Stable isotope and trace elements as New Zealand geo-location markers for biosecurity

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A collaborative PhD programme aims to assess the value of stable isotope and trace element analysis for determining the origin of high impact exotic insect pests that threaten New Zealand’s biosecurity.

Introduction

Knowledge of whether an exotic pest specimen collected ‘post border’ is a new arrival, or part of a hitherto undetected established population, enables effective biosecurity action, potentially saving millions of dollars used for emergency response surveillance for a pest that might not have established (Figure 1).

Rationale

Stable isotope technology is being considered as a key biosecurity tool to distinguish the geographic origins of invasive exotic insects in New Zealand. Stable isotope and trace element signatures have been used to trace the origin of a wide range of non-biological and biological materials. However, the value of this technology is unproven for accidentally introduced and potentially polyphagous taxa. Fundamental research, on how geo-location signatures are reflected in such insects is needed.

Aim

To test the feasibility of using multi stable isotope and trace element analysis for New Zealand geo-location discrimination in a biosecurity context.

An integrated research programme

Recent research in New Zealand, with light brown apple moth (LBAM) as a model insect, demonstrated good water-plant-insect δ2H geo-location expression in lab populations consistent with similar studies. However, the δ18O, δ34S and δ13C values of wild LBAM populations were found to be too variable to provide geo-location discrimination by any single isotope signature (Figure 2). A national isotope map of New Zealand precipitation is currently under development, under a Cross Department Research Programme (MAF BNZ + Department of Conservation + University of Otago). This PhD will build on the existing geo-location research, above, and be integrated as much as possible with ongoing aligned research in New Zealand, including planned food provenance research.

Objectives and methods

Complementary field and laboratory controlled environment studies will use model soil-plant-insect systems to

- confirm the biological representation of stable isotope and trace element signatures in plant and insect tissues as geo-location markers,
- identify the elements that have potential to contribute to a New Zealand point of origin signature (Figure 3),
- examine the constraints of small sample mass and restricted sample sizes,
- explore the influence of varying dietary and climatic histories.

This work will contribute to or enable a New Zealand point-of-origin classification model. This model will be applicable to other systems and disciplines.

References


Acknowledgments

Funded by TEC Centre of Research Excellence fund and the National Isotope Map of New Zealand Precipitation Cross Department Research Project. Images courtesy of: Asian gypsy moth University of Georgia, Figure 1 MAF BNZ, Scion Research, Public Health Image Library US CDC; Figure 2 Husheer and Frew (2006b); Figure 3 Stuart Larsen, Lincoln University.

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