

ENVIRONMENTAL HEALTH CONSIDERATIONS IN THE ARCTIC

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Abstract. The author stresses that the arctic environment is not only threatened by the adverse effects of local development, but by global influences whose sources frequently lie thousands of kilometres away from the circumpolar region. The fragility of the arctic ecosystem is emphasized, with simple food webs, shallow soil cover and a very short growing season. The effects of long-distance transport of air pollution, in terms of acid deposition, accumulation of heavy metals and organic materials and 'the greenhouse effect' are summarized, together with the appearance of 'holes' in the ozone layer, linked with the discharge to the atmosphere of various organic gases. The effects of the Chernobyl nuclear accident has been particularly important in relation to the accumulation of caesium in the arctic food web.

The second part of the paper deals with the effects of local development, in terms of urbanization and industrialization, with the need for special attention to appropriate housing and the provision of public utilities including water supply and waste disposal, which pose particular problems under arctic conditions.

The author stresses the need for the adoption of systematic environmental assessment procedures, whereby the effects of development could be predicted and promotion of the concept that 'prevention' is nearly always cheaper and more effective than 'cure'. An essential is systematic monitoring of a wide range of physical, chemical and biological parameters so that trends may be identified and necessary remedial action taken in good time.

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The Arctic environment is not only being confronted by widespread local development, including new settlements, large-scale mineral exploitation and other industries, but is being increasingly affected by global influences, whose sources frequently lie thousands of kilometres away from the circumpolar regions.

The ecosystem of the Arctic is extremely fragile, with simple food webs, shallow soil cover and a very short growing season. Its atmosphere is being increasingly affected by long-distance transport of pollutants, resulting in an increased prevalence of mists in the winter months, of acid deposition, deposit of both heavy metals and a wide range of organic materials, and—as a result of the Chernobyl accident—deposition of radionuclides, including caesium 134 and 137. In addition, increasing burning of fossil fuels is progressively causing a greenhouse effect, with potentially profound effects on the Arctic climate. In the case of the Antarctic, there is recent evidence of the appearance of "holes" in the ozone layer, and there is increasingly strong evidence of this being linked to the

discharge to the atmosphere of various organic gases.

It is encouraging that an increasing amount of work is now in progress to monitor trends in the effects of air pollution in the Arctic, including investigations into short-term accumulations in snow cover and longer-term accumulations in the icecap.

Man is also having a serious local influence on Arctic areas. Development has so far been intensive rather than extensive, due to limited accessibility of areas remote from the main townships. Among the major features during recent years have been migration to urban areas by the indigenous population, migration to the Arctic by newcomers, changes in lifestyle (nutrition, tobacco, alcohol), changes in expectations (housing, consumer goods, communications) and changes in occupations (industry, construction, tourism).

First, let me refer in a little more detail to the distant developments which are affecting the Arctic environment as it is essential that the day-to-day, bread-and-butter issues affecting Arctic communities should be seen in the context of the unique Arctic environment

and threats to its health and well-being coming from man's activities in the more populous parts of the world.

Thus, among major environmental priorities which are regarded as being of global concern, such as desertification, destruction of rain forests and the pollution of enclosed seas, should also be the special and unique problems of the circumpolar areas.

Let me first deal with some problems associated with air pollution.

We all know of the haze which appears to be progressively affecting extensive areas of the Arctic, particularly in winter.

There are several special features about the circumpolar atmosphere:

- sub-zero temperatures
- little precipitation
- stable stratification which prevents vertical mixing
- low solar radiation levels.

The pollution comes mainly from Eurasian sources, travelling north-east in winter, in periodic surges, perhaps 40% from the west Soviet Union, 35% from west Europe and 25% from central Europe.

Three sorts of aerosol appear important:

1. acidic, accumulation-mode particles. These cause hazes and reduce horizontal visibility. They contain light absorbing soot;
2. coarse particles. These are optically less active and are derived mainly from sea-salt and from soil;
3. giant particles. These represent a substantial part of the aerosol mass. They have a low settling velocity compared to (1) and (2), so they remain suspended. They are probably largely soil derived and are incorporated with ice crystals.

