Dear Friends: The following are some preliminary conclusions of the work of the Expert Group on the Impacts of Climate Change on POPs. The entire paper due for completion in late December, 2010 will be presented as a report to the Conference of the Parties to the Stockholm Convention in May, 2011 as information for Parties and Observers. This preliminary material is presented as a courtesy and should not be copied or cited.

1 General trends

The Stockholm Convention includes important obligations to reduce or eliminate releases from intentional production and use and requires parties to take measures to reduce the total releases of unintentionally produced POPs with the goal of their continuing minimization and where feasible ultimate elimination. Reductions in the manufacture, use and disposal of many of the original twelve POPs listed under Annexes A, B and C of the Stockholm Convention (*i.e*., the legacy POPs) have led to a general global decline in environmental concentrations. However, levels of some individual POPs (e.g., DDT, hexachlorocyclohexane and hexachlorobenzene, commercial pentabromodiphenylether, commercial octabromodiphenylether and perflurooctanesulfonate) may not decline as rapidly or may even increase in regions most affected by climate change. For newer POPs, for which regulations are only now entering into force or for which restricted uses are permitted, levels are not likely to decline for several years and may increase in most climate change impacted regions.

2 POPs Releases

Past and current manufacture, use and disposal of intentionally produced POPs lead to primary releases into the environment; however, overall trends of future releases of POPs are difficult to predict. Climate change will affect primary emissions of POPs by changing their rate of mobilization from materials or stockpiles due to higher ambient temperatures, or by altering use patterns or increasing demand for some POPs, e.g., DDT for disease vector control. Therefore, the intended results of the Stockholm Convention could be negated by climate-related factors should they lead to greater use and releases of some POPs.

3 Environmental fate of POPs

After primary release, POPs circulate via environmental media until deposited in environmental sinks. Secondary releases are described as revolatilization and remobilization from these sinks. The secondary release of POPs is a confounding factor in the interpretation of monitoring data. There is considerable uncertainty whether primary or secondary releases dominate on a regional basis.

The global, regional and local scale environmental fate of POPs will be affected by several factors related to climate change:

a. remobilization (secondary releases) from environmental reservoirs due to increased temperature and/or extreme events such as flooding;
b. increased airborne transport to locations downwind of main emission areas because of higher wind speeds and stronger air circulation (mainly relevant on a regional scale, *i.e.*, hundreds to thousands of km);
c. enhanced degradation of POPs if microorganisms have higher degradation capacity, but also increased formation of potentially POP-like transformation products; and
d. changes in deposition patterns due to changing precipitation patterns (spatially and temporally), which are mainly relevant at both the local and regional scale.

4 Exposure to POPs

As climate change alters primary and secondary releases of POPs, levels and patterns of exposure in wildlife and humans will change. Climate change is already altering food web structures in some areas. This will be an added influence on the exposure of wildlife and humans to POPs. However, there are large uncertainties concerning how climate change will affect ecosystem and food web structure. Given the small amount of baseline exposure information for POPs in many parts of the developing world, uncertain predictions of regional changes in climate, and uncertain ecosystem response to these changes, it is currently not possible to evaluate accurately how climate change will impact exposure of animal and human populations to POPs.

5 Effects on Biota

Overall, POPs are known to have direct adverse consequences on individuals of a species and can affect population size. Most significant are the endocrine effects of POPs which may directly affect fecundity and/or survival, and thus have direct consequences on an individual basis, as well as on population size. Endocrine disrupting POPs can also interfere with physiological and behavioural processes in animals which are important for adaptation and response to climate change. For instance, POPs impair the ability to respond to changes in environmental temperature. Endocrine disrupting POPs can also reduce the replenishment of heavily exploited stocks or populations and the immunosuppressive effects of POPs may facilitate the spread of disease and have other negative impacts on populations.

Several climate-related factors will modulate the toxicity and toxico-kinetics of POPs. These factors include salinity, ocean acidification, eutrophication, water oxygen levels, changes in the nutritional status of individuals/species, temperature change and the adaptability of individuals/species, and the proliferation of parasites and pathogens. These changes could enhance, either alone or in combination, the toxic effects of POPs and ultimately increase species vulnerability. Particular species with low genetic variability (as it is the case in some areas where DDT is applied) could face increased risk of extinction. Ecological effects of climate-related changes and POPs toxicity can be manifested as a top-down or bottom-up stress that cascades through the ecosystem.

In addition to POPs and climate-related impacts, ecosystems are also exposed to several other anthropogenic stressors such as habitat loss and fragmentation, over-harvesting of fish and wildlife populations, eutrophication, petroleum-related activity and urban and agricultural discharges. The combination of some or all of these factors can push species beyond their environmental tolerance limits and significantly reduce the rate of replenishment of harvested stocks or populations.

6 Human health effects of POPs

At elevated concentrations POPs are well known for their adverse effects on individuals and human populations. Those at most risk from the effects of increased exposure to POPs include the developing fetus (e.g., growth retardation, impaired neurological development), children (e.g., cardiovascular disease, immune-suppression, metabolic disorders, neuro-behavioural impairment) and women of reproductive age (e.g., endocrine and reproductive effects). Recent data suggest that the elderly, who have been exposed for a life–time to mixtures of POPs, may also be vulnerable to late-onset chronic disease (e.g., cardiovascular disease, metabolic disorders including diabetes and thyroid dysfunction, bone disease and cancer).

Data on current human exposure levels to POPs from many regions in the developing world are unavailable. This paucity of exposure data combined with uncertainty in climate change models for these same regions make predictions of changes in exposure to POPs and risks to health difficult. It is probable that subsistence consumers (especially those harvesting food from the aquatic/marine environment) are at a higher risk due to contamination of their traditional food sources. Indigenous people in the Arctic are known to be exposed to some of the highest levels of environmentally transported POPs and may become even more exposed from remobilization and revolatilization of some POPs (hexachlorocyclohexane and hexachlorobenzene) from melting polar ice and from the Arctic Ocean. Individuals who live in the regions most affected by climate change may spend more time indoors and be exposed to higher levels of typical indoor POPs (e.g., perflurooctanesulfonate, polybrominated diphenylethers). Individuals living in or near regions where DDT may be applied for public health reasons, e.g., to control the increase in prevalence of disease vectors, will become more exposed to this POP.

Several climate-related factors will combine to aggravate the effects of POPs on humans, e.g., excessive heat or greater cold, overcrowding and disease spread associated with population migration, increased exposure to vector-borne diseases and other microbial pathogens, changes in the availability and quality of traditional foods. Other determinants of health (e.g., socio-economic status, education, adequacy of shelter, and general health status) may also combine to adversely affect human responses to POPs and climate change.

7 Mitigation co-benefits

Mitigation actions to reduce greenhouse gas emissions and short-lived climate forcers (e.g. black carbon) are expected in most cases to result in simultaneous reductions in emissions of unintentionally formed POPs and other contaminants of concern. These reductions may be expected for emissions from major anthropogenic sources of carbon dioxide, including stationary combustion of fuels, incineration of wastes, and transportation. In some cases, however, such as increased use of biomass as fuel for heating and cooking, unintentional POPs emissions may increase.

Technological and non-technological options for climate change mitigation can be considered when discussing co-benefits for reductions of unintentional POP. Major technological options include switching fuels, improving combustion efficiency, improving heat recovery and better recycling, and changing combustion technologies. Non-technological measures contributing to co-benefits include measures such as introduction and enforcement of regulations.

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