Royal Entomological Society

13 May 2026

Insect Hour
Dave Goulson: Pesticides, dogs and insect declines

Transcript

Liz Evesham: Well, a warm welcome to our very first Insect Hour, which we're delighted to have Dave Goulsen, who's Professor of Biology at the University of Sussex, giving a talk on pesticides, dogs, and insect declines.

Liz Evesham: Before I, do an introduction, I'm just going to run through the many wonderful things that the Society does.

Liz Evesham: So if you're a fellow or a member already, a reminder to you, and if you're thinking about becoming a member, then hopefully by the end of this, you will become a member.

Liz Evesham: Our insect hours are running every month, and you can book the next two already, so you need to go to our website to have a look at that, or scan the QR code on the right-hand side.

Liz Evesham: If you want to become a member, there are lots of benefits for doing that. Currently, it's at £17 a year, and if you're a student, you get your first year free, so that's an incentive if you are a student.

Liz Evesham: And at the moment, we have 15% discount for any new members who want to join, if you can use that code.

Liz Evesham: Access to our library and all the many journals that we produce. You will also have discounts on many events and handbooks, and numerous lots of other exciting talks to come, so…

Liz Evesham: Do fill, and become a member.

Liz Evesham: We've also got Insects Week coming up, of which you can get involved. I'll find out more about it, again, using the QR code, or look on our website.

Liz Evesham: We also have annually the ENTO, and we've got ENTO26 currently, asking for registration and any abstracts, so if you've got something that would you… you would like to,

Liz Evesham: produce, then, please, abstracts are now open.

Liz Evesham: We've got very, many, forthcoming events which you can, attend. We've got lots of SIG meetings, as well as talks coming up, and so, the list is there for the coming ones for the next year.

Liz Evesham: The very many journals that we produce, if you have a paper that you would like to get published, we produce lots of varieties of different journals, many peer-reviewed, and also there's an option for open access.

Liz Evesham: So, back to our speaker, Dave Goulson.

Liz Evesham: And he has published, numerous scientific articles on the ecology of insects.

Liz Evesham: He's also authored very many books, the latest of which is The Silent Earth in 2021, which have also been written in very many languages.

Liz Evesham: He founded the Bumblebee Conservation Trust in 2006, which is a charity that has now grown to more than 12,000 members.

Liz Evesham: He has been, had several awards, again, the latest being the Zoological Society of London's award, Clarovet Award for Communicating Zoology.

Liz Evesham: In 2015, he was named number 8 in the BBC's Wildlife Magazines list of the most influential people in conservation.

Liz Evesham: And he's also Ambassador to the UK Wildlife Trusts. So, with a warm welcome, Dave Goulson, over to you.

Dave Goulson: Thank you, Liz. Please bear with me, everyone, while I…

Dave Goulson: Oh, someone else is sharing. Liz, I think you need to stop sharing.

Dave Goulson: And then I can…

Liz Evesham: How do I do that?

Dave Goulson: It should be…

Dave Goulson: Somewhere at the top of the screen, there should be a little box to stop sharing.

Dave Goulson: Oh, there we go.

Dave Goulson: Okay.

Dave Goulson: I'll just open my… File up, we're nearly there. Bear with me. Okay.

Dave Goulson: hopefully you can now see some random assortment of wildlife and a dog. Thanks for joining me to hear a bit about insects and pesticides, and one particular sort of thread of research relating to

Dave Goulson: Products used on dogs and cats, which we've recently discovered may be impacting on.

Dave Goulson: insect life. But I'm going to start with a bit of a general preamble, because I figure this might be quite a mixed audience. I guess most of you are members and fellows of the Royal Entomological Society, and probably insect enthusiasts, but maybe not everybody that's joined is

Dave Goulson: is an insect aficionado already, so bear with me.

Dave Goulson: So you probably don't need me to tell you that insects are amazing, beautiful, incredibly diverse, over a million known species, and probably many millions yet to be discovered.

Dave Goulson: But sadly, many are in decline. There are huge knowledge gaps around this, particularly from the tropics, but the evidence we have

Dave Goulson: suggests that insects are becoming less abundant, and have probably declined quite a bit already. The chart in front of you is from a German study, quite a well-known study, sometimes called the Crefeld Study, which used malaise traps to catch

Dave Goulson: flying insects.

Dave Goulson: And the biomass of insects caught per trap per day is what's plotted on the chart there, and you can see it fell. It actually fell by 76% over 27 years, which is pretty alarming.

