

The Effect of Climate Change on Human Activities

There are at least six very different ways in which climate change may lead to an alteration of contaminant pathways through a modification of human activities. First, people on the margins of the Arctic Ocean will make dietary choices, as they have always done, based on the availability of traditional country foods including terrestrial and marine animals (Krupnik, 2000; McGhee, 1996; Vibe, 1967). Second, a marginal sea that clears of ice for large portions of the year will encourage shipping, tourism, oil exploration and other industrial activities each of which brings with it associated contaminants. Furthermore, enhanced shipping increases the risk of introducing exotic species or diseases which then affect indigenous species. Third, the encroachment of commercial fisheries into the Arctic could alter the food web structure in oceans (Bockstoce, 1986; Parsons, 1992; Pauly *et al.*, 1998, 2001) and lakes (AMAP 2003b; de Graff and Mychasiw, 1994). Fourth, climate change may promote the spread of insect pests globally forcing some countries to re-introduce or increase the use of pesticides. Fifth, climate change toward conditions suitable for domestic crops may encourage further expansion of agriculture or silviculture within the Arctic drainage basin along with increased industry. Lastly, the various changes listed above will probably contribute to demographic shifts and population increases in northern regions, which will in turn lead to increased local releases of contaminants (for example from burning, power and fuel consumption, use of industrial or agricultural products).

It is well known that the dietary composition of the human 'food basket' (e.g., marine versus terrestrial foods, fat versus protein, older fish or seals versus younger fish or seals) controls the amounts and kinds of contaminants ingested (AMAP, 1998; Kinloch *et al.*, 1992; Van Oostdam *et al.*, 1999). Dietary changes can be forced by fluctuations in the populations of target species as discussed in chapter 4 (e.g., beluga (*Delphinapterus leucas*), bowhead whales (*Balaena mysticetus*), walrus (*Odobenus rosmarus*), seals, bears, birds, fish, caribou/reindeer (*Rangifer tarandus*), muskox (*Ovibos moschatus*)) or by changes in access to the species (early melt, permafrost

degradation, open water, loss of multi-year ice, late freeze-up (see, for example, Fast and Berkes, 1998; Riedlinger, 2001)). Because the manner in which contaminants enter and concentrate in these two food webs is so different, the balance between terrestrial and aquatic food items in the food basket will be a pivotal point of change in exposure to biomagnifying contaminants.

With marginal seas clear of ice for long periods of the year, it is inevitable that the Arctic will become a favoured shipping route between Europe, Asia and North America either via the Northern Sea Route (Russia) or the Canadian Arctic Archipelago. Shipping brings with it specific, well-known contaminants such as hydrocarbons and marine antifoulants (e.g., tributyltin) and, potentially, non-indigenous species in ballast water. The major concern, however, is likely to come from accelerated oil exploration and development on the Arctic continental shelves of North America and Eurasia (Bakke *et al.*, 1998).

Outside the Arctic, global warming and alteration of hydrological cycles will probably cause insects and other pests to flourish in some locations. Many of the Arctic's problematic pesticides (toxaphene, DDT, hexachlorohexane (HCH)) continue to be used in central America, Africa and Asia, particularly by developing countries, and it is these countries that may be forced to rely more heavily on pesticides in coming decades (Harner, 1997).

Within Arctic drainage basins, warming may expand the area suitable for agriculture. Much of the southern portion of the Mackenzie Basin in North America is presently cultivated; under a global warming scenario this region is projected to contribute an additional 10 million hectares of land suitable for small grain crops (Cohen, 1997b), an area that might be further expanded with the development of new 'climate' resistant crops. In Russia, most of the major Arctic river basins contain agricultural land, particularly within the river valleys and as far north as 65°N (including the Severnaya Dvina, Ob, Yenisey and Lena River basins). Agriculture brings with it pesticides and other chemicals and, should pests thrive in a warmer Arctic climate, farmers may resort to increased reliance on pesticides to protect crops.