Pesticides and their metabolites in amphibian spawning waters are positively associated with nearby arable land

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Supplementary tables

Supplementary table S1: List of tested for and detected pesticides.
Supplementary table S2: Land-use data for sampling sites.
Supplementary table S3: Changes to the original category labelling of the land-use data.
Supplementary table S4: Pesticide co-occurrences.
Supplementary table S5: Results of the bootstrap models.

Supplementary figures

See below.

A
Pesticide concentrations
Importance
10
5
0
ShadowMin
Permanent snow (5000 m)
Orchard (500 m)
ShadowMean
Sands (500 m)
Rocks (100 m)
Dense settlementt (100 m)
Vineyard (100 m)
Grassland (500 m)
Open settlementt area (2500 m)
Rocks (2500 m)
Orchard (100 m)
Wetland (100 m)
Permanent crops (500 m)
Water bodies (100 m)
Urban green (100 m)
Wetland (500 m)
Rocks (500 m)
Scrubs (500 m)
Railways (500 m)
Open settlementt area (5000 m)
Scrubs (100 m)
Railways (100 m)
Artificial surfaces and constructions (100 m)
Sands (2500 m)
Vineyard (500 m)
Artificial surfaces and constructions (500 m)
Sands (5000 m)
Woody features (500 m)
Rocks (5000 m)
Industrial and commercial zones (100 m)
Woody features (100 m)
Permanent crops (2500 m)
Vineyard (5000 m)
Tracks (100 m)
Urban green (500 m)
Roads (2500 m)
Open settlementt area (500 m)
Water bodies (2500 m)
Railways (2500 m)
Grassland (100 m)
Vineyard (2500 m)
Permanent crops (100 m)
Built up area (500 m)
Woody features (2500 m)
Tree cover (2500 m)
Dense settlementt (500 m)
Woody features (5000 m)
Tree cover (100 m)
Orchard (2500 m)
Dense settlementt (2500 m)
Railways (5000 m)
Orchard (5000 m)
Tree cover (500 m)
Low density settlement (5000 m)
Scrubs (2500 m)
Built up area (2500 m)
Urban green (5000 m)
ShadowMax
Wetland (5000 m)
Scrubs (5000 m)
Dense settlementt (2500 m)
Tracks (2500 m)
Permanent crops (5000 m)
Roads (5000 m)
Low density settlement (100 m)
Built up area (5000 m)
Tree cover (5000 m)
Water bodies (2500 m)
Urban green (2500 m)
Tracks (5000 m)
Sparsely vegetated land (500 m)
Sparsely vegetated land (5000 m)
Artificial surfaces and constructions (2500 m)
Water bodies (5000 m)
Tracks (500 m)
Artificial surfaces and constructions (5000 m)
Wetland (2500 m)
Sparsely vegetated land (2500 m)
Low density settlement (2500 m)
Arable land (2500 m)
Low density settlement (500 m)
Grassland (2500 m)
Grassland (5000 m)
Built up area (100 m)
Industrial and commercial zones (2500 m)
Roads (100 m)
Industrial and commercial zones (500 m)
Industrial and commercial zones (5000 m)
Roads (500 m)
Arable land (100 m)
Arable land (5000 m)
Arable land (500 m)
B
Pesticide numbers
Importance
10
5
0
−5
ShadowMin
Dense settlementt (100 m)
Artificial surfaces and constructions (100 m)
Rocks (500 m)
Woody features (100 m)
Vineyard (500 m)
Wetland (100 m)
Sparsely vegetated land (500 m)
Low density settlement (100 m)
Industrial and commercial zones (100 m)
Woody features (500 m)
Orchard (100 m)
Grassland (500 m)
ShadowMean
Built up area (100 m)
Railways (500 m)
Artificial surfaces and constructions (500 m)
Scrubs (500 m)
Roads (100 m)
Industrial and commercial zones (500 m)
Rocks (2500 m)
Permanent crops (100 m)
Rocks (100 m)
Scrubs (100 m)
Permanent crops (500 m)
Sands (500 m)
Permanent snow (5000 m)
Low density settlement (500 m)
Tracks (100 m)
Orchard (500 m)
Wetland (500 m)
Urban green (500 m)
Railways (100 m)
Roads (500 m)
Open settlementt area (2500 m)
Sands (2500 m)
Grassland (100 m)
Orchard (2500 m)
Urban green (100 m)
Sparsely vegetated land (5000 m)
Woody features (2500 m)
Vineyard (5000 m)
Tree cover (500 m)
Urban green (5000 m)
Permanent crops (2500 m)
Vineyard (100 m)
Built up area (2500 m)
Woody features (5000 m)
Sands (5000 m)
Roads (2500 m)
Tree cover (2500 m)
Open settlementt area (500 m)
Tracks (2500 m)
Railways (5000 m)
Urban green (2500 m)
Open settlementt area (5000 m)
Water bodies (100 m)
Low density settlement (5000 m)
Industrial and commercial zones (2500 m)
Tracks (5000 m)
Dense settlementt (500 m)
Water bodies (2500 m)
Railways (2500 m)
Dense settlementt (2500 m)
Vineyard (2500 m)
Water bodies (5000 m)
Tree cover (100 m)
Wetland (5000 m)
Water bodies (500 m)
Dense settlementt (5000 m)
Sparsely vegetated land (2500 m)
Scrubs (2500 m)
Grassland (2500 m)
ShadowMax
Orchard (5000 m)
Rocks (5000 m)
Industrial and commercial zones (5000 m)
Tracks (500 m)
Grassland (5000 m)
Tree cover (5000 m)
Low density settlement (2500 m)
Scrubs (5000 m)
Built up area (5000 m)
Permanent crops (5000 m)
Built up area (500 m)
Artificial surfaces and constructions (2500 m)
Roads (5000 m)
Wetland (2500 m)
Artificial surfaces and constructions (5000 m)
Arable land (2500 m)
Arable land (100 m)
Arable land (5000 m)
Arable land (500 m)

