

Seabirds as a transport vector for persistent organic pollutants (POPs) to Lake Ellasjøen, Bjørnøya (Bear Island), Norway

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High concentrations of persistent organic pollutants (POPs) have been measured in sediment and biota from Ellasjøen, a lake located in the southern, mountainous part of Bjørnøya. In Lake Øyangen, located only 6 km north of Ellasjøen on the central plains of the island, levels of POPs are several times lower. There are several differences between the lakes that may have led to the differences in contaminant status. One of the most important differences is the occurrence of seabirds. Large colonies of seabirds (mainly kittiwake (*Rissa tridactyla*), little auk (*Alle alle*) and glaucous gull (*Larus hyperboreus*) are situated close to Ellasjøen, while there are few seabirds around Øyangen. The seabirds feed in the marine environment, and deposit large amounts of guano (excrements) directly into Ellasjøen or in the catchment area of the lake. There are two ways in which input from seabirds can lead to higher levels of POPs in Ellasjøen: 1) a change in trophic state as a result of nutrient loadings or 2) direct input of POPs through allochthonous material (guano, bird remains). The effect of guano on the Ellasjøen food-chain has been demonstrated through analyses of stable isotopes of nitrogen. The $\delta^{15}\text{N}$ -values are significantly higher in biota from Ellasjøen than in corresponding samples from Øyangen. These results indicate that the food chain in Ellasjøen has been shifted upwards. The shift is probably caused by utilisation of nitrogen originating from seabird guano. Analyses of guano from the three above-mentioned seabird species have revealed elevated levels of POPs. Contaminants that are transported by seabirds have gone through one or more bioaccumulation cycle before they are deposited in the limnic ecosystem. Bioaccumulation processes alter the contaminant pattern (increase concentrations of the most persistent compounds) and increase concentrations. Organisms from Ellasjøen have a higher share of the most persistent POPs than organisms from Øyangen. In Øyangen the composition of POPs in the whole lake system seem to reflect atmospheric deposition as a contamination source. The high levels of POPs in Ellasjøen, the differences in contaminant patterns and stable isotope ratios between Ellasjøen and Øyangen, as well as the elevated levels of POPs in guano indicate that input from seabirds represent a significant source for POPs to Ellasjøen.

Keywords: Bjørnøya, guano, persistent organic pollutants, stable isotopes

