Pine Pollen and the Rotorua Lakes

Every spring throughout much of New Zealand, a fine yellow dust is sprinkled on the land.

It only takes a slight breeze to blow the dust, pollen, to lake edges and bays where it can glow like a brilliant golden scum that sometimes seems alarming. Closer to forests, pollen can clearly be seen blowing from trees and streaming away. The question is whether this pollen affects lake water quality in any way.

How far does pine pollen travel?

Pine trees rely on the wind to carry their fine pollen particles long distances for pollination. Pine pollen has been detected on USA prairies more than 300 km from the nearest pine forest and 100km out into the North Sea. However, pollen dispersal is diluted as it spreads and settles. Most pine pollen is deposited within 700 m of the trees where it is produced.

How much pollen is produced?

Pine pollen is very small, averaging 40µm (micrometres) in diameter and weighing only 37 ng (i.e. 37 billionths of a gram). A New Zealand experiment found that a 22-year-old Pinus radiata stand had 530 kg/ha of pollen cones. Since half the weight of pollen cones is pollen, a hectare of pine may produce 265 kg of pollen.

For Environment Bay of Plenty's Air Emissions Inventory, a technical specialist from Fletcher Forests estimated that 200 kg of pollen would be produced per hectare of forest. Pollen production by a pine stand will vary with site, age, stand health and vigour. However other estimates indicate that forests of fully-grown pine trees produce around 200-300 kg of pollen per hectare.

Pinus radiata pollen contains 2.21% nitrogen. A high proportion (60%) of that is readily water-soluble amino nitrogen

To find the amount of nitrogen produced by one hectare of forest we can use this equation:

Pollen x percent of nitrogen in pollen = Nitrogen

250 x (2.21/100) = 5.525

So the amount of nitrogen produced by one hectare of fully grown pinus radiata is estimated at 5.525 kg per year.

Around 60% of this nitrogen (3.3 kg) quickly transfers from the pollen to our waterways and lakes.

This is within the range of pine forest nitrogen-leaching estimates from New Zealand experiments (range: –28 kg-N/ha/yr; average: 3–4 kg-N/ha/yr).

The problem

A few studies have been done that have estimated or measured pine pollen production in New Zealand. None have taken place that estimate how much pine pollen leaves a stand of trees. We need to make a few assumptions to estimate how much pollen will leave a forest and land on a lake.

Most of the pollen a stand of trees produces will only be blown as far as nearby trees.

The Rotorua Lakes Problem

- Many of Rotorua's lakes have too many nutrients, caused by activities such as farming and residential settlement.
- These nutrients (nitrogen and phosphorus) feed algal growth, which degrades water quality.
- The Rotorua Lakes Protection and Restoration Action Programme is initially tackling water quality problems in five lakes in the Rotorua district
- Some long-term solutions focus on land management and include new wetlands, restricting nutrients "outflows" from properties, and changes in land use.
- More urgent solutions include sewerage reticulation, structures to divert flows, and the use of mineral products to lock up nutrients.

The amount of pollen that leaves the forest will depend on wind speed, direction, slope, size of the forest and age of the trees. The highest percentage we can estimate is 50% (although this could be much less). Of this, the amount that would land on a lake is less again. If 25% of all pollen produced from a pine forest landed on a lake, we could estimate that for every hectare of mature pine forest near that lake, around 1.38 kg nitrogen would enter the lake each year.

These are broad assumptions about the amount of nitrogen entering a lake per hectare of forest. They do not help us estimate the total amount of pollen that lands on the lakes in the Rotorua district. This would require assessment of forestry areas, wind direction, and other parameters. Alternatively, pollen traps placed on the lake during spring could collect samples, and the results used to give an estimate of nitrogen input to the lakes.

Does pollen affect our lakes?

Despite the lack of research on this topic, current scientific agreement is that the nitrogen input from pollen on a lake is of minor significance when compared with other nitrogen inputs into a lake. It is within the measured range of low nitrogen leaching from forestry.

The perception of pollen as a massive input of nutrients is increased by its bright colour, because it floats on water, small size, wide distribution by wind, and finally by the fact that it all falls over a short time which seems to concentrate its effect. However the pollen particles only contain 2.2% nitrogen. The actual effects on lake nutrient levels are small in comparison to other nutrient sources.

This fact sheet does not consider any other organic compounds associated with pollen that may have some unknown effects on lake water quality. There are other adverse effects of pine pollen: it is an asthma irritant, a cause of hayfever symptoms, causes lowered visual air quality, and is a nuisance covering on property. However from a lake water quality perspective, based on current scientific knowledge, pine pollen is only a minor contributor of nutrients.

References:

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