Dave Goulson: I, I should say, keep an eye out, I believe that Crefeld II The Return is… is… is on its way, so… because they've been monitoring it ever since. So there's… there's…

Dave Goulson: what happens next will soon be announced. I believe they're still declining, but anyway.

Dave Goulson: I'm not going to dwell too long on that. These declines are… there are many causes. People argue about which are most important, but I guess the key point that most people agree on is that it's a combination of factors, all of them man-made.

Dave Goulson: with perhaps loss of habitat still being number one, but there are many others. Diseases, climate changes starting to have impacts, and so on. And pesticides undoubtedly are a contributor, particularly given the fact that we make pesticides specifically to kill insects. So it would be kind of surprising if they didn't impact.

Dave Goulson: Now, this is not a new story. You've probably all heard of Silent Spring, and some of you may have read it, written by Rachel Castle… Castle? Carson? Published in 1962.

Dave Goulson: Synthetic pesticide use, to control insect pests started really after the Second World War, with DDT,

Dave Goulson: And its relatives, and the organophosphates, the first pesticides to be widely used. And they were hugely…

Dave Goulson: successful when they were first introduced. Crop yields leapt up. They seemed like a sort of magic silver bullet to control insect pests of crops.

Dave Goulson: But of course, it wasn't long before problems started to arise, and it was Rachel Carson that first brought the negative aspects of pesticide use to the world's attention in this book. And it was very controversial at the time,

Dave Goulson: she was… she was widely, kind of, criticized and derided. But ultimately, I think it… she was proved correct. There was a huge problem. Pesticides were, impacting on wildlife and farmers' health and… and so on and so on.

Dave Goulson: And partly as a result of her book and this growing realization, pesticide use has become more and more regulated over time. There are now lots of systems in place to try to prevent

Dave Goulson: pesticides from harming.

Dave Goulson: Either people or the environment. Which is good, but…

Dave Goulson: I would argue, in many ways, things have got worse rather than better.

Dave Goulson: Certainly the number of pesticides available and the amount of pesticides applied to the planet.

Dave Goulson: has increased pretty dramatically. We're now up to about…

Dave Goulson: 4 million tonnes of active ingredient, applied to farmland and in other ways each year. And that is a figure that keeps going up.

Dave Goulson: the number of different pesticides, well, in Rachel Carson's day, there were in the region of 30 or 40 different active ingredients available to farmers. Today, in the United States, where she lived.

Dave Goulson: There's more like a thousand,

Dave Goulson: the European number is 450-ish. So there's a bewildering array of different products available and going into the environment.

Dave Goulson: As I say, the European… oh, no, I haven't said it, actually. The system in Europe is probably the best regulated in the world. We've restricted many pesticides. Quite a lot have been banned, hence the big difference between the number available in Europe and the US.

Dave Goulson: But elsewhere outside Europe, pesticide use is certainly more indiscriminate.

Dave Goulson: pesticides are still applied from aeroplanes, which in this picture, shows how messy that is. You're obviously going to get considerable drift if you

Dave Goulson: dump pesticide, dust or spray from an aeroplane or a helicopter, as is common practice in the Americas, for example.

Dave Goulson: And in the developing world, or the Global South, as I think we're supposed to call it these days, things are much messier. There's very little regulation and almost no policing of the regulation in many countries.

Dave Goulson: This is a picture I took in…

Dave Goulson: India, just outside Calcutta a few years ago now. This guy is spraying a herbicide, with an ancient sort of setup. It's an old brass hand pump connected to that tank he's got slung from his shoulder. He's not even wearing shoes, this guy.

Dave Goulson: And he's spraying Paraquat, which is… it's banned in Europe, because it's really, really toxic to people. Causes Parkinson's disease, amongst many other things.

Dave Goulson: And, he's… he's using it without any Protective equipment at all.

Dave Goulson: that, ironically, Paraquat, although we've banned it in Europe, we still manufacture it in Huddersfield. Most of the world's Paraquat comes from a Syngenta plant in Huddersfield in Northern England. So we're happy to sell it to the Third World, but not to use it ourselves, which seems somewhat hypocritical.

Dave Goulson: Anyway, my interest in pesticides really is tied into one particular family of pesticides, the neonicotinoids, or neonicotinoids, or another name, I just pronounce the darn things.

Dave Goulson: Which became quite a controversy that's bubbled on over the last 20 years, and you've probably heard of them, unless you've been hiding under a rock for the last 20 years.

Dave Goulson: So let me just tell you a little bit about them. They're neurotoxic pesticides. There are various different versions of them, five main ones in Europe, which are listed on the left there. Imidocloprid was the first one.

