in which individual male moths can move around in a two-dimensional virtual arena in the center of which a pheromone source (a lure in a trap) was placed. The pheromone plumes were developed from the source according to the wind direction. Simulations were executed considering the intensity of wind swinging, the detail flight pattern oriented toward pheromone plume and the mechanisms of pheromone-inspired flight of male moths.

Many males gathered near to and downwind from the pheromone trap as the time elapsed in the simulations. Such the phenomenon was named as 'clustering of males'. The simulations indicated that 1) the clustering of male moths was most prominent when the wind swung mildly, 2) although the clustering tendency was strengthened with an increase in the number of zigzags per moth, this did not significantly influence the number of trap

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catches, 3) increasing the effusing density of a pheromone source did not result in a greater catch of males but made the clustering distribution more prominent. The positive and negative effects of cluster-formation on the control of moth pests are discussed [5].

References

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