Pollution makes carnivorous plants go vegetarian

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Pollution makes carnivorous plants go vegetarian

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Nitrogen pollution is giving carnivorous plants on Swedish bogs so many nutrients that they don't need to catch as many flies, new research shows.

The common sundew *drosera rotundifolia* grows in rain-fed bogs across much of northern Europe. These habitats have few nutrients, so the plant needs to boost its nitrogen intake by trapping midges and other insects with its sticky leaves.

But human activities involving burning fossil fuels for transport and industry have greatly increased levels of nitrogen deposited by rainfall over these bogs, disturbing the specialised ecosystems that have grown up there.

A study published in *New Phytologist* shows that this artificial rain of fertiliser is now making carnivorous plants lose interest in insect prey. Plants in lightly-polluted areas got 57 per cent of their nitrogen from insects; in areas that receive more nitrogen deposition, that figure fell as low as 22 per cent.

'If there's plenty of nitrogen available to their roots, they don't need to eat as much,' explains Dr Jonathan Millett from Loughborough University, the report's lead author. Instead, they rely more on nitrogen absorbed through their roots.

How did the plants manage this rapid shift in diet? Millett says earlier experiments have suggested they can make their leaves less sticky, trapping fewer prey. He adds that a colour change may also contribute; sundew plants in highly polluted bogs are much greener than those growing in nutrient-poor conditions. The latter typically have a red colour that's believed to attract insects. He even suggests that looking at the colour of sundew plants could give ecologists a quick way to gauge how much nitrogen pollution an area has suffered.

The team took samples of sundew plants growing at several bogs in northern Sweden, in conditions ranging from almost pristine to heavily polluted with nitrogen. They also collected insect species that the plants feed on, and mosses growing in the same places that don't eat animals.

They then ground the samples up and analysed the presence of various isotopes of nitrogen - different forms of the same element that have different atomic weights. Nitrogen that's of biological origin, like that in flies, has a different mix of isotopes from nitrogen deposited in the rain.

So by analysing the breakdown of these isotopes in the sundew plants and comparing it to that found in the flies and in non-carnivorous plants growing nearby, the researchers could work out what proportion of each plant's nitrogen came from prey and how much from its roots.

Scientists have theorised that plants adopt the carnivorous lifestyle when they can't get enough nitrogen through the more conventional means of absorbing it with their roots. Catching and eating insects provides another source of nitrogen, but it's hardly an ideal solution.

Plants have to spend lots of energy on the specialised equipment; once a species has gone down this path, it finds it hard to compete with non-carnivorous rivals outside its favoured nitrogen-poor setting. These results lend support to that theory - when plants can get away with it, they scale back on their carnivorous activities.

'In the sites with more nitrogen deposition, these plants now get much more of their nitrogen from their roots, but they still have to bear the residual costs of being carnivorous, and other plants without these will be better able to survive,' Millett

comments. 'So it's quite likely we'll see less abundance and perhaps local extinctions from carnivorous species. The individual plants get bigger and fitter, but the species as a whole is less well adapted to high-nitrogen environments and will lose out over time.'

This study confirms that it's not just a matter of the plants absorbing more root nitrogen, causing a steady level of prey nitrogen to become more diluted. The level of prey nitrogen actually falls, suggesting the plants are somehow limiting their insect-catching activities, presumably to save energy.

Millett is now broadening his study to look at bogs in other areas, including Britain. The situation in Britain could be far more serious because of more heavy industry. 'In the UK, almost all of our bogs will be at least equivalent to the Scandinavian sites we classified as intermediate.' He notes that the low-pollution Swedish bogs showed deposition rates of around 1.8kg of nitrogen per hectare per year; many UK sites are closer to 30kg.

He worked with colleagues at Sweden's Uppsala University and at the Scottish University Environmental Research Centre. NERC provided funding for the isotope analysis used in the research, via its Life Sciences Mass Spectrometry Facility.

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