Long-Range Transport of Persistent Pollutants in the Northern Hemisphere

(Schadstoff-Ferntransport in die Arktis)

[UWSF – Z Umweltchem Ökotox 13 (4) 2001]

Roland Kallenborn and Dorte Herzke

Norwegian Institute for Air Research, The Polar Environmental Centre, NO-9296 Tromsø, Norway; e-mail: rok@nilu.no

The Arctic is still considered as one of the few unpolluted regions in the world. This is true if one compares the Arctic region with middle latitude regions which are influenced more by human activities. However, the Arctic region is not isolated from all human impacts. In recent years, high concentrations of persistent pollutants (organic chemicals, metals) were detected in top predators of the Arctic food chain and indigenous peoples from the Canadian and Greenland Arctic, although no local contamination sources are known. The comprehensive, scientific investigations of the past 20 years confirmed that the combination of atmospheric and waterborne long-range transport is the major source of the high concentrations of persistent organic pollutants (POPs) in the pristine Arctic environment. However, also pelagic marine organisms (e.g. Atlantic cod, marine mammals) can transport large amounts of persistent pollutants in their lipids and introduce contaminants into the Arctic food web. Thus, the pollutants are transported into the Arctic and subsequently accumulated through the short and unbranched Arctic food web of the top predators. The most accepted theory nowadays describes the long-range transport of persistent pollutants as a combination of atmospheric and sea current transport, or as a 'global distillation' process. Depending on such physical properties of the substances as vapour pressure and the ambient temperature, persistent (semivolatile) contaminants are transported over different distances prior to deposition (sea surface, sediment, soil). After the deposition, however, and depending on the weather conditions and surrounding temperature, persistent pollutants will be re-evaporated into the atmosphere and undergo further atmospheric transport to the Arctic region. This pro-

cess is also called the 'grasshopper effect'. The global transport of persistent pollutants into Arctic regions can be described as a repeatedly occurring combination of atmospheric and waterborne transport in which the main transport vehicle depends on the physical properties of the transported compound. The role of characteristic meteorological conditions in the respective climate zones through which the contaminant is transported must not be underestimated. Strong seasonal differences in temperature and precipitation rule the global weather situation. Therefore, seasonal pattern differences occur for the distribution of some persistent pollutants in the Arctic environment depending on average temperature, main wind and sea current directions, humidity and daytime light conditions (causing photochemical degradation).

The consumption of traditionally hunted marine mammals (seals, whales) was identified as one of the main reasons for high contamination burdens in the Canadian and Greenland Inuit populations. Consequences and counter measures against high contamination loads in the Arctic human populations and ecosystems are currently under discussion. However, no comprehensive measures concerning restrictions of hunting traditions are taken by the respective governments to date due to the primary social consequences which are to be expected. The advising experts argue that such a restriction would destroy the original social structures of the Inuit populations. Therefore, the drawbacks of such a hunting restriction would weigh heavier than the expected positive effects of the reduction of contaminant burdens ('Arctic dilemma').

Forthcoming in UWSF – Z Umweltchem Ökotox 2001

Persistent Organic Pollutants in the Southern Hemisphere

Jochen F. Müller

National Research Center for Environmental Toxicology, 39 Kessels Road, Coopers Plains 4108 Qld, Australia

Biomagnification of Hexachlorobenzene: Influence of Uptake Routes in a Laboratory Test

Philipp Egeler, Michael Meller, Jörg Römbke, Peter Spörlein

ECT Oekotoxikologie GmbH, Böttgerstr. 2-14, D-65439 Flörsheim/Main, Germany

Tributyltin on its Way to the 'Top of the POPs'?

Peter Luthardt, Jochen Schulte und Matthias Strickeling

GfA – Gesellschaft für Arbeitsplatz- und Umweltanalytik mbH, Otto-Hahn-Straße 22,
D-48161 Münster-Roxel, Germany