Scottish Wildlife Trust

Environmental Audit Committee

Insects and insecticides

The Scottish Wildlife Trust welcomes the opportunity to submit evidence to the Environmental Audit Committee (EAC) regarding insects and insecticides.

Our evidence concentrates on our concerns with regard to the impacts of neonicotinoid insecticides and is summarised below:

- Effects on insect pollinators- honeybees, bumblebees, hoverflies, butterflies and moths
- Half-life in soil; routes of exposure and contamination of non- target vegetation (such as that found along field margins)
- Effects on ecosystems in the agricultural landscape
- Inadequacy of risk assessment for these types of insecticides

Scottish Wildlife Trust's position

1. There is a growing body of evidence that shows that neonicotinoids have a detrimental effect at sub-lethal doses on insect pollinators. For this reason, the Scottish Wildlife Trust believes that the Scottish Government should adopt the precautionary principle and place a moratorium on their use on all outdoor crops in Scotland until there is convincing scientific evidence that pollinator populations, and by extension ecosystem health, are not significantly impacted upon by use of neonicotinoids.

Effects on insect pollinators

2. Pollination[1] has been estimated to be worth c. £430 million p.a. and 20% of UK cropped areas are pollinator dependent.[2]

3. Defra has estimated that the number of UK registered honeybee hives is only sufficient to supply a third of the pollination services required for agricultural crop production; the remainder of the services being supplied by wild pollinators.[3] Some crops such as strawberries, tomatoes and peppers are mainly pollinated by managed bumblebees; honeybees are also not as effective pollinators of field beans, apples and raspberries as wild pollinators.[3]

4. There is an increasing body of research that has shown that sub-lethal doses of the active ingredient in neonicotinoids is damaging to the honeybees and bumblebees. The effect on other pollinators is largely unknown.

[1] This includes all pollinators such as honeybee, bumblebee, hoverfly and to a lesser extent butterflies and moths
[2] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment Technical Report (UKNEATR). UNEP-WCMC Cambridge.
[3] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment Technical Report (UKNEATR). UNEP-WCMC Cambridge

Honeybees

5. Research by Mickaël et al[4] examined the sub-lethal effects of neonicotinoids on honeybee behaviour rather than on bee mortality *per se*. It showed that non-lethal exposure of honeybees to thiamethoxam caused high mortality due to homing failure at levels that could put a colony at risk of collapse. The researchers tested the theory that although sub-lethal doses of insecticide (in this case thiamethoxam) may not cause direct mortality, it could cause behavioural difficulties in bees and thereby cause homing failure in foraging honeybees. The conclusions of the study were that*: exposure of foragers to non-lethal but commonly encountered doses of thiamethoxam can affect forager survival, with potential contributions to collapse risk. Furthermore, the extent to which exposures affect forager survival appears dependent on the landscape context and the prior knowledge of foragers about this landscape. Higher risks are observed when the homing task is more challenging.*

6. Defra's response has been that although the results are interesting, they believe the artificiality of the experiment calls it in to question. We can appreciate that the 'perfect' experiment would be conducted totally in the 'wild' to mimic field conditions, but this assumes that it is easy to ensure that a 'control' group of bees have not been exposed to the insecticide (given the fact that research has also shown the long half-life of the active ingredient and contamination of field margins - see below).

7. **We would like the EAC to ascertain how unintended contamination of control bees would be dealt with in a field trial**.

8. With regard to Defra's observation of the potential artificiality of the dosing regime compared to exposure under field conditions - where is the evidence of this? The researchers claim that: *To simulate daily intoxication events, foragers received a field-realistic, sub lethal dose of thiamethoxam (a real dose of 1.34 ng in a 20-ml sucrose solution) and were released away from their colony with a microchip glued on their thorax.*

9. Their methods are explained in Supplementary Material[5] and the dosage has been verified and it is stated that: *The real content was measured to be 67µg/l, i.e. slightly above the expected 50µg/l, leading to an effective dose of 1.34 ng per honeybee.*

10. This dosage is in accordance with that which honeybees would be exposed in the wild i.e. in the order of parts per billion.

