

Native specific reactions may cause the paradox of population control: A theoretical approach with mathematical model

Hiromi SENO

*Division of Mathematics, Graduate School of Information Sciences, Tohoku University
Aramaki-Aza-Aoba 6-3-09, Aoba-ku, Sendai, 980-8579 JAPAN*

seno@math.is.tohoku.ac.jp

One of serious problems in agriculture has been the pest outbreak. Usually some pesticides have been used against the pest. However, in some cases, such a pesticide is effective only in the early period of its application and results in an outbreak of the pest in the later period. Such phenomenon is often called the *pest resurgence* [1-4]. It could be caused by the emergence of a pesticide-resistant strain of the pest or by the decrease of its enemy population affected by the pesticide [1, 2]. Some researches showed that a small amount of pesticide could increase the pest fecundity whereas a large amount of pesticide decreases the pest population. Such phenomenon is called the *hormesis* or *hormoligosis*. Hormesis would play an important role to cause the resurgence [4]. In our work [3, 6], we analyze a time-discrete host-parasite system in order to consider the condition in which the harvesting of the host (pest) population results in the increase of the host population itself so as to cause the paradox of pest control, that is, the resurgence. Our model is a time-discrete population dynamics model extended from the Nicholson-Bailey model [5], introducing the host intra-specific density effect and the harvesting effect [3, 6, 7]. We could analytically prove that the resurgence occurs even when the harvesting does not directly affect the parasite (natural enemy) population at all. Our result suggests that such a paradox would not be necessarily caused by the reduction of the natural enemy population due to the harvesting itself (e.g., with a pesticide), or by the appearance of some pesticide-resistance or the pest hormesis. Instead, the purely ecological balance in the population dynamics may cause it [3, 6, 7]. Our theoretical results can be easily extended to those for the other contexts including some biological conservation in not only land but also marine habitat. Our conclusion implies the importance of biological (ecological) researches for controlling ecological system.

References

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