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DIOXIN SOIL CONTAMINATION OF A FORMER SAWMILL AREA
(BANNOYE LAKE, OLENIY ISLAND) AS A POTENTIAL THREAT
TO AQUATIC ECOSYSTEMS

Rimma D. Korobitsyna *

*N. Laverov Federal Center for Integrated Arctic Research,
Ural Branch of the RAS, Arkhangelsk, Russia*

Bol'shiye Khruslomeny and Bannoye Lakes on Oleniy Island (Kandalaksha Bay, White Sea) represent a unique example of anthropogenic transformation of marine bays into isolated water bodies. In the late 19th century, during sawmill construction, two bays were separated from the sea for fresh water supply, and passages between islands were filled with sawmill waste. After 130 years of isolation, contrasting hydrochemical conditions developed: Bannoye Lake became freshwater dimictic with seasonal anoxia, while Bolshiye Khruslomeny Lake became meromictic with euxinic anoxia and up to 600 mg/L hydrogen sulfide in bottom layers. However, accumulated environmental damage from plant operations, including soil contamination with PCDD/PCDFs, has not been previously assessed. A pilot study was conducted in September 2025. Soil samples were collected layer-by-layer at a storage site for antiseptic-treated timber. Analysis of 17 toxic PCDD/PCDF congeners was performed by GC-MS with toxicity equivalent calculation (WHO-TEQ). Extremely high contamination levels were recorded in all soil horizons. In the 0–20 cm layer, total PCDDs reached 1449 ng/kg, PCDFs reached 335 ng/kg, and the WHO-TEQ value was 71.4 ng/kg, which exceeds the current Russian hygienic standards for residential areas (50 ng/kg) and agricultural land (5 ng/kg) (SanPiN 1.2.3685-21). Deep vertical penetration was observed: at a depth of 40–80 cm, total PCDDs remained at 1444 ng/kg, while PCDFs increased to 354 ng/kg. The PCDD/PCDF ratio > 4 and dominance of highly chlorinated congeners are typical for contamination from chlorophenol-based preservatives. This vertical distribution is atypical for aqueous antiseptic solutions (dioxins usually sorb in the upper 5–10 cm). The observed migration indicates an oily carrier (petroleum oils, creosote), increasing hydrophobic dioxin mobility. This hypothesis is supported by local testimonies about a red-colored preservative, characteristic of technical pentachlorophenol in oil. Thus, chronic pollutant input occurred for decades via dripping from timber and precipitation infiltration. Soils of the former sawmill represent a significant secondary dioxin source. The proximity of the lakes poses a high risk of supertoxicants entering aquatic ecosystems, with subsequent accumulation in bottom sediments and trophic chains. This pilot study substantiates the need for a detailed survey of the territory, including storage areas, runoff pathways, and lake water areas.

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* **Corresponding Author:** Rimma D. Korobitsyna, Junior Researcher, the Laboratory of Ecoanalytical Research, N. Laverov Federal Center for Integrated Arctic Research, Ural Branch of the RAS, Nikolsky Ave., 20, Arkhangelsk, Russia. E-mail: rimma.korobitsyna@gmail.com