11. One of the subtleties of the French experiment was investigating the 'homing challenge'. It was found that the homing failure effects of exposure to neonicotinoids was exacerbated when honeybees were inexperienced or faced a more complex landscape.

12. In refuting Henry et al's research, Defra state: *Existing studies submitted in support of the present regulatory approvals fully meet current standards. They do not explicitly address all the sub-lethal effects suggested by the academic research. However, they do cover a wide range of important endpoints and, in these studies, hives exposed to treated crops did not show any gross effects when compared to control hives exposed to untreated crops.*

13. **We would call on the EAC to scrutinize these studies that Defra refers to because we do wonder if the foraging bees faced the complex landscape challenges that were introduced into Henry et al's research. If not, can they be thought of as reliable and do they mimic the field conditions that Defra so clearly want to see?**

Bumblebees

14. Research published earlier this year by Whitehorn et al.[6] has found that bumblebees suffer decline when exposed to neonicotinoids. Researchers at Stirling University exposed colonies of bumblebees to miniscule doses (mimicking field realistic conditions) of the neonicotinoid, imidacloprid. They found that

[4] Mickaël Henry et al (2012) A Common Pesticide Decreases Foraging Success and Survival in Honeybees. Science Vol 336 :348-350
[5] Mickaël Henry et al (2012). Supplementary Material for A Common Pesticide Decreases Foraging Success and Survival in Honeybees. Published on 29 March 2012 on *Science* Express DOI: 10.1126/science.1215039
[6] Penelope R. Whitehorn et al.(2012). Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production. , Science Vol 336: 351 - 352

treated colonies had a significantly reduced growth rate and suffered an 85% reduction in production of new queens compared with control colonies. They conclude that: *there is an urgent need to develop alternatives to the widespread use of neonicotinoid pesticides on flowering crops wherever possible.*

15. Defra's response to this research is that because bumblebees are not covered in the current EU Authorisations Regulation *it is more difficult to assess the significance of the findings of this study*. **We do not see why this is the case, and the point regarding 'assessing the significance of these findings' needs further clarification by the EAC.**

16. We note that Defra commissioned a further study (PS 2371) to examine the potential effects of imidacloprid on bumblebees foraging on oilseed rape grown from imidacloprid treated seed under field conditions. The recently published research by Gill et al[7] confirms the findings of Whitehorn et al's[6] work in that they showed:
imidacloprid exposure at concentrations that can be found in the pollen and nectar of flowering crops causes impairment to pollen foraging efficiency, leading to increased colony demand for food as shown by increased worker recruitment to forage.

17. They also found that a 'cocktail' of insecticides was even more damaging. In addition, they found that effects were seen when there was prolonged exposure (not over the 96 hour test) i.e. 2- 4 weeks - which mimics the crop blooming period.

18. The researchers concluded that:
Our findings have clear implications for the conservation of insect pollinators in areas of agricultural intensification, particularly social bees with their complex social organization and dependence on a critical threshold of workers performing efficiently to ensure colony success.

Other insect pollinators

19. We are not aware of any research being conducted on the effects of neonicotinoids on other insect pollinators. As pollination has been estimated to be worth c. £430 million p.a. and 20% of UK cropped areas are pollinator dependent,[8] we do find it surprising that the risk to other pollinators has been ignored (see also paragraph 3 above). However, we are aware of the ongoing research investigating which insects pollinate UK crops.[9] This may throw new light on the importance of other pollinators in the agricultural landscape but the research will not ascertain what impacts neonicotinoids have on all pollinators.

20. **In light of the fact that wild pollinators (i.e. not honeybees) make up a significant proportion of pollination services in UK crop production (see paragraph 3 above), we would like the EAC to scrutinize why Defra does not consider the risk to wild pollinators an important consideration in assessing the safety or otherwise, of neonicotinoids.**

Half-life in soil and routes of exposure

21. Krupke et al[10] have found that neonicotinoid compounds are persistent in soils and are also found in untreated fields. In their research they conclude that:
These results demonstrate that honeybees living and foraging near agricultural fields are exposed to neonicotinoids and other pesticides through multiple mechanisms throughout the spring and summer. The potential for greatest exposure (and the period when mortality was noted), occurs during planting time when there is potential for exposure to extremely high concentrations of neonicotinoids in waste talc that is exhausted to the environment during and after planting.

