The conference is supported by the National Laboratory for Health Security project RRF-2.3.1-21-2022-00006

The effect of age-dependent toxicity of twig segments

Rongsong Liu

University of Wyoming, USA

rliu1@uwyo.edu

We use two types of age-structured population models to study how the distribution of toxins among segments of the twigs of woody plants, by affecting the feeding behavior of snowshoe hares, might affect snowshoe hare population dynamics. In the first model a twig has N discrete toxin containing segments joined end to end. Depending on species these segments vary tremendously in length. Preferred browse species such as the deciduous shrub birch Betula glandulosa have a small number of long twig segments and defend only the youngest segments near the twig tip. Hares counter this defense by biting off a twig at an older segment, eating only the older segments and rejecting younger, more toxic attached segments. Twigs of less preferred foods, such as the juvenile developmental stages of the evergreen spruces Picea glauca and P. mariana, have an arrangement of toxin producing resin ducts along their twig's long axis that is best modeled using a large number of short segments. We also propose a continuous model as an alternative to the N-segment model in the case when N is large. For each model we determine completely the conditions for linear stability of the hare-extinct equilibrium. An important implication is that the most effective defense against hares is to defend twig segments of all diameters that a hare can eat, as does spruce. Numerical simulations of both models confirm and enhance our understanding of the dynamics of the interaction between woody plants and snowshoe hares.