COMPARISON OF LABORATORY V'S FIELD EFFECTS FOR NON-RADIOACTIVE POLLUTANTS

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Abstract

Laboratory toxicity tests are widely recognised as key workhorses of ecological risk assessment. A range of protocols currently exist that can be used to derive concentration response data for a range of species. Whether obtained for bacteria, plants or animals, there is always a question about how well the results for any given laboratory toxicity test represent effects occurring for different species, under variable environmental conditions, for exposure temporally variable, cumulative and combined exposure in the field. In their classic paper on the potential use of species sensitivity distribution, Van Straalen and Denneman (*Ecotox. Environ. Saf.* **1989** 18, 241-51) already recognised that the use statistical model based on laboratory toxicity data to generate environmental quality standard designed to protect a certain percentage of species in natural communities would be flawed if the data used to build these models was not field relevant. They listed 8 factors that could cause different in observed effect between lab and field. Four were identified that could lead to greater field effects. These were: 1) exposure may be under sub-optimal environmental conditions in the field, but rarely is in the lab; ii) in the field, organisms may be exposed to mixtures of stressors; iii) adaptation to one stressor may entail ecological cost when faced with another stressor; and, iv) in the field, exposure is long-term compared to short-term in lab. A further four factors were identified that could cause effects to be less in the field than in the lab. These were: 1) in the field, biological availability may be lower than in lab tests, ii) in the field ecological compensation and regulation mechanisms may occur; iii) evolutionary change may allow populations to adapt to high concentrations; and, iv) contamination is heterogeneous in the field, but homogenous in the lab.

In the intervening years since the publication of the Van Straalen and Denneman paper, ecotoxicologist have gone a long way to understanding which of the factor may be the most important for defining the relationship between lab and field toxicity. Many studies have investigated the toxicity of chemical under different field relevant environmental conditions. These have shown that variables can indeed increase toxicity. However, some conditions have been shown to have little influence or even to mitigate effects. For mixtures, models to describe and predict effects have been developed. These have shown that additive is a reasonable starting point for joint assessment, although this is not always the case especially where detoxification pathways and mechanisms of effect interact. Adaptation has been shown to occur. However, this has been found to be chemical and species dependent and indeed can even be absent in some cases. One of the major areas of research has been on differences in bioavailability between laboratory and field tests. For metals in particular, the form of addition to laboratory test systems have been shown to represent a worst cases, with high bioavailability to toxic free ion forms. This evidence has led to the development of approach that can counter such effects both experimentally and during risk assessment. Finally the development of physiological models has greatly improved our understanding of how difference in exposure time affect toxicity. This relates not just to progression of effects in a single generation studies, but also to a growing body of evidence for the prevalence of multigenerational effects and their possible impacts.