Effects of Pollutants at the Ecosystem Level
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CHAPTER 7
Introduction to Case Studies

These studies are presented to compliment the survey of pollutant effects on populations, communities and ecosystems proffered in Part I. The case studies illustrate the variety of approaches used and problems encountered in assessing ecosystem-level changes. Contributors were asked to prepare case studies of stressed ecosystems which had been examined in detail and to synthesize general principles from their experiences. The studies were to be limited to those in which the ecosystem itself had been deleteriously affected. Cases in which only distribution and cycling of pollutants and not their toxic effects were studied were specifically excluded, as were those in which possible danger was identified for only a single 'target' species.

The authors were encouraged to follow a common format and to address, whenever applicable, the following points: pollutant input, ecosystem description, pollutant behaviour, effects noted on individual species, on communities, on structural and functional properties of the ecosystem (species diversity, total biomass, productivity, material balance and cycling), and recovery (characteristics and time scale, new stable configuration achieved).

The cases presented cover a variety of current or recent chemical or physical disturbances to freshwater, marine and terrestrial environments. The 'Thames Estuary Study' (Case 7.1) contains a brief historical account of the problems caused by release of sewage and industrial effluents into the Thames River, and then provides a quantitative description of ecosystem recovery following abatement measures. This contribution exemplifies nicely the usefulness of a number of analysis techniques and indices in assessing community changes related to reduction in pollution stress.

The 'Clearwater Lake Study' (Case 7.2) examines the effects of atmospheric inputs of H^+ and metals from diffuse sources on a poorly buffered lake system. A number of changes in phytoplankton, zooplankton and macrophyte communities are related to acidification. The importance of community interactions and of shifts in primary production to ecosystem function are discussed.

'Copper Gradient Studies' (Case 7.3) compares the responses of a variety of structural indices to levels of heavy metal pollution in three contaminated streams. The similarities in stressed macroinvertebrate communities between a stream receiving a controlled dose of copper and others receiving seasonally and industrially influenced inputs are discussed in terms of ecosystem tests. The dominance of chironomids as an index of metal stress is proposed.

The 'Ecological Effects of Hydrodevelopment' (Case 7.4) illustrates the use of ecosystem assessment techniques for the analysis of a physical perturbation. The mitigation of disturbances in major projects such as hydrodevelopment are also discussed, in relation to the history of the disrupted system.

The influence of oil spills on marine biota, particularly commercially exploitable species, is the primary emphasis of Case 7.5. This study examines some of the critical life processes (e.g. reproduction, recruitment) of marine fishes and macroinvertebrates which were seriously impaired as a result of the Amoco Cadiz and Gino spills.

The three concluding case studies exemplify the effects of toxic substances on terrestrial biota and ecosystem processes. The 'Impact of Airborne Metal Contamination' study (Case 7.6) underscores the gradient approach to assessing the response of a forest system exposed to a mixture of toxic heavy metals. The influence of metals on the rate of organic decomposition and the consequent disruption of nutrient cycles is examined, as a case of impaired ecosystem function.

Several of the problems encountered in the analysis of secondary effects of pesticides are exposed in the 'Fenitrothion' study (Case 7.7). The need for coordinated exposure and response assessment programmes is highlighted. The problem of identifying sensitive species with functionally important roles is examined in detail.

The reestablishment of an ecosystem on a virtually sterile land base (mine tailings) is addressed as a problem facing mining industries (Case 7.8). Despite the fact that the reseeding project was not primarily undertaken as a study of ecosystem rehabilitation, it was hoped that such a report would identify those ecosystem processes which require the greatest amount of assistance in order to become successfully reestablished (e.g. N-recycling).

Conclusions from these case studies reinforce those drawn from the literature survey and lead to the generalizations and recommendations developed in Chapter 8.