Dave Goulson: Their use in Europe was mostly as a seed dressing, so those blue things are oilseed rapeseeds covered in a casing of insecticide and some blue dye, so that

Dave Goulson: farmers know that they're treated seeds.

Dave Goulson: And the idea is that they protect the growing crop from insect pests.

Dave Goulson: But concern pretty soon emerged that flowering crops

Dave Goulson: were poisoning bees, because these chemicals are systemic, they spread through the plant, they get into the pollen and the nectar, so if a farmer was growing oilseed rape, or sunflowers, or any other crop that bees visit, then he was giving them a dose of a neurotoxic insecticide. Not just bees, I should say, any pollinator.

Dave Goulson: And these are really potent insecticides, just to put it in context, imidocloprid.

Dave Goulson: is about 7,000 times more toxic to an insect than DDT, which you've all heard of, I'm sure. I've listed on the left this list of names of the different neonics. At the bottom, I put Fipronil, which is, I should clarify.

Dave Goulson: is not technically a neonic, but it's part of the story that's gonna… that I'm gonna explain. And it behaves in many ways very similarly to a… to a neonic. It's a…

Dave Goulson: It's a neurotoxin, and it's water-soluble, and it's systemic.

Dave Goulson: So, for all practical purposes, I'm going to treat it as if it were an ear nick. Anyway, so…

Dave Goulson: As I mentioned, these things are used primarily as seed dressings on crops, and this diagram tries to explain the sort of environmental fate of that use.

Dave Goulson: So…

Dave Goulson: If we start with the… where's… where's my mask on? There we go. Start with the seed. The farmer buys the seed pre-coated in pesticide. He doesn't have to do anything but drill it into the ground.

Dave Goulson: And, oh, my mouse keeps disappearing. Where are I?

Dave Goulson: Anyway, there we go. So he sows the seed, seedling… the seed germinates, and the idea is that the coating dissolves the water-soluble chemicals, it dissolves in the damp soil, and the roots of the crop take up the pesticide,

Dave Goulson: And it spreads throughout the tissues of the plant and makes it toxic to insect herbivores, which is a really neat idea. It protects the whole plant without the farmer having to do anything at all. He just buys the seed and saves it in the ground. Sounds brilliant.

Dave Goulson: But, as I've mentioned, the obvious first problem is that if it's a flowering crop, given that the chemical spreads everywhere in the plant, it gets into the pollen and nectar, which is…

Dave Goulson: Clearly a cause for concern, but there's more to it than that, it turns out. Over time, it became apparent that actually

Dave Goulson: Most of the chemical in the seed coating wasn't taken up by the crop.

Dave Goulson: Somewhere in the region of 5% of the active ingredient ends up in the crop where you want it. The rest of it is going into the soil and soil water.

Dave Goulson: From where it can leach to the right on this diagram into ditches and hence into streams and rivers and ponds and so on.

Dave Goulson: Or any other plants with roots in the soil, such as hedgerow plants, which are often encouraged for nature, they can also suck up the pesticide in the same way that the crop does.

Dave Goulson: So, for example, if a farmer sows a strip of flowers next to the crop, as is a common practice to encourage biodiversity, there's a real risk that that strip of flowers is going to be contaminated from the contaminated soil with these insecticides.

Dave Goulson: And to illustrate the scale of global contamination of flowers with these pesticides, there's this really nice, well, nice is perhaps the wrong word, depressing, scary, study from

Dave Goulson: a Swiss group, who collected honey samples from around the world. Each dot is a honey sample, and they tested them for neonics. And the white dots are clean.

Dave Goulson: The darker the color of the dot, the more, insecticide was in it.

Dave Goulson: Three-quarters of the samples from all over the world were contaminated with these highly potent neurotoxic insecticides.

Dave Goulson: Which is bad news for honeybees, clearly.

Dave Goulson: But it isn't just honeybees. They're getting exposed by feeding on contaminated flowers, which means that every other pollinating insect that visits

Dave Goulson: flowers is also going to be being exposed to these pesticides, and now we're talking about hundreds of thousands of different species, most of which nobody is looking out for or monitoring. So this is a really… is a global issue.

Dave Goulson: And there's been an abundance of studies connecting neonat use to decline of wildlife, primarily insects, but also things that eat insects.

Dave Goulson: So I've just put some of the studies that emerged. There have been many others over the years. So, for example, at the top there, the frequency of honeybee colonies dying off has been found to be related to exposure to neonics.

Dave Goulson: Similarly, wild bees, declines, seem to follow a pattern of higher rates of decline in areas of higher neonat use.

