ECOTOXICOLOGY TESTING EXPERIENCES WITH EPT TAXA

Marie Brown#, Hanna Schuster, Zoe Jones, Jamie Smith, Nadine Taylor
Cambridge Environmental Assessments, Boxworth, UK; #Corresponding author: Marie.Brown@cea-res.co.uk

CAMBRIDGE ENVIRONMENTAL ASSESSMENTS
20 YEARS | 2001 - 2021

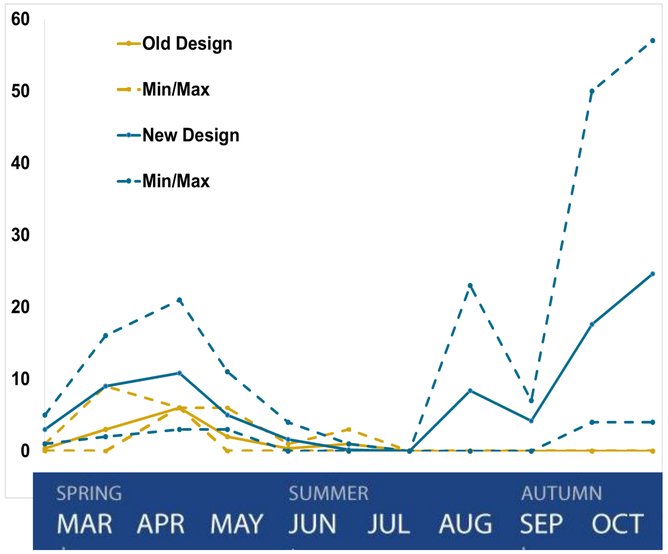
INTRODUCTION

EPT taxa (**E**phemoptera mayflies; **P**lecoptera stoneflies; and **T**richoptera caddisflies) are used as biological indicators of water quality and have been shown to be more sensitive to environmental pollutants such as PPP's in some instances. The life histories of EPT taxa can make them more vulnerable to adverse effects of chemical exposure as they are generally low in abundance in the natural environment and typically have a 1 to 2 year life cycle, which can limit recovery. These traits make EPT taxa inherently problematic for ecotoxicology testing in the field and the laboratory. Here we highlight the challenges in using EPT taxa as test organisms in (1) Mesocosm studies and (2) Laboratory Studies and discuss some of the ways these approaches could be improved.

One of the major challenges for mesocosm studies is achieving consistently high abundances of EPT taxa to allow sufficient statistical power to detect significant differences. EPT taxa naturally yield low abundances and highly variable data, which can result in uncertainties in the detection of treatment-related effects. Here we use the caddisfly family, Phryganeidae, as a case study.

CASE STUDY: CADDISFLY ABUNDANCE

The mesocosm study design at CEA has been optimised to improve abundance data. For macroinvertebrates this includes: an extended pre-application phase in order to establish similar communities between replicates and using different types of traps and techniques to sample macroinvertebrates. To investigate the impact of these optimisation techniques on the abundance of caddisfly, we compared mean control abundance data from an older study design (**Old Design**), with a more recent study design (**New Design**). Although variability was still observed in the data, there was a higher number of Phryganeidae in the more recent study (**New Design**), allowing test item effects to be evaluated with more reliable data.



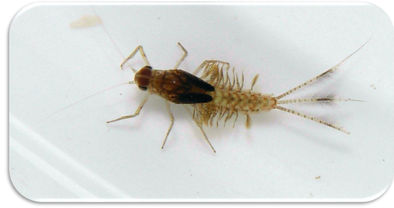
ECOLOGICAL CONTEXTUALISATION

In the caddisfly case study above, the variability in abundance over time can be partly attributed to emergence of the larval taxa during the summer. The complexity of mesocosm studies makes it difficult to interpret the data and determining which effects are as a result of the test item and biologically relevant requires expert judgement. Each taxa also has to be considered within their individual biological and ecological context. In the phyrganeidae example, knowledge of the life cycle and seasonality of this taxa is required to contextualise any direct or indirect effects.

Whilst full life-cycle studies need to be field based, it is possible to perform laboratory toxicity tests with EPT taxa using field collected organisms. Standardising field caught organisms is required to reduce variance between individuals at the start of the test, e.g. by selecting organisms based on similar sizes or life stages. Although it is currently challenging to assess, long term effects on emergence and reproduction in the laboratory can be directly recorded and extrapolated from surrogate sublethal endpoints such as growth and feeding. Three case studies are presented below.

CASE STUDY: MAYFLY GROWTH AND EMERGENCE

- Field collected *Cloeon dipterum* larvae were selected for testing based on similar sizes of organisms and the developmental stage of wing cases.
- Monitoring growth rate was achieved by regular length measurements of mayfly larvae and observations of wing case development.
- Successful growth in mayfly larvae was observed when feeding on commercial fish food.
- Successful emergence is highly dependent on the growth during the test and the standardisation of size at the start of the test.



CASE STUDY: CADDISFLY FEED CONSUMPTION AND BEHAVIOUR

- Field collected Phryganidae larvae were selected for testing based on similar sizes of organisms.
- The caddisfly larvae were fed bloodworms and feed consumption was successfully determined by recording uneaten bloodworm.
- Abnormal behaviour in response to exposure to treatment was recorded.
- Growth and emergence could not be determined in the laboratory due to long life cycles.

CASE STUDY: STONEFLY SURVIVAL

- Field collected Plecoptera larvae were selected for testing based on similar sizes of organisms.
- Although stoneflies are associated with stream habitats, high control survival was achieved by aerating vessels and providing a substrate to reduce stress.
- Emergence could not be determined in the laboratory due to long life cycles.

CONCLUSIONS

1. Further research is required to determine statistically inherent variability between mesocosms to improve statistical power and increase reliability of endpoints. Research is also required to better understand the biology and ecology of EPT taxa as supporting information for long term studies.
2. It is possible to test with field caught EPT taxa in the laboratory, however further research is required to develop and standardise methods for testing on EPT taxa, including developing suitable surrogate endpoints where reproduction cannot be feasibly replicated in laboratory conditions.