CORRESPONDENCE

Response to Stevens and Jenkins' pesticide impacts on bumblebees: a missing piece

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Stevens & Jenkins (2012) highlight neonicotinoids as an important potential threat to wild bumblebees. Experiments on the effects of neonicotinoids on bumblebees demonstrate negative impacts on colonies exposed in field experimental (Whitehorn *et al.* 2012) or lab conditions (reviewed in Blacquière *et al.* 2012; Hopwood *et al.* 2012). Hence, neonicotinoid use may threaten wild bee populations at or near sites where these pesticides are used. We agree that better tracking of neonicotinoid input from various treatments is needed (as described by Stevens & Jenkins 2012) to assess their wildlife impacts. However, the data available indicate that neonicotinoid use does not explain broad-scale declines among the three eastern North American bumblebee species we studied (Szabo *et al.* 2012). This is supported by recent evidence that these species began exhibiting declines prior to the registration and widespread use of neonicotinoids in North America (Colla *et al.* 2012).

Stevens & Jenkins (2012) correctly point out that our data exclude seed application of pesticides. However, our data do include other neonicotinoid treatments, which can lead to higher neonicotinoid residues (see Figure S1). Although none of the relationships were statistically significant, for two of the three species studied insecticide use was actually *positively* related to population persistence.

As noted by Stevens & Jenkins (2012), most corn seed planted in North America is treated with neonicotinoids. In the region we considered, corn is a commonly produced crop (USDA 2011). To examine the potential role of corn treatment in declines, we carried out a new analysis testing for relationships between declines and corn production density. If neonicotinoid corn treatment was a significant cause of decline, species studied should persist to a greater extent in areas with little corn production. Yet, there are no significant relationships in the direction predicted (see Table S1). The lack of suitable data for pesticide concentration/amount used on corn crops as well as for additional seed-treated crops (e.g., potato, wheat, canola, sunflower) prevents further analyses. Thus, we cannot completely rule out the possibility that neonicotinoids may explain declines.

Single factor explanations for the rapid decline of North American pollinators remain elusive. At most, our analyses support prior suggestions that pathogen spillover may be contributing to the loss of wild populations (e.g., Colla *et al.* 2006). However, bumblebees differ in their susceptibility to environmental change (Williams *et al.* 2009), landscapes are complex and threats interact differently throughout species' ranges. With such complex interactions at play, leapfrogging the evidence to find "silver bullet" explanations for pollinator declines is likely to yield ineffective interventions. Yet, we conclude on a note of caution: our results do not disprove previous research, which clearly demonstrates that bumblebees can be harmed by proximate pesticide, and especially neonicotinoid, application at local scales. Our results suggest that field-level effects do not scale up to cause range-wide declines known to have occurred among the species we have considered here but better data are required for more thorough study. Until better data exist, strong limitations on pesticide use around at-risk pollinator populations are recommended.

Supporting Information

Additional Supporting information may be found in the online version of this article at the publisher's web site:

Figure S1: Scatterplots and logistic regression results of losses of *B. affinis*, *B. terricola*, and *B. pensylvanicus* in American counties or Canada census divisions against corn density. Corn density is in units of km^2 of corn per km^2 land area. Coefficients, *P*-values, and Nagelkerke R^2 values from logistic regressions are shown. $N = 45$, 49, and 95 for *B. affinis*, *B. terricola*, and *B. pensylvanicus*, respectively.

Table S1: Scientific studies that have quantified residues for seed-treated and soil-drenched crops as reviewed in Hopwood *et al.* (2012).

References

Blacquière, T., Smagghe, G., van Gestel, C.A. & Mommaerts, V. (2012) Neonicotinoids in bees: a review on concentrations, side-effects and risk assessment. *Ecotoxicology*, **21**, 973-992.

Colla, S.R., Gadallah, F., Richardson, L., Wagner, D. & Gall, L. (2012) Assessing declines of North American bumblebees using museum specimens. *Biodiversity Conserv.*, **21**, 3585-3595.

Colla, S.R., Otterstatter, M.C., Gegear, R.J. & Thomson, J.D. (2006) Plight of the bumblebee: pathogen spillover from commercial to wild populations. *Biol. Conserv.*, **129**, 461-467.

Hopwood, J.L., Vaughan, M., Shepherd, M. *et al.* (2012) Are neonicotinoids killing bees? A review of research into the effects of neonicotinoid insecticides on bees, with recommendations for action. Xerces Society for Invertebrate Conservation. http://www.xerces.org/wp-content/uploads/2012/03/Are-Neonicotinoids-Killing-Bees˙Xerces-Society1.pdf (visited Sep. 17, 2012).

Szabo, N.D., Colla, S.R., Wagner, D.L., Gall, L.F. & Kerr, J.T. (2012) Do pathogen spillover, pesticide use, or habitat loss explain recent North American bumblebee declines? *Conserv. Lett.*, **5**, 232-239.

Stevens, S. & Jenkins, P. (2012) Pesticide impacts on bumblebee decline: a missing piece. *Conserv. Lett.*

United States Department of Agriculture (USDA). (2011) National Agricultural Statistics Service, Crop Production Annual Summary and Crop Values Annual Summary. http://www.nass.usda.gov/Publications/index.asp (visited Nov. 29, 2012).

Whitehorn, P.R., O'Connor, S., Wackers, F.L. & Goulson, D. (2012) Neonicotinoid pesticide reduces bumble bee colony growth and queen production. *Science*, **336**, 351-352.

Williams, P., Colla, S. & Xie, Z. (2009) Bumblebee vulnerability: common correlates of winners and losers across three continents. *Conserv. Biol.*, **23**, 931-940.