Dave Goulson: Evidence for that driving insectiv-risk bird declines, which would hardly be surprising, given that insective-risk birds depend entirely on

Dave Goulson: healthy insect populations to survive. Butterflies in the UK and California seem to be declining faster in places with more neonics. And then finally, aquatic insects,

Dave Goulson: decline more rapidly in areas with more, aquatic pollution with neonics. As I say, lots of other studies. Probably one of the most dramatic I've come across is this one from Lake Shinji, which is the largest lake in

Dave Goulson: largest freshwater lake in Japan, which,

Dave Goulson: was monitored… the chart here shows the zooplankton biomass and how it's changed over time.

Dave Goulson: neonics were introduced to Japan in 1993, and were widely used on rice paddies surrounding the lake, which drain into the lake. And you can see the effect of neonics' introduction is pretty dramatic, and in fact, there were substantial fisheries based on

Dave Goulson: this lake, which collapsed because there was no food for the fish, essentially. So neo-niks clearly have

Dave Goulson: Big environmental impact.

Dave Goulson: And it's… it's quite a nice, nice, satisfying, encouraging story, actually, this whole neonic thing, because… so they were introduced in… well, in Europe in 94, and Japan in 93. Almost immediately, if we follow the timeline down, French beekeepers

Dave Goulson: Flagged up that if they noticed that if they put their bees near treated sunflower crops, they were dying.

Dave Goulson: And they started kicking up a fuss, but were ignored for quite a while.

Dave Goulson: But eventually, scientific evidence started to accumulate that actually they were right, that sunflowers and oilseed rape and so on were harmful.

Dave Goulson: to pollinators. And so the European Union took action in 2013. It banned their use on flowering crops.

Dave Goulson: But then more and more evidence started to emerge, some of it from my group, that wildflowers were still being contaminated from use of these chemicals on non-flowering crops like wheat, which is one of the biggest crops, of course, in Europe, and was still being

Dave Goulson: almost universally treated with neonics, which were contaminating the soil and contaminating wildflowers and hedgerow plants and so on. So…

Dave Goulson: 2018, the EU banned all farming uses, though it did allow some derogations, emergency uses.

Dave Goulson: for a few years, but in 2023, the European Union decided that was a bad idea and stopped them altogether. It took us a couple of years to follow suit, but in 2025, there was lots of celebration in Europe.

Dave Goulson: sorry, in the UK from environmental campaigners, when the UK government, did something good and, refused to grant

Dave Goulson: the last derogation for neonics. So, there's quite… it's quite a, you know, it's nice to see governments acting on scientific research, following the science, and taking action to protect the environment. Fabulous.

Dave Goulson: And you'd think that might have been the end of the story, were it not for…

Dave Goulson: this study from Bug Life that came out, in 2017, in the midst of the whole, sort of, neonixin farming debate. Written by Matt Shardlow, who used to be CEO of

Dave Goulson: Of Bug Life, the insect conservation charity. I'm sure you're familiar with them.

Dave Goulson: So, he got hold of Environment Agency data on river pollution with imidacloprid.

Dave Goulson: And, the chart is… the map is fairly self-explanatory, really. Green dots were rivers that were clean.

Dave Goulson: Up to red dots, which were rivers, which were…

Dave Goulson: contaminated with imidocloprid at levels that are sufficient to do harm to aquatic insects, even in the short term.

Dave Goulson: And the broad pattern is for higher levels of pollution in the arable, intensively arable regions of eastern Britain, which is exactly what you'd expect. Except there's just this odd thing that Matt picked up on.

Dave Goulson: Which is that there was a contaminated river in the middle of the Kangol National Park.

Dave Goulson: Which was miles from the nearest arable crop, and that flagged up, something which

Dave Goulson: almost all of us were completely unaware of, even people who've been studying neonics for years, like me. I didn't know at the time that

Dave Goulson: While they'd been… they were being banned for arable use, they were still widely available.

Dave Goulson: For use to put on the family pet.

Dave Goulson: Dogs, cats, and even rabbits.

Dave Goulson: the two main products are imidacloprid, which I've mentioned repeatedly, the neonic, and also Fipronil, which you'll remember I talked about, earlier as a very similar compound. Both of them are widely available as what are called spot-ons, little, little plastic

Dave Goulson: Bottles, which you squeeze a few drops of insecticide onto the skin on the neck of your dog.

Dave Goulson: Or cat, or rabbit. And if you follow the advice on the packet, you do that every month, to protect the dog against fleas and ticks. And they're widely, advertised as… for prophylactic use, so you use them year-round, 12 months, 12 times a year.

