Temperature, seasonality and recurrent insect outbreaks

Two PhD positions are available in the area of Experimental Population Dynamics, which is part of a larger project aimed at understanding how seasonal temperature changes influence the stability of population dynamics.

The overall project is an international collaboration between Dr. Nelson (Queen's University, Canada), Dr. Bjornstad (Penn State, USA), Dr. Tobin (USDA, USA) and Dr. Yamanaka (NIAES, Japan) and is funded by the National Science Foundation (USA). The project is strongly interdisciplinary between mathematical and experimental approaches; Candidates for this position will have the opportunity to work with the tortrix tea pest (*Adoxophyes honmai*), which is a new experimental model system for studying population dynamics. It is anticipated that one graduate student project will take a predominantly experimental approach, and the other project will take a predominantly mathematical modelling approach to investigating how temperature effects population dynamics.

While the experimental parts of the project will be done at Queen's University and the theoretical work done at Penn State, all graduate students and faculty on the project will have regular interactions. More background on the project can be found in the grant summary and two recent papers given below.

Applicants for this position should have a strong academic record and demonstrated ability for independent research. We encourage applicants with a background in either mathematics or experimental biology. Please send your CV, a copy of academic transcripts and a cover letter to Bill Nelson (nelsonw@queensu.ca) and Ottar Bjornstad (onb1@psu.edu).

Queen's University is a research intensive institution with a strong graduate program in Ecology and Evolution, and Mathematical Biology. The Biology department provides stimulating academic environment with a collegial atmosphere.

Sincerely,

Bill Nelson

William Nelson
Associate Professor

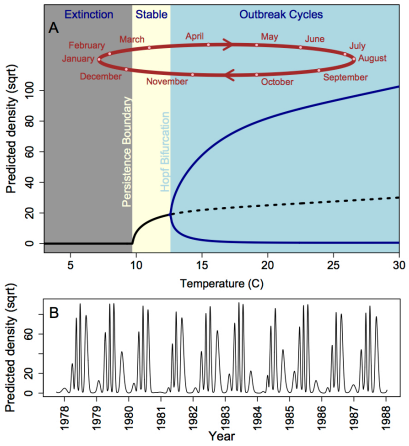
Department of Biology
Queen's University
Kingston, ON, Canada, K7M 3N6
Phone: (613) 533-6130 Fax: (613) 533-6617
http://post.queensu.ca/~nelsonw/Index.html

Key recent papers

Nelson WA, Bjornstad ON & Yamanaka T (2013) Recurrent insect outbreaks caused by temperature-driven changes in system stability. *Science* 341: 796-799.

Takehiko, Y., Nelson, W.A., Uchimura, K. & Bjornstad, O.N. (2012) Generation Separation in Simple Structured Life Cycles: Models and 48 Years of Field Data on a Tea Tortrix Moth. *American Naturalist* 179: 95-109.

Grant summary



"Insect development is largely driven by temperature, and many insect pests have multiple generations each year. Among these, some have distinct generations such that only a specific stage (eggs, larvae, pupae or adults) is present at any one time, while others have overlapping generations with multiple stages present at all times. There is currently no general explanation for what causes one pattern or the other. However, it is important for pest management because insects with distinct generations may require only one intervention per generation for control, while those with overlapping generations may require more intensive management. In a particular case study of the smaller tea tortrix, the scientific team recently discovered that an unrecognized process of temperature-dependent destabilization of population dynamics may be a key missing predictor of whether a particular pest species will have distinct or overlapping generations. The researchers plan to use a three-pronged experimental, theoretical and statistical approach to investigate this new ecological process. The three specific aims are to (1) Develop and extend models that incorporate temperature dependence in life-history traits to make general ecological predictions about patterns of generation overlap, as well as species-specific predictions about temperature-dependent destabilization; (2) Conduct detailed time series analysis of historical data across latitudinal gradients to understand how climate affects this process; and (3) Develop an experimental model system to test our theoretical predictions. The research will lead to important new insights into the dynamics of insect pests including the dynamic consequences of future climate scenarios."