In terms of gaseous pollutants, there is ample evidence that CO₂ levels are increasing, contributing to the greenhouse effect which is now being held responsible for increasing ambient temperatures, and with potentially vast implications in the next century, in terms of melting of the polar icecap and resulting rises in sea-level, for example in Europe. If this trend is not reversed, its implications for agriculture in different climatic zones could have profound effects on global politics and on national economies, not the least in the Arctic.

SO₂ levels are also increasing and there is excellent correlation between increasing emissions since 1910 in Europe and the conductivity of melt water in north Canada. Deposition of pollutants is affected by precipi-

itation scavenging (wet deposition) and direct uptake at the earth's surface (dry deposition).

Organic gases can play an important role as infrared absorbers, for example, C₂-C₆ hydrocarbons, chlorofluorohydrocarbons, CCl₄, CHCl₃, etc. CF₃Br is also important, being utilized in high technology electronics. There is now a threat to the stability of the ozone layer, with so-called "holes" appearing over the Antarctic.

Many measurements of acidity, metals and pesticides are now being made on the snowpack and in glacial ice.

Very low pH values are being obtained in rain and snow from some areas. In addition to ecological effects, the acidity in drinking-water may in a few cases be low enough to corrode metal fittings in the supply system with resulting increases in metal content in the water reaching the consumer.

Pesticides are being carried to high latitudes in ever-increasing quantities from very remote sources. Accumulations are now becoming manifest in the Arctic animals and fish which form a large part of the staple diet of the indigenous people.

Pollution by heavy metals from atmospheric fall-out is of importance in Arctic food webs and we are aware of the high levels of mercury being accumulated by northern people with a high fish diet. The classic work on deep cores taken from the Greenland icecap showed the increasing levels of lead deposited from the atmosphere since the growth of industrialization and vehicular traffic. Recent work by the European Office of WHO, in which the Arctic dimension should be taken into account in future, is showing that very small concentrations of lead in blood, perhaps below 10 mg/100 ml, can have effects on children's intelligence, behavior and learning ability. In fact, although the situation is clouded by many confounding factors and uncertainties, these epidemiological studies appear to be indicating a lack of threshold.

It might also be useful for northern populations to be included in the WHO European Office studies on the influence of cadmium on renal dysfunction and on the effects of methylmercury from seafood on pregnant women and the fetus. At present this study is limited to the Mediterranean countries, where a relatively small number of people derive a major proportion of their protein intake from eating fish.

Summarizing, it is important that we should have a better understanding of the situation concerning Arctic air pollution before too many alarm bells start ringing. There is no doubt that, in winter, the Arctic air

mass is more "pollutable" than any other in the northern hemisphere and pollutants are much less readily dispersed and removed.

At the time of the nuclear bombs atmospheric tests about 25 years ago, it was already known that the fragile and relatively simple and direct Arctic food webs were particularly susceptible to the effects of fall-out of radionuclides. The Chernobyl accident, in the follow-up to which the WHO Regional Office for Europe was deeply involved, had serious consequences for the Arctic environment. In particular, the vagaries of wind and rain led to particularly heavy deposition of caesium 134 and 137 in certain areas, with effects quickly manifesting themselves in lichen, berries, fungi, reindeer and other mammals, and fish. Rapid action, not always well-coordinated but nevertheless effective from the standpoint of public health, prevented the most likely effects on man, but there have been very serious results on local economies and the way of life of affected communities. It will be many years before the caesium in certain products return to previous levels.

The WHO Regional Office for Europe is holding an important working group this week in Ulm, Germany, on the health implication of caesium pathways and is now establishing a steering group for the epidemiological follow-up to Chernobyl, in USSR and elsewhere.

It now turn to some of the more local environmental health issues affecting Arctic communities. Water supply and sanitation pose special problems, as does the disposal of solid wastes. The Regional Office has now progressively developed and revised a draft manual on management of public utilities in cold climate conditions. A meeting to review and complete the entire work will be held in Greenland in October 1987 and it is expected that experience will be available from Sweden, Finland, Norway, Denmark, Iceland, USA, Canada, China, Chile, Argentina and, hopefully, USSR and Mongolia.