Dave Goulson: On your dog or cat, even if it doesn't have ticks or fleas. And they've become very popular. They're often rolled into pet healthcare plans, where you sign up with a direct debit, and all of your dog's treatments are included, including

Dave Goulson: a flea treatment. But, Matt pointed out that maybe this river in Scotland

Dave Goulson: was contaminated from this use on pets. Maybe a dog or dogs had swum in that Scottish River and contaminated it, which raised the issue, okay, we'd all been concerned about farmers using these chemicals, but was there a risk that their use on pets might be causing problems?

Dave Goulson: So, DEFRA, listened and decided to fund a PhD to investigate the environmental fate of these chemicals when used.

Dave Goulson: on dogs and cats. Thankfully, I got the… managed to win the contract, as it were, and, employed Rosemary Perkins as a PhD student, and her remit was to basically find out, okay, we put this stuff on dogs and cats, where does it go?

Dave Goulson: Does enough of it go into rivers to explain the levels of river pollution that we're seeing in environment agency data?

Dave Goulson: So…

Dave Goulson: When you apply an insecticide to the outside of a pet, there are lots of places it might go in the environment, and this diagram attempts to sort of sketch out,

Dave Goulson: the environmental fate of the chemicals, the different routes it might go down. So, at the top, we've got the simple one, where it could get into rivers if the dog's… a treated dog jumps in a river and has a swim, then we've got contamination of rivers. But if we go down, there are lots of other ways

Dave Goulson: That the chemical… or the fates that the chemical might have.

Dave Goulson: Many of which end up in river… in polluting of,

Dave Goulson: outflow grey water pipes from domestic properties. So, for example, if the dog gets wet and you dry it with a towel and then wash the towel, maybe some of the chemical will come off that way and go down the drain. Or maybe if you wash the dog's bedding.

Dave Goulson: then some of it's going to go down the drain. Or maybe just if you cuddle and stroke your dog, and then wash your hands or wash your clothes, maybe that results in some goings down the drain, and so on and so on, and so it might come out in poo, and end up in being incinerated if you collect the poo, and so on.

Dave Goulson: All these possibilities, and Rosie's job was to basically try and put numbers to these, so…

Dave Goulson: with how much of the chemical goes down each of these routes, which is quite a job, and she couldn't possibly have done all of it, but she did her best. Did an amazing job, I have to say. She was brilliant. So, let's go back first to more recent river pollution data.

Dave Goulson: These are for 20 English rivers, which Rose collected data, again, from the Environment Agency from. It just shows Fipronil on the left here, and Fipronil sulfone on the right, which

Dave Goulson: Is an extra detail in this story is Fipronil and Dmitacloprin, both

Dave Goulson: break down in the environment to other chemicals, but those other chemicals are just as toxic, or in fact, in the case of Fipronil sulfone.

Dave Goulson: Significantly more toxic than the parent compound.

Dave Goulson: Anyway, so, if we look on the left.

Dave Goulson: the triumph is fairly self-explanatory. Every one of the 20 rivers was contaminated with some fipronil.

Dave Goulson: Four of them, the ones in yellow, were below levels that may be harmful to, to wildlife. But the orange ones would be… had levels that would be harmful in the long term if insects and other aquatic life were exposed to them. And the red ones.

Dave Goulson: would be toxic in the short term, even a short exposure to water with such levels of contamination would be harmful. So this is pretty worrying that most of our rivers have

Dave Goulson: levels of pesticide in them, which exceed the levels deemed to be safe. And even more so when you look at fipernil sulfone on the right, because it's, as I say, it's more toxic than the parent compound.

Dave Goulson: So, every single river had concerning levels.

Dave Goulson: There's an extra thing here which is really interesting, which Rose spotted, which is that the… some of these triangles have little exclamation marks in them, and those are samples taken from downstream of wastewater treatment works, and there was a really marked,

Dave Goulson: association with much higher levels of pollution downstream of wastewater treatment work, sewage outflows, essentially you could call them.

Dave Goulson: So if you compare, here we've got, if we look top left to start with, fiperonyl concentrations in rivers, on the left, within 2 kilometers of a wastewater treatment works outflow, and on the right.

Dave Goulson: more than 2 kilometers from, or with no wastewater treatment outlet at all. And you can see that consistently for Fipronil and its breakdown products, and for imidacloprid, there's… there's way more pesticide

Dave Goulson: downstream of wastewater treatment work, so much of river pollution is basically seemingly coming from our homes, rather than dogs swimming,

Dave Goulson: Which we wouldn't expect to give us this pattern, obviously.

