Editorial: Neonics in salmon-farming – alarm bells are ringing

Salmon farm off the Isle of Harris, Outer Hebrides. Jan Holm/Alamy Stock Photo

Most people have heard of neonicotinoid insecticides, even if they cannot pronounce the name. These neurotoxic insecticides were widely used in farming across Europe from the mid-1990s onwards, but became notorious as evidence grew that they were killing bees. Eventually this evidence became so strong that neonicotinoids were banned from agricultural use by the European Union in 2018. Now, it seems that the pesticide industry may be looking for a new outlet for these chemicals. The salmon-farming industry is seeking to introduce a new pesticide, Ectosan (known also as BMK08), to control fish lice. The active ingredients have been shrouded in secrecy, but an application to use Ectosan in Norway reveals one to be imidacloprid, one of the banned neonicotinoids. The fact that this proposal was not rejected immediately suggests that we have not learned our lesson.

As the name suggests, neonicotinoids are synthetic variants of nicotine. They are phenomenally toxic to almost all insects, and in minute amounts; four billionths of a gram of the imidacloprid is enough to give a lethal dose to a honeybee. Since billionths of a gram are impossible to visualise, this means that one teaspoon of imidacloprid (5g) could kill one and a quarter billion bees, roughly enough to fill four large lorries. Imidacloprid is about 7,000 times more toxic to insects than DDT, an insecticide long banned for the environmental harm it caused. Neonicotinoids act on neuroreceptors in the insect brain, causing paralysis and death, while at truly minuscule 'sublethal' doses they cause confusion, impair learning, damage the immune system, and reduce fertility.

The high toxicity of neonicotinoids to beneficial insects such as bees would not matter if they could be used in such a way that only pest species encountered them. In farming, neonicotinoids were used mostly as seed dressings, coatings applied to seeds of arable crops such as cereals and oilseed rape before the farmer bought them. The idea was that the pesticide dissolves in the damp soil once the seeds are sown, and is then absorbed by the roots of the crop, spreading systemically through its tissues. It seems like a neat system, and a very convenient one for farmers as they do not have to spray the chemical, but it had unexpected problems. Since the chemicals spread throughout the crop plant, they get into the pollen and nectar of crops that flower, such as oilseed rape, poisoning pollinators. Worse still, it turned out that most of the seed dressing was not taken up by the crop at all, but stayed in the soil and ground water, contaminating wildflowers and hedgerow plants growing around and near arable fields. Once in the soil, neonicotinoids can last for many years, and so they accumulate when used every year.

Being water-soluble, neonicotinoids also seep into streams. Some aquatic life, such as mayflies, are phenomenally sensitive to neonicotinoids, and studies in the Netherlands found that streams polluted with imidacloprid had much lower abundance of insect life. Neonicotinoid pollution has also been linked to faster declines of Insect-eating birds and, in Japan, to declines of dragonflies and damselflies. Japan also provides perhaps the most dramatic example of the potential of neonicotinoids to have profound impacts on aquatic systems. Lake Shinji, one of the largest lakes in the country, had for centuries supported a thriving fishery based mainly on smelt and eels. In 1993, imidacloprid was used for the first time on the surrounding farmland. Zooplankton populations in the lake immediately crashed, removing the food supply for the fish. In just one year the weight of fish harvested fell from 282 tonnes to 32 tonnes, and it has remained low ever since.

It is thus deeply troubling to hear that permission is being sought to use imidacloprid in salmon-farming in Scotland. Norwegian-owned company Benchmark proposes to use the insecticide to treat salmon for fish lice, and has submitted a regulatory dossier to the Veterinary Medicines Directorate and the Scottish Environmental Protection Agency. The proposal is that salmon will be removed from their pens in the sea into a tank on a 'wellboat' containing imidacloprid solution. Once their treatment is over, the fish will be rinsed and returned to their pen. The literature available from Benchmark states that the contaminated water will then be purified onboard by means of their patent 'CleanTreat' system, and be tested for purity before being returned to the sea, so that the operation is 'environmentally safe'. No details are given, however, about how the water will be purified or what level of sensitivity can be achieved while carrying out purity tests on board a boat, and so major questions remain unanswered.

Bear in mind that imidacloprid is toxic to aquatic life at exceedingly low concentrations, less than one part per billion. To detect such low concentrations in an analytical chemistry laboratory on land one would normally need to use liquid chromatography coupled to a tandem mass spectrometer – highly delicate and sensitive equipment costing hundreds of thousands of pounds. Are they really able to do this on a boat at sea? Can we be sure that none of the well-water will wash overboard in stormy conditions? What about the salmon themselves, which will be impregnated with neurotoxin? They will be likely to excrete imidacloprid once back in the sea pens, and they may still be contaminated when they go to market, with unknown consequences for human health. Are we really expected to take it on trust that Benchmark has all of these issues covered, given the very long track record of industry in polluting our environment?

Benchmark claims that the system has been successfully trialled for two years in Norway, but there seems to be no publicly accessible, independent evaluation of this claim. Agriculture has seen a succession of pesticides arrive on the market, be used by farmers for many years, and eventually be banned when evidence accumulates that they are harmful to the environment or pose health risks to humans. DDT and other organochlorines, organophosphates, neonicotinoids, herbicides such as paraquat, and fungicides such as chlorothalonil – all were deemed to be safe, until we found that they were not. It took over 30 years to ban DDT, 24 years to ban neonicotinoids and nearly 50 years to ban chlorothalonil, and in the meantime these chemicals were all harming the environment.

There is no doubt that many chemicals currently in use will eventually be banned, once enough evidence accumulates. Our regulatory system for agricultural pesticides has repeatedly failed to prevent harmful products from entering the market.

Fish-farming well boat off the Isle of Skye. Gerry Neely/Alamy Stock Photo

Parasite treatments of farmed salmon have followed a similar pattern: dichlorvos was banned in the 1990s owing to its potential carcinogenic risks, and teflubenzuron in 2015 following research showing that it harmed shellfish. Emamectin and azamethiphos are both currently used but are controversial, since the former kills crabs and lobsters while the latter harms shellfish. When it comes to Ectosan/imidacloprid, surely we should invoke the precautionary principle, or we risk discovering in twenty or thirty years' time that the marine environment near salmon farms is chronically contaminated with a potent and indiscriminate neurotoxin, with who-knows-what consequences for marine life and fisheries.

We humans are very poor at learning from experience, and so we repeat the same mistakes over and over again. It seems to me that it is time we learned; industrial-scale use of poisons to manage pests cannot be done without harming the environment, and risking our own health. Is it not time we stopped?

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