There is now rather rapid growth in many Arctic settlements. Up until about 1950, many townships comprised small primitive wooden huts or peat wall dwellings. Tuberculosis was rife and in some places was responsible for 50% of deaths. The level of health was often very low, with housing conditions and nutrition largely responsible.

In a number of countries, there was thereafter a dramatic swing. Large sums of money and much undoubted enthusiasm were thrown at the problems. Perhaps understandably, many mistakes were made.

There was ignorance of engineering skills to combat the climatic conditions and ignorance or insensitivity in disregarding cultural values, and the way of life of the local people. No issue has been more contentious than the decisions to build large apartment blocks, following a trend towards system building which has resulted in huge social problems in many countries. The Arctic people in particular resented the absence of rooms in which they could store their outdoor clothing and fishing, hunting and boating equipment and where they could skin and prepare fish and other marine products. They missed the space which they were used to around their dwellings and, indeed, the breathtaking views to which they were accustomed. The "concrete jungle" became a feature of a number of Arctic townships.

At the time, there were apparent good reasons for the decisions to construct these apartment blocks, especially in terms of economics and energy conservation. Much has subsequently been learnt as the result of hard-won experience. The very real benefits of central heating, thermal insulation and good water and sanitation are increasingly being accompanied by more sensitive town planning and architecture. Much has also been learnt in relation to such important design features as (i) "cold roofs" to prevent the unfortunate effects of snow melt and causing heavy loading of icicles around the eaves of buildings, and (ii) the construction of building foundations above snow-melt level and (iii) the construction of ditches along township roads to cope with high water levels in springtime. Various forms of utilidor, in the permafrost, to take water, sewerage, district heating, power and telephone cables are now being installed at lower relative cost than a few years ago. Appropriate disinfection systems for water supplies are becoming available.

Many changes in town planning procedures are reflecting community dissatisfaction with the over-centralized and over-bureaucratic approach which developed in many places over the last 30—40 years. Community involvement is increasing and there has been a progressive growth in self-confidence. After a rather general, and in many ways, flexible, structural plan has been developed, much should rightly be left in the hands of local democracy.

It increasingly happens that an Arctic community is confronted with very large-scale development, perhaps related to mineral exploitation or the establishment of new industry or port facilities. The process of environmental impact assessment is now becoming more

generally accepted as a useful tool for predicting likely effect on the environment and hopefully modifying plans in such a way as to minimize the impact. Such an assessment should be made in good time before irrevocable decisions are made, it should be comprehensive and it should study alternative scenarios for development. The necessary skills must be available when called for and it is not reasonable or practicable to expect that they can be totally found at the level of a small Arctic community, taking into account the wide range of disciplines which must be involved. Nevertheless, the active involvement of the local community is a *sine qua non*.

Such environmental impact assessments have, in the past, concentrated on predicting effects on the natural environment, rather than public health. A recent survey by the WHO Regional Office for Europe into impact assessments for 13 petrochemical developments showed that only one had seriously dealt with health issues.

A national workshop, held in Canada two weeks ago, recommended that environmental and health authorities should in future be equally involved in impact assessment. Such a process would necessitate the generation of reliable and relevant baseline data on health statistics and environmental monitoring (including, where necessary, human tissue) and the development of projections covering the work force and the

general population, including particularly vulnerable groups. Environmental impact assessment is a far cry from the traditional role of public health personnel in most countries, but it is essential that the necessary skills are learned and that the necessary legislative and administrative machinery should be in place, if public health is to be regarded as of equal importance to the safeguarding of wilderness areas and of flora and fauna.

At least there has been a move forward during the last decade, with perhaps less arrogance by many sections of the community (including the medical professions and WHO!) towards man in relation to his environment. For millennia, the northern people lived as part of nature and not in opposition to it. It is hoped that greater humility, sensitivity and understanding will become manifest in relation to the circumpolar environment, both in terms of local developments and those taking place at a great distance, which are beginning to have profoundly disturbing effects on the Arctic and Antarctic regions.

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