Dave Goulson: Okay, so that's quite an interesting outcome, and helps us understand a little bit about the roots of… by which these chemicals flow into rivers.

Dave Goulson: To find out more, Rose… the next step was to conduct a survey of more than a thousand pet owners to find out

Dave Goulson: which products they were actually using, we needed to see if… what we wanted to know was, could levels of river pollution be explained by this use on… of insecticide on dogs and cats? So, to understand that, we need to know how much is being used, which products are being used.

Dave Goulson: how many dogs are treated, and the frequency of application, and also cats. Are they treated every month, or just a few times a year, or once a year, or whatever? And critically, how often do people wash their dogs, bathe them, let them swim, wash their bedding.

Dave Goulson: stroke their dogs and wash their hands. How often do each of these things happen? Because if each one is contributing to the river pollution, we need to know its frequency, if we can want to calculate whether that could be a significant route of exposure… of exposure.

Dave Goulson: So, from that survey, various interesting things emerged.

Dave Goulson: We got data on the frequency with which people wash their dogs, and so on, and wash their bedding. We got data on which products they're using, which is what you can see here.

Dave Goulson: We'll talk about Brevecto, the thing at the top, right at the end. But products containing imidacloprid, which are in green, or pipronil in blue, make up quite a significant chunk of all the,

Dave Goulson: tick and flea treatments that people use. So we know from that how many animals are being treated

Dave Goulson: Per year.

Dave Goulson: We then wanted to find out how much pesticide comes off a dog,

Dave Goulson: In various circumstances. So, for example, if you treat your dog

Dave Goulson: And then give it a bath some days later, or take it to a poodle parlour for a bath.

Dave Goulson: in nice, soapy water, how much comes off and goes into the soapy water and down the drain. So Rose did an experiment where she got 98 dogs to volunteer, very kindly of them.

Dave Goulson: Half of them were treated with Fipronil and half with imidacloprid, following the manufacturer's guidance. And then, at intervals, post-treatment.

Dave Goulson: They, the instructions on treatment say don't allow your dog to swim or wash it for 2 to 4 days. It varies depending on the product.

Dave Goulson: So Rose didn't wash any of the animals shortly after they'd been treated. The earliest they were washed was 5 days, or 14, or 28 days, which would be just before the next monthly treatment.

Dave Goulson: She also… and she also then, got dog owners to, bring in beds. She gave them clean beds, and then at different intervals after the dog had been sleeping on them, she washed the bedding to see how much would come off the bedding.

Dave Goulson: And she got the owner's dogs to wash their hands to see how much pesticide was actually on the hands of the owners. And these are the results, so…

Dave Goulson: Fipronil in green, imidacloprid in orange, there's an overall pattern that's slightly more imidacloprid seems to come off than fipronil, but the overall takeaway, I guess, from this is that whether it's via bathing or hand washing.

Dave Goulson: That,

Dave Goulson: product is coming off the dog throughout the month, whether it's 5, 14, or 28 days after treatment. There's more at 5 days than at 28 days, but even at 28 days following the treatment, these dogs are still covered in significant amounts of insecticide, which washes off, if they're given a bath.

Dave Goulson: or stroked.

Dave Goulson: Top right, I'm not sure whether you can see the label, but top right, I think, is bed washing at different intervals post-treatment.

Dave Goulson: So… so Rose was able to quantify… she knows how often dogs are washed and their beds are washed, and she knows now how much comes off.

Dave Goulson: I should say Rose would give a much clearer explanation of this work than I… you've been shortchanged by having me to explain it, but anyway. So we know how much is going down the drain, which enables us to then start to fill in

Dave Goulson: follow the fate of the chemical from its application to the dog through to where it ends up.

Dave Goulson: So, this is imidocloprid, and this is… this is kind of… shows what Rose has managed to construct.

Dave Goulson: As to the… the different… pathways.

Dave Goulson: And amounts of chemical but… Flow from dogs and cats through to potentially ending up in wastewater.

Dave Goulson: So on the… if we start with on the left, that shows the amount of chemical being used. The height of those bars shows the amount of chemical going onto the pets.

Dave Goulson: And on the right, you've got the amount in wastewater, both before and after… before it goes into a wastewater treatment works and after it comes out.

Dave Goulson: And a lot of it is unknown. So, for example, we… Rose didn't have time to study dogs

Dave Goulson: given impregnated collars, which is another… rather than put spot… using a spot on, dripping the stuff onto their neck, you can give them a collar. We didn't… she hasn't, at least in this chart, she has since looked at this, but…

Dave Goulson: There's no data shown here. We don't know where that goes. We don't know where cat treatments go, because you didn't look into that. But for dogs, we have now figures for bathing, bed washing, and hand washing.

