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# ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

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**Fish from sensitive ecosystems as bioindicators of global climate change (High-Arctic 1997-2009)**

Global Circulation Models (GMCs) predict maximum warming in high mountain and polar regions. Due to similar environmental characteristics (e.g. long ice-cover, oligotrophy) high-altitude and high-latitude lakes are very sensitive ecosystems where even slight environmental changes (e.g. input of pollutants, climate change) may substantially affect ecosystem function.

HIGH-ARCTIC 1997-2009, an ongoing multi-year study coordinated by G. Köck and D. Muir (Environment Canada, Burlungton Canada), and carried out in cooperation with various Canadian research facilities, is investigating the effects of short-term and long-term climate change on freshwater ecosystems in the Canadian High Arctic and in the Austrian Alps. The study illustrates that global warming may endanger fish populations from Arctic and alpine lakes by leading to an increase of both metal accumulation and stress. Comparison of metal levels (e.g. cadmium) and biochemical stress indicators in Arctic char (*Salvelinus alpinus*) collected from Canadian Arctic lakes revealed marked seasonal and interannual trends in the turnover of metals, as well as stress responses in the liver. Results indicate metal accumulation and level of stress to be higher the warmer the summers are in the Canadian Arctic. Predictive relationships between lake temperature and metal uptake were similar for high Arctic lakes and previously studied Austrian high mountain lakes, thus confirming water temperature to be a driving force of metal accumulation in char from these sensitive ecosystems. Furthermore, additional data indicate bioavailability of mercury to fish to increase with ambient temperatures.

The observed effects provide clues as to what would happen to the extremely vulnerable land-locked char populations in the event of a longer-term, synoptic warming trend associated with global climate change. We speculate that the projected warming conditions could be a serious threat to the stability of Arctic char populations in high latitude and high altitude lakes.

The study illustrates that fish from high latitude and high altitude lakes appear to be sensitive bioindicators of the interactive effects of pollution and global climate change.

*Effects of climate warming on Arctic freshwater ecosystems:*

- Increase of metal accumulation in freshwater fish
    - Negative effects on stability of fish populations
    - Risk of increasing contamination (in part. mercury) for humans
    - Effects on biodiversity: Animal species shifts (fish species from the South will move in; neobiota)

**Recommendations:**

- MAB Biosphere reserves are excellent sites for long-term monitoring. Furthermore, they could serve as learning sites for adaptation and mitigation processes. Taking into account that currently only five BRs (Russian Federation: Taimyrsky Biosphere Reserve, Laplandskiy Biosphere Reserve; Denmark: North East Greenland Biosphere Reserve, Sweden: Lake Torne Biosphere Reserve; USA: Lake Torne Biosphere Reserve) are existing in Arctic regions, it would be highly desirable to establish a circumpolar network of BRs.
- High mountain lakes and Arctic lakes are very similar ecosystems, in particular in their sensitivity to climate warming and pollution. Studies show that knowledge derived from high-mountain lakes can to a large extent be transferred to Arctic lakes (and vice versa). In consequence, comparative research in high-mountain BRs and protected areas (BRs, national parks) in Arctic regions should be facilitated and intensified.