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Ammonia emissions detected upwind from an intensive poultry farm

High levels of ammonia were observed at a Natura 2000 site nearly three kilometres upwind from an intensive poultry farm in a recent study. While downwind effects of ammonia emissions are to be expected, this study suggests that ammonia emissions could be a significant source of nitrogen pollution even upwind from the source.

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Intensive livestock operations, such as poultry farms, are significant point sources of ammonia pollution. Ammonia is a form of nitrogen and is easily deposited onto soil and plants. Sensitive habitats, such as sand dunes containing mats of lichens and mosses, can be damaged by high ammonia levels.

In this UK study, the researchers investigated the impact on a Natura 2000[1] site of ammonia emitted by an intensive poultry farm. The Natura 2000 site is situated upwind of the farm, and consists of coastal sand dunes with grasses, lichens and bryophytes (e.g. mosses). Over 12 months, the researchers measured deposition of ammonia in and around the farm at eight points upwind to a distance of 2800 metres away, within the Natura 2000 site.

Ammonia concentrations were greatest (60.1 micrograms per cubic metre ($\mu g/m^3$)) closest to the poultry farm and dropped sharply further away from the farm. Concentrations were 6.3 $\mu g/m^3$ at 300 metres upwind, 1.2 $\mu g/m^3$ at 800 metres upwind, inside the Natura 2000 site, and 0.9 $\mu g/m^3$ at the furthest point, 2800 metres upwind and also within the Natura site boundary.

Levels of ammonia at the different sampling sites rose and fell in cycles with peaks that coincided with ammonia emission peaks at the poultry farm. They were not linked to lower ammonia emissions that came from a nearby sewage treatment plant or grazing livestock farm, which were the only other potential sources of the pollutant in the area.

The average annual background concentration of ammonia was estimated to be 0.6 $\mu g/m^3$, suggesting that ammonia emissions from the poultry farm contributed an additional 0.6 $\mu g/m^3$ to the 1.2 $\mu g/m^3$ measured at the 800 metre upwind sampling point. This level exceeds the critical threshold of 1.0 $\mu g/m^3$ for bryophytes and lichens under the Gothenburg Protocol[2]. Atmospheric ammonia concentrations above this threshold are considered damaging to these groups of species.

Furthermore, at the 800 m sampling point, ammonia emissions accounted for 44% of the total amount of nitrogen deposited from all sources (11.1 kg of nitrogen per hectare per year (kg N ha^{-1} yr^{-1})), which exceeds the lower bound of the critical load range for fixed dunes with herbaceous vegetation of 8-15 kg N ha^{-1} yr^{-1}.

Further experiments revealed that the sand dune plants were affected by these concentrations of ammonia. Plant tissues showed higher concentrations of nitrogen, indicating they were using ammonia as a source of nitrogen for plant growth. For example, orchard grass (*Dactylis glomerata*) and ribwort plantain (*Plantago l*anceolata*),* which are both nitrogen-loving species, showed significant increases in growth as a result of the deposition of ammonia. Faster growth of these species may allow them to outcompete other sand dune plants of higher conservation value, and reduce the extent of bare sand on which many rare insects depend. These results suggest that ammonia emitted at these levels is likely to alter the composition and functioning of the sand dune habitats.

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1. http://ec.europa.eu/environment/nature/natura2000/
2. http://ec.europa.eu/environment/nature/natura2000/