Dave Goulson: And those three things alone account for, or account for a sufficient chemical going into wastewater influence.

Dave Goulson: That that explains about very nearly half Of the total amount.

Dave Goulson: But… We detect in wastewater.

Dave Goulson: So, these…

Dave Goulson: just bathing, bed washing, and hand washing, if that accounts for half, then if the other half is coming from the remainder, so this amount of chemical, this big blue block in the middle, is unaccounted for, this yellow block above it, or green, or whatever color that is, is unaccounted for. If

Dave Goulson: a similar amount makes it through to wastewater. That's the whole pollution of wastewater explained by these chemicals going on to dogs and cats. I'm not explaining this as well as I should. I do apologize. Do read the original paper if you want to properly understand it. Rose explains it much better than I do.

Dave Goulson: The next chart is Fipronil, which is very similar. The pathways at the bottom that we've quantified explain only about a quarter of the

Dave Goulson: the amount of chemical we see in wastewater influence. But…

Dave Goulson: It's easy to imagine that more makes it through to wastewater that we haven't yet worked out exactly what the pathway

Dave Goulson: is. Okay.

Dave Goulson: Finally, Rose looked at… forget wastewater treat… wastewater. The thing that Matt first suspected, Matt Shardlow, was that, dog swimming was the problem. So Rose did another experiment to find out.

Dave Goulson: If dogs were just dunked in cold water, rather than being washed in hot, soapy water.

Dave Goulson: how much comes off the dog, and this basically is similar to one of the early charts, shows you different time intervals post-treatment.

Dave Goulson: Remember that you're not supposed to let your dog swim for 4 days.

Dave Goulson: But clearly, if it swims on the fifth day, which you're allowed to do.

Dave Goulson: A whole wadge of insecticide comes off it and goes into the environment, be it fipronil or

Dave Goulson: imidacloprin. And the amount declines over time, which is what we'd expect. But even at 28 days, just before the dog is due to be treated again, that's quite a significant amount.

Dave Goulson: Okay.

Dave Goulson: Rosie's study has been kind of corroborated by

Dave Goulson: a really interesting recent study from Hampstead Heath by Lauren Yoda of Imperial. Hampstead Heath has various ponds.

Dave Goulson: Which, some of which have lots and lots of dogs that go swimming in them.

Dave Goulson: Others of which are in remote locations and are designated as non-dog swimming ponds. What this chart shows you is the relationship between the number of dogs along the bottom and the concentration of these two insecticides, imidacloprid on the left and fipronil on the right.

Dave Goulson: And it's a bit noisy, but basically, ponds without dogs,

Dave Goulson: Had no pesticide in them. Ponds with lots of dogs had loads of pesticide, exactly as you'd expect. The green dashed line shows you the safe level, as it were.

Dave Goulson: for these pesticides for impact on aquatic wildlife. So, all the dog ponds, basically, were way, way above the safe limit.

Dave Goulson: For these chemicals.

Dave Goulson: So, coming slowly towards the end, I've overrun slightly, I do apologize. It does seem that these chemicals are the major source of

Dave Goulson: pollution of our English rivers. Obviously, there are many other pollutants, but they ex…

Dave Goulson: treatment of dogs and cats is probably enough to explain the pollution we're seeing of rivers. And the pollution we're seeing routinely exceeds what are deemed to be safe levels.

Dave Goulson: Interestingly, it's… although we started out suspecting dogs swimming were the cause of all this, it turns out that actually that's probably a relatively small

Dave Goulson: driver, but most of the stuff is going down the drain and getting into rivers that way.

Dave Goulson: Importantly

Dave Goulson: The advice not to let your dog swim or wash it for 4 days, is of very little help, because there's tons still on the dog on the 5th day, and even up to the 28th day when you next treat it.

Dave Goulson: Interestingly, it's pretty clear from all of this that if you treat your dog with one of these chemicals, or your cat.

Dave Goulson: then the chemical will be all over the dog's bedding, and almost certainly the carpet, or anywhere else the dog goes. And it's definitely all over the owner's hands, we've shown that.

Dave Goulson: Which makes you kind of wonder where else it is, and whether it's… there's significant issues from human exposure. Is this…

Dave Goulson: Safe to be continually exposed To neurotoxins from a…

Dave Goulson: family pets. There is evidence for human health concerns.

