Introduction

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THE FEDERAL INSECTICIDE, Fungicide, and Rodenticide Act (FIFRA) gives the U.S. Environmental Protection Agency (EPA) the responsibility of determining whether a pesticide can be registered for a particular use without causing "unreasonable adverse effects on the environment." Until recently, the potential environmental effects of pesticides have been predicted largely by laboratory toxicity tests on a few individual nontarget species that are considered to be representative indicators. However, there have always been problems with extrapolating these results to the "real world." If a species dies or lives after experimental exposure to a pesticide in the artificial conditions of the laboratory, will it also die or live after similar exposure in the environment where it naturally exists? If one particular species dies or lives in the laboratory, will its relatives similarly die or live? If some nontarget species are killed by a pesticide, what will be the net effect on the whole ecosystem in which many species interact in a myriad of ways? In very simple language, using laboratory toxicity tests to predict environmental effects has always left a very fundamental question unanswered: "So what?" Leaving this "so what" question unanswered is not prudent, considering that the regulatory decisions being made will have far reaching economic and environmental consequences.

One solution might be to test pesticides in natural ecosystems such as streams, rivers, lakes, or reservoirs, but there are problems with variability, replication, interpretation of results, and testing safety. The EPA is attempting to solve the problem of determining the ecological effects of pesticides by using the concept of the "mesocosm" (Touart 1988). For the purpose of this introduction, mesocosms can be defined as manmade, outdoor study systems that are large enough to be representative of natural ecosystems, yet small enough to be experimentally manipulated. The mesocosms that are currently being proposed for testing pesticides are either small dug ponds, ranging in size from 0.04 to 0.10 ha, or enclosures within a larger lentic environment (a lake or pond). Mesocosm tests to support pesticide registration are intended to be ecosystem-level studies that include analyses of structural and functional parameters. This represents a rapid, giant step beyond the traditional laboratory tests that have been required. These complex and expensive environmental toxicology studies are already being required to register some new insecticides (primarily pyrethroids), and it appears that they could also be required for other kinds of new pesticides, as well as many existing pesticides that have to be reregistered.

Whenever a new approach is proposed, particularly one that pertains to regulation by the federal government, it is inevitable that there will be different opinions. Some have long argued that environmental decisions should be based on ecosystem-level studies (e.g., Odum 1971, 1984; Pimentel & Edwards 1982); however, others have questioned if ecosystem theory is sufficiently developed to be useful in ecological risk assessment (e.g., Barnthouse et al. 1986). The National Agricultural Chemicals Association (NACA) has acknowledged that the mesocosm may be a theoretically sound test system but is critical of the EPA for requiring such extremely expensive tests, which, in their opinion, still have design problems and are not fully evaluated from either a scientific or regulatory point of view (Gagne 1987). The theoretical and practical questions about mesocosm testing for pesticide registration have been discussed at three workshops (two sponsored by EPA and one by NACA). Scientists attending those workshops (including the editor and most of the authors of this publication) generally have endorsed the concept but also have generated many questions, particularly regarding design, methodology, and interpretation.

To the best of my knowledge, this was the first symposium on mesocosm testing for pesticide registration to be held by a scientific society; therefore, it was intended to be broad in scope and to cover as many issues as possible. The specific goals for the symposium were as follows: