Environmental research

Acidification under attack

CAUSTIC exchanges on the topic of acid rain have been a feature of relationships between 'exporting' countries, such as the United Kingdom, and 'importers' like Norway and Sweden. But while, or perhaps because, the politicians bicker, the scientific effort to understand the causes and consequences of environmental acidification is on the increase, not least in Norway.

During the past few decades, acidifications of lakes and rivers in northern Europe has resulted in severe losses of fish, most notably the brown trout and Atlantic salmon. However, the fact that acidic waters are found in areas with acidic soils has led some scientists to cast doubt on the role of atmospheric acid deposition in acidification and to argue that it can be accounted for by changes in the terrestrial ecosystem. This controversy has raged over the past fifteen years or so stimulating much research into the effects of atmospheric acid deposition on soils, lakes, fish and trees.

Detailed studies of soil chemistry have provided convincing evidence that acid rain is the cause of the transfer of acidity from soils to their surface waters and thence to lakes and rivers. One of the critical questions is how quickly and to what extent the damaged ecosystems respond to changes in atmospheric acid deposition. The water quality changes of interest occur over years in natural systems, so direct observation of the dynamics of these changes requires lengthy time series data.

The five-year international RAIN (Reversing Acidification In Norway) project is looking at links between deposition and freshwater acidification. At Sogndal in north-west Norway, where there is no acid rain, experimental acidification of the precipitation is allowing the effect of acid rain on a previously clean environment to be monitored. At Risdalsheia in southern Norway, which is one of the worst-afflicted areas, acid precipitation is excluded from a headwater catchment by means of a roof and is then purified to a pre-acid condition and sprayed onto the catchment. Richard Wright of the Norwegian Institute of Water Resources (NIVA) is a driving force behind this project and says that the results "show that the chemical changes caused by acid deposition are largely reversible".

Much of the research on soil, surface water and fish forms part of the Surface Water Acidification Project (SWAP), a joint venture of the Norwegian Academy of Sciences and Letters, the Royal Swedish Academy of Sciences and the UK Royal Society, and supported by the UK Central Electricity Generating Board (CEGB). The focus is on the biological, chemical and hydrological factors that are important in determining whether water quality is acceptable for fish, and on the effects of reduced deposition of anthropogenic sulphur on surface waters.

Considerable work on the modelling of sulphur and nitrogen deposition has been performed at the Norwegian Meteorological Institute in Oslo. This work was first started around 1972 as part of an OECD programme on acid deposition in Europe and has subsequently developed under the sponsorship of the United Nations EMEP programme. All participating countries have to give total annual emission data for the relevant pollutants. According to the institute's Professor Anton Eliassen, all Western European countries give more-or-less gridded data on emissions (the grid scale of the model used is 150 km) but "some have difficulty in agreeing on emission distribution".

A new model for nitrogen oxide emission has been developed this year in collaboration with Øystein Hov of the Norwegian Institute for Air Research. Comparisons between measured and calculated data generally show good agreement although there is a systematic underestimation of nitrate in precipitation. Nitrogen oxides are transported at least as far as sulphur oxides with deposition differences reflecting the geographical distribution of sources.

Since Norway, like other Nordic countries, has a substantial industry based on wood, there is particular concern over the effect of acid rain on trees, a matter of considerable controversy among Norwegian scientists. Opinion is divided among those who believe that forest damage is caused largely by climatic change, those who feel that changes in soil chemistry are the key, others who attribute the damage primarily to acid deposition on the needles and those who believe it is due to a combination of all these.

Eliassen says that "there is a great deal of tension among forestry scientists in Norway". In part this stems from an SNSF project set up by the Norwegian government in 1972. One of the underlying assumptions was that acid rain was responsible for forest damage. Some scientists seem to have resented this assumption, over-reacted and set themselves to prove that acid rain was not the major cause. By contrast, there is little dissent among Swedish scientists who share the view of Jan Nilsson of the Swedish Environmental Protection Board that acid deposition has caused a dramatic change in soil chemistry in southern Sweden which has undoubtedly stressed the trees. □

'Green' ministry goes critical

THE 'critical load concept' has become an oft-used phrase in acid rain policy. The critical load, defined as the highest deposition that will not cause chemical changes that will lead to long-term harmful effects on ecosystems, was accepted as the basis for negotiations in Geneva on transboundary pollutants in November 1986. For sulphur, the critical load is 3–5 kg per hectare per year for the most sensitive ecosystem. For nitrogen, it is 10–20 kg per hectare per year. Current research in Sweden is planned to determine the critical loads for different types of ecosystems. Negotiations based on critical loads have yet to be carried out.

Per Bakken of the Norwegian Ministry of the Environment says that the critical load concept is "more or less agreed" among the Nordic countries, and Norway is aiming to

Per Bakken: can his ministry "save the rain"?

reduce emissions accordingly.

The Norwegian government will be applying stricter standards for all types of heavy truck in the 1990s and catalytic converters will be fitted on all new cars from the beginning of the 1990s in an attempt to reduce their nitrogen oxide emissions. But the many boats in Norway that are sources of nitrogen oxide emissions create a more serious problem because people do not often buy new boats and it is difficult to convert them to comply with regulations.

Sweden plans to decrease sulphur dioxide emissions by 65 per cent and nitrogen oxide emissions by 30 per cent between 1980 and 1995. All new petrol-driven cars will have to be fitted with catalytic converters to reduce emissions from 1989 and many new cars are already so equipped. But both Norway and Sweden feel strongly that other countries, especially Britain and Poland, need to do more to control their 'exports'. □