Dave Goulson: A Swiss study, for example, found imidacloprid in the cerebrospinal fluid of every single child that was tested, which is worrying, given that these are neurotoxins. A French study found

Dave Goulson: Every woman that they tested,

Dave Goulson: Had, fipronil sulfone in the cord blood flowing to the baby. And babies with higher levels of fipronil sulfone in their blood

Dave Goulson: had poorer APGAR scores, which is a score of their

Dave Goulson: vitality at birth. It's a standard procedure to assess how healthy babies are. Basically, if the mom had been exposed to lots of Fipronil, babies weren't so healthy, which is really concerning, I would have thought. And several other studies seem to suggest that Fipronil is really not good for us.

Dave Goulson: There are also other wildlife concerns which have barely been explored at all. You imagine a dog jumps in the garden pond after you've treated it. You can't tell it not to jump in for 4 days. And even if you did, as we've learned, it doesn't make much difference.

Dave Goulson: Imagine it, so that's going to be catastrophic for your pond's wildlife.

Dave Goulson: Imagine then it jumps out of the pond and shakes itself, spraying.

Dave Goulson: insecticide all over the lawn, the flower beds, yew, who knows where it goes. We have no idea what are the problems we may be

Dave Goulson: Causing with these chemicals.

Dave Goulson: one… line of… interesting line of research is that one of my other PhD students

Dave Goulson: Canal Tassan de Montague, great name, discovered recently that,

Dave Goulson: Blue-tit and great-tit nest linings, which are lined mainly with animal fur,

Dave Goulson: Every single one of 103 nests that she tested was contaminated with both… with either Fipronil or imidacloprid, and nearly all was

Dave Goulson: There were more dead chicks or unhatched eggs in nests with higher levels of pollution.

Dave Goulson: So, there are concerns for all sorts of other pathways for these chemicals in the environment.

Dave Goulson: Okay, what are the ways forward? I really need to wrap up. I would say…

Dave Goulson: the current situation is not acceptable. I don't want to sound pompous, but come on, you know, to have every single English river contaminated with

Dave Goulson: potent insecticides is surely not something we can allow to continue. DEFRA ought to be doing something about this urgently, I would say. There are various things could be done.

Dave Goulson: it would seem to me that making these chemicals prescription-only would be an easy step in the right direction. At the moment, you can buy them from the supermarket, which seems pretty bonkers. There's anecdotal evidence that fiperonil

Dave Goulson: that most… many flea populations have resistance to fiperonil, so it doesn't work anyway.

Dave Goulson: In which case, why… why are we allowing it to be sold? Shouldn't it be withdrawn? I think we should certainly be promoting alternatives, and the simplest of those, and the most environmentally friendly, is to… to encourage dog owners and cat owners to wash the

Dave Goulson: Bedding to kill fleas, rather than treating the dog.

Dave Goulson: And hoover under the bed to also… because the larval fleas live, in and under the bedding, not on the dog. And use a flea comb to get rid of adult fleas, rather than a chemical.

Dave Goulson: treatment.

Dave Goulson: I really don't think vets should be encouraging prophylactic use, that just seems bonkers. You wouldn't treat your kid for nits if he didn't have nits, so why on earth would you treat your dog for fleas or ticks if it doesn't have either?

Dave Goulson: We urgently need to find out whether the tablet alternatives, like the Asoxazalins in Brevecto, which you may remember from the chart of usage.

Dave Goulson: was actually the most used option. These are basically tablet treatments that you can give as an alternative to spot-ons. But we know there's not been any kind of thorough environmental risk assessment, so we really don't know how safe they are, or whether they just pose a whole different raft of problems.

Dave Goulson: And personally, I'd love to see more research done on the alternatives, whether there are truly sustainable options.

Dave Goulson: Well, I could talk more about those, but I haven't got time. Broadly, also, I just wanted to flag up

Dave Goulson: There seem to be huge knowledge gaps, generally, with regard to the environmental fate and harm being done by veterinary drugs.

Dave Goulson: More broadly. Vets are really focused on

Dave Goulson: on looking after the health of livestock and pets, which is understandable, because that's their job, but surely they're also responsible for any environmental harm that chemicals they supply might cause, be it to people or the environment. I think we need a more holistic approach to

Dave Goulson: To… to drug use in… in… General on our animals.

Dave Goulson: Finally, flag up, I've got a new book out. It's published tomorrow, how exciting, but it's got very little to do with what I've been talking about. Thank you, everybody, for bearing with me. Sorry I overran slightly.

Evesham: Well, thank you very much, David. That was absolutely fascinating, and obviously quite concerning. We are open to questions, if you'd like to put them in the chat.