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Risks for amphibians in agricultural landscapes: insecticide use and prey availability

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Introduction

Beside other causes like pathogens, climate change or ozone depletion the main reason for amphibian population declines in Europe is habitat degradation. More than 50% of the land in Europe is agriculturally used and in the course of the intensification of farming, land clearance and the increasing use of fertilisers, pesticides and heavy machines lead to large-scale amphibian inappropriate environments. Most middle European amphibians (except water frogs) spend more than 80 % of their life in terrestrial habitats using fields for foraging and for migration between ponds or migration to over-wintering habitats (e.g. forests, hedges). So even if adequate aquatic habitats (breeding ponds) are available, amphibians face threats in their terrestrial habitats like being hurt or killed during ploughing practices, desiccating due to nitrogen fertiliser application containing Urea or probably also important: beeing affected by pesticide applications. Direct lethal effects of pesticides on amphibians were shown by Relyea (2005) for the herbicide Roundup. And it can be assumed that also indirect negative effects on amphibians occur like the reduction of amphibian prey availability after insecticide application. Therefore we tried to assess in a field trial if a reduction in biomass of potential amphibian prey items after insecticide use occurs and how much the biomass is reduced.

Figure 1: Fire-bellied Toad (*B. bombina*)

Figure 2: test site (source: ZALF e.V.)

Figure 3: pitfall trap

Figure 4: Suction sampling (D-Vac)

Materials & Methods

The test site is situated 40 km east of Berlin, in Müncheberg, and lies within an agriculturally intensive used landscape with a high density of small ponds, relicts of the Recent Ice Age (see figure 2), used as breeding habitats by eleven amphibian species. Six of them are endangered species registered on the red list for Germany.

We applied the single field rate of KarateZeon (7.5 g a.i./ha; a.i.: lambda-cyhalothrin, pyrethroid) on 32.5 ha of winter rye fields. Ponds were lying within the fields and were surrounded by 20 m wide extensive used grass strips.

We compared biomasses of potential prey items (arthropods) for the three frog species *Rana arvalis* (Moor Frog), *Bombina bombina* (Fire-bellied Toad, figure 1) and *Pelobates fuscus* (Common Spadefoot) on the treated fields with biomasses of prey items on winter rye control fields.

To assess the arthropod biomasses, we positioned pitfall traps (figure3), after Cornish et al. (1995) analogons to sit-and-wait-predators (frogs) along transects from the pond shores to the middle of the fields or walked transects with a suction sampler (D-Vac, figure 4) obtaining data for pond shores, buffer strips (drift, off-crop) and in field habitat. Arthropods not appropriate as prey items, because of size, taste or mobility, were excluded in the data processing. Prey items for adult and juvenile frogs were separately assessed as well as differences in prey preference (especially prey size) between the three frog species were respected.

Results & Discussion

In total about 40,000 arthropods were sampled with a biomass of about 3000 g. No drift effects in off-crop habitats (shore areas and grass strips) could be observed. The in-crop biomass of prey items for juveniles and adults of the Common Spadefoot was significantly lower on treated fields than on untreated fields during the first week after application (Figure 5). Similar results were also obtained for adult Moor Frogs and adult Fire-bellied Toads and based mainly on significantly lower biomasses of carabid beetles and spiders on the treated fields. Within the first week after application the lowest biomasses during the whole study period were measured on treated as well as on control fields. The reason for the overall reduction of biomasses was probably the cold and rainy weather during this sampling period resulting in low arthropod activity. But as the median biomasses on treated fields decreased up to 6 times as much as on untreated fields, we conclude that the significantly lower biomasses on treated fields occurred mainly because of insecticide effects. E. g. for adult and juvenile Common Spadefoots the reduction of prey item biomass compared to control was 65% within this sampling period.

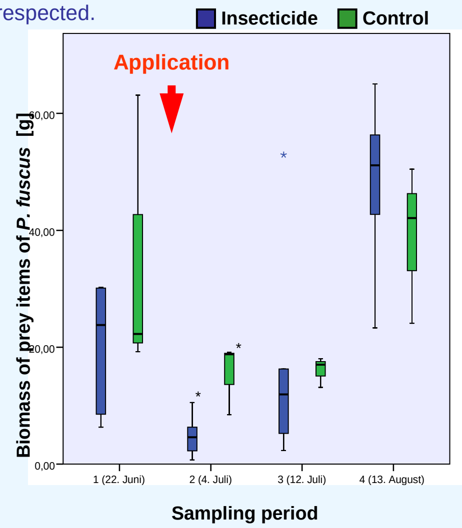

Figure 5: Biomass of prey items [g] for juvenile and adult Common Spadefoots on insecticide treated (blue) [N=6] and control [N=3] (green) sites, significances (*) after Mann-Withney-U-Test

Conclusion

As assumed insecticide use (shown for KarateZeon) can significantly lower prey availabilty for amphibians and may therefore lead to suboptimal foraging conditions. So insecticide use should be reduced as much as possible in regions where endangered amphibian species occur.

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