

CHAPTER 16

Conclusions

G. C. BUTLER

*Division of Biological Sciences, National Research Council of Canada,
Ottawa, Canada, K1A 0R6*

In the Introduction the new science of ecotoxicology was defined. To paraphrase that definition, ecotoxicology is a study of the effects of released pollutants on the environment and on the biota that inhabit it. According to me, the human species is the most important of the biota and thus the effects of pollutants on human health are central to ecotoxicology; the Introduction explains why a chapter was not devoted specially to this subject. There are two additional reasons for close connection between human activities and ecotoxicology: (a) human beings not only alter the environment but also produce and release pollutants on human health are central to ecotoxicology. The introduction explains or indirectly, the physical, economic, or aesthetic wellbeing of mankind.

The preceding chapters have described the behaviour of different pollutants, a variety of effects caused by them and mathematical procedures for relating those effects to their causes. From a reading of the chapters it becomes evident that the subject of ecotoxicology may be divided into the following five parts:

- (1) Chemical and physical form of the pollutant(s) released to the environment and the medium into which they are released.
- (2) Transformation of the pollutant(s) by abiotic and biotic processes during its transport from the point of release to the receptor.
- (3) Quantitative metabolism of the pollutant in transporting and receptor organisms; this permits calculations of accumulation in food chains and doses to receptors.
- (4) The effects of these doses on individuals, populations, and communities of receptors.
- (5) The results of these effects on the welfare of the ecosystem.

The views of the writers on the five elements of the subject are consolidated below:

The physical and chemical forms of released pollutants will determine their

toxicity and environmental behaviour, especially their transformation and transport. The medium into which they are released will determine which of the candidate receptors are most affected and the most probable routes of intake. It is the role of monitoring to provide information on this subject.

Many chemicals, especially non-persistent pollutants, undergo chemical changes in the environment as a result of abiotic and biotic agents. A series of metabolic alterations may result from several organisms acting in succession. As a result of such changes, pollutants may be converted to more toxic compounds (e.g. the conversion of mercury and fluoride ions to organic compounds) or to compounds more easily accumulated in food chains. These changes should be known before models for environmental transport are constructed. 'Universal' models are not possible since an individual one is usually required for each pollutant in each ecosystem. The models need to comprise the elements of time and space. Models should be tested for 'robustness' and the results should be given as estimates of uncertainty.

Much more quantitative information is needed about the pharmaco-kinetics of pollutants in living organisms. Compartmental analysis leading to time-dependent formulations of pollutant levels is a useful approach.

In studying the relations between doses and responses in single species more attention should be paid to:

- sublethal effects, especially rapid and economical screening tests for mutagens and carcinogens;
- integrative tests such as those for effects on reproduction and growth;
- the long-term effects of low levels of pollutants;
- the variation of lethal and sublethal effects on populations from different geographical areas;
- the interaction of pollutants with environmental variables such as temperature, salinity, and oxygen tension; and
- the variation in the effects of a pollutant acting alone or in concert with others.

One of the most frequently identified needs for improvement is in concepts and methods for using the results of tests on single species to predict the effects on communities existing in nature. A prerequisite is a greater knowledge of community dynamics in undisturbed systems. It has been suggested that first steps should be to establish 'standard communities' under controlled conditions or to study microcosms. There is, however, no confidence that the results of such tests would permit predictions about the effects on whole ecosystems.

With enough knowledge of ecosystem dynamics, models might be constructed, normal variations estimated, and criteria for significant perturbations produced. In this subject lie the greatest possibilities for important developments in the new science of ecotoxicology.

