The toxicity of PAHs in European mountain lakes

Long-range atmospheric transport of polycyclic aromatic hydrocarbons (PAHs) has polluted sediments in high mountain lakes in Europe. Recent research has found that lakes in northeastern Europe are a hotspot for PAH contamination, and concentrations of these toxic compounds were also above the ‘no effect’ threshold in lakes in north, central, west and southeast Europe.

PAHs are a large group of chemical compounds found naturally, for example, in oil and coal. PAHs are also emitted to the environment as the result of human activities, particularly from the incomplete combustion of fossil fuels and other organic matter, such as the burning of wood.

Emissions of PAHs can be transported long distances in the atmosphere, contaminating remote regions far from the source of pollution. Most PAHs are not very soluble in water and can settle on the bottom of water bodies, such as lakes. The wide distribution of PAHs is of concern because the compounds can persist in the environment and cause long-term adverse effects: many PAHs have toxic and carcinogenic properties that can affect a variety of organisms.

In this study, conducted under the EU EuroLimpacs and ArkRisk projects, the researchers assessed the concentrations and toxicity of PAHs in the sediment of 14 high mountain lakes across Europe. Lakes were selected from different geographic regions: the west (Maam (Ireland), Escura (Portugal), Cimera (Spain), La Caldera (Spain) and Redo (Spain)); the central region: Noir (Switzerland), Schwarsee ob Solden (Austria) and Gossenkolkeesee (Austria); the northeast (Dlugi and Starolesnianske (both in the Tatra Mountains in Slovakia and Poland)); the southeast (Bubreka (Bulgaria) and Negru (Romania)); and the north (Øvre Neadalsvatn and Arresjøen (both in Norway)).

Calculated concentrations of the PAHs were compared with sediment quality guidelines and toxic equivalent factors (used to assess mixtures of PAHs of different toxicities) in order to determine whether the toxicity levels found in the lake sediments could cause harm to those ecosystems.

All the lakes had total PAH concentrations above the “no effect” threshold. This is the level, below which no adverse toxic effects on organisms could be expected. The lowest concentrations of total PAHs were found in lakes in the central, west and north lake districts, whilst the highest values were found in lakes in the northeast.

However, only lakes in the Tatra mountains (Slovakia/Poland) in the northeast region had total PAH concentrations above the level where probable effects were likely to be observed. Chrysene+triphenylene, dibenzo[a]anthracene, benzo[k]fluoranthene and indeno[1,2,3-cd]pyrene were mainly responsible for the toxicity of the mixture of PAHs. Benzo[k]fluoranthene and indeno[1,2,3-cd]pyrene contributed 84 per cent of the total toxic effect. It is likely that the PAHs found in these lakes have been emitted from regional sources.

Previous studies have found high concentrations of PAHs in lakes in the Tatra mountains: this study has assessed the toxicity to organisms of these PAH mixtures. The researchers suggest their approach for addressing risks from mixtures of PAH compounds can provide toxicity unit indices for lake sediments that are consistent with experimental studies on the estrogenic (hormonal) effects on sedimentary organisms and the biochemical response of cells in fish found in the same lakes.

1. Euro-limpacs (Evaluating the Impacts of Global Change on European Freshwater Ecosystems) was supported by the European Commission under the Sixth Framework Programme. See www.eurolimpacs.ucl.ac.uk. ArcRisk is supported by the European Commission under the Seventh Framework Programme. See www.arcrisk.eu/


Contact: jgoqam@cid.csic.es

Theme(s): Chemicals, Water