[7] Richard J. Gill, Oscar Ramos-Rodriguez & Nigel E. Raine (2012). Combined pesticide exposure severely affects individual- and colony-level traits in bees, *Nature*, published 21 October 2012
[8] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment Technical Report (UKNEATR). UNEP-WCMC Cambridge.
[9] The £10 million Insect Pollinators Initiative
[10] Krupke CH, Hunt GJ, Eitzer BD, Andino G, Given K (2012). Multiple Routes of Pesticide Exposure for Honeybees Living Near Agricultural Fields. PLoS ONE 7(1): e29268. doi:10.1371/journal.pone.0029268

22. They go on to state:
Our results also demonstrate that clothianidin is present in the surface soil of agricultural fields long after treated seed has been planted in that field. All soil samples we collected contained clothianidin, even in cases where no treated seed had been planted for 2 growing seasons. During the spring planting period, dust that arises from this soil may land on flowers frequented by bees, or possibly on the insects themselves. Of potentially greater concern are the very high levels of neonicotinoids (and fungicides) found in the talc that has been exposed to treated seed, since part of this highly mobile material is exhausted to the outside environment during planting and after planting. The large areas being planted with neonicotinoid treated seeds, combined with the high persistence of these materials and the mobility of disturbed soil and talc dust, carry potential for effects over an area that may exceed the boundaries of the production fields themselves.

23. This exposure to waste talc has also been found by Tapparo et al[11]. They investigated environmental exposure of honeybees to particulate matter containing neonicotinoid insecticides coming from corn coated seeds which have been drilled into soil. They found that:
particulate matter released by the drilling machine during the sowing of corn seeds coated with neonicotinoid insecticides represents a significant mechanism of environmental diffusion of these insecticides. Bees flying over the sowing field and approaching the emission cloud of the drilling machine can efficiently intercept the suspended particles being directly contaminated with elevated dose of insecticide, significantly higher than the LD50 values estimated for contact, with the cuticle, administration (18, 22, and 30 ng/ bee for imidacloprid, clothianidin, and thiamethoxam, respectively).

24. **As both experiments were conducted on maize/corn it is unknown whether the seed coating on OSR would present similar problem. We would like to know if this route of exposure has been investigated by Defra**.

25. Other routes of exposure include through guttation drops. Guttation is a natural plant phenomenon causing the excretion of xylem fluid at leaf margins Girolami et al[12] found that*:*
leaf guttation drops of all the corn plants germinated from neonicotinoid-coated seeds contained amounts of insecticide constantly higher than 10 mg/l, with maxima up to 100 mg/l for thiamethoxam and clothianidin, and up to 200 mg/l for imidacloprid. The concentration of neonicotinoids in guttation drops can be near those of active ingredients commonly applied in field sprays for pest control, or even higher. When bees consume guttation drops, collected from plants grown from neonicotinoid-coated seeds, they encounter death within few minutes.

26. **We would like the EAC to determine if this route of exposure is being investigated by Defra.**

Effects on ecosystems in agricultural landscapes

27. Most of UK's plant communities rely on pollinating insects to reproduce and therefore spread (apart from species such as grasses which are wind pollinated). Although the loss of semi- natural habitat is thought to be a major driver of wild bee declines (and most likely other insect pollinators), the fact that there are less pollinators present will affect the composition of plant communities themselves because of limited reproductive capacity, genetic diversity and plant dispersal.

28. Pollinating insects also form a vital part of the food chain for other species such as birds, reptiles and amphibians. It follows that any insecticide that drastically reduces pollinator numbers and causes pollen limitation within wildflower populations[13] will reduce biodiversity and have effects beyond the agricultural sector which will ultimately affect the health and function of entire ecosystems.

