

IBM based study of a disease propagation through the lemming population

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A new individual-based model (IBM) was proposed in papers [1] and [2]. Numerical investigation carried out with the help of the direct simulation Monte Carlo method showed that the IBM permits to reproduce a three-year period oscillations of the lemmings population at western Taimir. It was noted in the papers that the IBM can be used for solving large number of population dynamics problems and in particular for modeling a disease propagation on a real population dynamics background. In the present paper results obtained for the above-mentioned problem will be presented. A scheme of infection and propagation of a hypothetical disease can be described as follows. Initially several individuals in a vicinity of some point in a habitat become infected with the disease. Colliding to other individuals during feeding they infect them with a probabilities p_1 and p_2 during incubation period (duration t_1) and disease itself (t_2) correspondingly. In their turn these infected individuals become a source of the infection. At the end of the incubation period infected individuals are ill with a probability p_i . After the disease an individual dies with a probability pd or gets well with a probability $1 - pd$. A ratio of number of infected and ill individuals to the population size for $p_i = 1$, $pd = 0$, $t_1 = t_2 = 10$ days and several values of $p_1 = p_2$ is presented at the plot. One can see that the relative part of the infected and ill individuals runs at first up to maximum and then decreases to zero. The second maximum at

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the curves for the greater values of infection probabilities is a consequence of a sharp decrease of the population size during the depression. The results obtained for different calculation cases will be presented and analyzed in the report. In particular we are going to show a film illustrating the disease propagation through the habitat area.

References

- [1] V.D.Perminov, D.A. Sarancha, Application of direct simulation Monte Carlo method to ecological objects modeling. Modeling a tundra animals population. *Proceedings of 5th European Conference of the ESMTB on Mathematical Modeling and Computing in Biology and Medicine*. 2002, Milan, Italy (to be published)
- [2] V.D. Perminov, D.A. Sarancha, On some approach to solving population ecology problems. *Mathematical Modeling*(to be published, in Russian)