29. Wildflower communities make up semi-natural grasslands, woodlands, agricultural field margins, hedgerows and have a recreational, aesthetic and cultural value which is difficult to quantify. Wildflower

[11] Tapparo et al (2012). Assessment of the Environmental Exposure of Honeybees to Particulate Matter Containing Neonicotinoid Insecticides Coming from Corn Coated SeedsEnviron. Sci. Technol. 2012, 46, 2592−2599
[12] Girolami et al (2009). Translocation of Neonicotinoid Insecticides From Coated Seeds to Seedling Guttation Drops: A Novel Way of Intoxication for Bees. Journal of Econ Entomol. 102(5): 1808Ð1815
[13] See: Ashman et al (2004). Pollen limitation of plant reproduction: ecological and evolutionary causes and consequences. Ecology **85** 2408-2421

strips along crop margins have also been shown to harbour natural 'enemies' which can help control crop pests.[14]

30. Cardinali et al[15] reviewed two decades of research that has examined how biodiversity loss influences ecosystem functions, and the impacts that this can have on the goods and services ecosystems provide. They have made a number of concluding statements from their research including:
There is now sufficient evidence that biodiversity per se either directly influences or is strongly correlated with certain provisioning and regulating services – these included the regulating service of biocontrol.

31. Other researchers have also stated that conservation of biodiversity in the agricultural landscapes can be considered an insurance policy - providing ecosystem resilience in the face of perturbation.[16] Using aphids as an example Tscharntke et al stated:
The identity of naturally occurring enemies as cereal aphid antagonists greatly differs among regions and years. Around the city of Göttingen, Germany, there are years in which parasitoids are key mortality agents and others where ladybird beetles or syrphid flies[17] cause most of the mortality. Hence, cereal aphids suffer from a large number of enemies, but the effectiveness of each enemy seems to vary with landscape, region and. This spatio-temporal variation in effectiveness of each enemy species emphasizes the need of biodiversity preservation as insurance and to take large spatial scales into account. The long-term sustainability of ecosystems may depend on substitutable insurance species within each functional group. As environmental constrains change with time and space, it is hardly predictable which life history traits of aphid enemies is best adapted. Hence, only a diverse species pool for one ecological function may provide the best chance to include at least one well adapted, efficient species in a given environmental situation.

32. **We would like the EAC to ask Defra how they assess the impacts of neonicotinoids on biodiversity, ecosystem function and provision of ecosystem services.**

Inadequacy of risk assessment for these types of insecticides

33. The risk assessment process used to evaluate the risks of neonicotinoids (and indeed other insecticides) is outdated and designed for the older generation of insecticides which were sprayed on crops. Unlike systemic insecticides, the earlier foliage sprayed crops degraded quickly and so the risks to honeybees were only during the period of spraying or contact with recently treated foliage.

34. Neonicotinoids pose risks to insect pollinators, which are not currently accounted for, because:
    - they are persistent in soils,
    - they are transported to all parts of the plant including pollen and nectar (and guttation);
    - minute quantities found in pollen and nectar have sub-lethal effects
    - effects can vary depending on landscape complexity, timescales over which contaminated food stuff is ingested, cocktail effect of other insecticide;
    - they are not confined to crops but can contaminate wildflower field margins.

35. **In light of the risk assessment review currently underway by the European Food Safety Agency[18] we would like the EAC to determine why Defra continues to consent to the use of these neurotoxic chemicals even though the risk assessment of their effects on non-target species is acknowledged to be not fit for purpose.**

[14] Haenke, S., Scheid, B., Schaefer, M., Tscharntke, T. and Thies, C. (2009). Increasing syrphid fly diversity and density in sown flower strips within simple vs. complex landscapes. Journal of Applied Ecology, 46: 1106–1114
[15] Cardinali et al (2012). Biodiversity loss and its impact on humanity. Nature 486
[16] Tscharntke, T., Klein, A. M., Kruess, A., Steffan-Dewenter, I. and Thies, C. (2005). Landscape perspectives on agricultural intensification and biodiversity – ecosystem service management. Ecology Letters 8: 857–874.
[17] This includes hoverflies
[18] EFSA is currently revising the European Guidance Document on terrestrial ecotoxicology elaborated by the Commission and experts from Member States. In the context of this revision, the bees risk assessment will also be addressed.

36. **Furthermore will a new risk assessment mean that there will be a moratorium placed on neonicotinoid use until it can be convincingly shown that pollinator populations are not significantly impacted upon by use of neonicotinoids?**

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