***Figure S1**: Pesticide concentrations (A) and numbers (B) results of the Boruta analysis comparing the possible effects of all land use parameters including four different radii around the water bodies (100 m, 500 m, 2500 m, 5000 m). Box plots in green are above the chance level when compared to randomized control samples (shadow features (min, mean and max), in blue).*

A
Birds acute – toxic load
Importance
8
6
4
2
0
−2
−4
ShadowMin
Vineyard (500 m)
Railways (100 m)
Wetland (500 m)
Wetland (100 m)
Vineyard (100 m)
Dense settlementt (100 m)
Orchard (500 m)
Artificial surfaces and constructions (100 m)
Permanent crops (500 m)
ShadowMean
Rocks (500 m)
Rocks (2500 m)
Scrubs (100 m)
Rocks (100 m)
Permanent snow (5000 m)
Open settlementt area (2500 m)
Orchard (100 m)
Open settlementt area (5000 m)
Urban green (100 m)
Permanent crops (2500 m)
Orchard (5000 m)
Tree cover (100 m)
Scrubs (500 m)
Grassland (500 m)
Permanent crops (100 m)
Sands (2500 m)
Sands (500 m)
Sands (5000 m)
Urban green (500 m)
Water bodies (100 m)
Open settlementt area (500 m)
Rocks (5000 m)
Scrubs (2500 m)
Woody features (500 m)
Woody features (5000 m)
Woody features (100 m)
Grassland (100 m)
Built up area (500 m)
Scrubs (5000 m)
Vineyard (2500 m)
Dense settlementt (500 m)
Vineyard (5000 m)
Artificial surfaces and constructions (500 m)
Built up area (2500 m)
Water bodies (500 m)
Tree cover (2500 m)
Permanent crops (5000 m)
Tracks (2500 m)
Woody features (2500 m)
Built up area (5000 m)
Dense settlementt (5000 m)
Low density settlement (5000 m)
Orchard (2500 m)
Industrial and commercial zones (100 m)
Roads (5000 m)
Roads (2500 m)
Railways (2500 m)
Tree cover (5000 m)
Artificial surfaces and constructions (2500 m)
ShadowMax
Arable land (2500 m)
Arable land (100 m)
Dense settlementt (2500 m)
Urban green (5000 m)
Railways (5000 m)
Railways (500 m)
Low density settlement (100 m)
Urban green (2500 m)
Tracks (100 m)
Wetland (5000 m)
Sparsely vegetated land (5000 m)
Water bodies (2500 m)
Tree cover (500 m)
Low density settlement (2500 m)
Tracks (5000 m)
Sparsely vegetated land (500 m)
Wetland (2500 m)
Sparsely vegetated land (2500 m)
Artificial surfaces and constructions (5000 m)
Water bodies (5000 m)
Tracks (500 m)
Grassland (5000 m)
Arable land (500 m)
Low density settlement (500 m)
Roads (500 m)
Industrial and commercial zones (5000 m)
Roads (100 m)
Industrial and commercial zones (2500 m)
Industrial and commercial zones (500 m)
Built up area (100 m)
Arable land (5000 m)
Grassland (2500 m)
B
Mammals acute – toxic load
Importance
8
6
4
2
0
−2
−4
ShadowMin
Wetland (100 m)
ShadowMean
Permanent crops (500 m)
Rocks (100 m)
Sands (500 m)
Permanent snow (5000 m)
Artificial surfaces and constructions (100 m)
Wetland (500 m)
Dense settlementt (100 m)
Open settlementt area (2500 m)
Scrubs (100 m)
Orchard (500 m)
Scrubs (500 m)
Vineyard (500 m)
Permanent crops (2500 m)
Sands (2500 m)
Rocks (2500 m)
Rocks (500 m)
Railways (100 m)
Permanent crops (100 m)
Orchard (100 m)
Sands (5000 m)
Industrial and commercial zones (100 m)
Vineyard (100 m)
Open settlementt area (5000 m)
Grassland (500 m)
Urban green (100 m)
Low density settlement (100 m)
Woody features (500 m)
Water bodies (100 m)
Woody features (100 m)
Vineyard (2500 m)
Grassland (100 m)
Built up area (500 m)
Vineyard (5000 m)
Open settlementt area (500 m)
Rocks (5000 m)
Water bodies (500 m)
Urban green (500 m)
Built up area (2500 m)
Scrubs (5000 m)
Artificial surfaces and constructions (500 m)
Railways (500 m)
Scrubs (2500 m)
Woody features (2500 m)
Sparsely vegetated land (500 m)
Roads (2500 m)
Dense settlementt (5000 m)
Railways (2500 m)
Orchard (2500 m)
Dense settlementt (500 m)
Woody features (5000 m)
Tree cover (2500 m)
Urban green (5000 m)
Tree cover (100 m)
Railways (5000 m)
Tracks (100 m)
Tracks (2500 m)
Low density settlement (5000 m)
ShadowMax
Orchard (5000 m)
Tree cover (5000 m)
Permanent crops (5000 m)
Dense settlementt (2500 m)
Urban green (2500 m)
Roads (5000 m)
Tree cover (500 m)
Wetland (5000 m)
Built up area (5000 m)
Water bodies (2500 m)
Artificial surfaces and constructions (2500 m)
Tracks (5000 m)
Arable land (2500 m)
Water bodies (5000 m)
Tracks (500 m)
Low density settlement (2500 m)
Sparsely vegetated land (5000 m)
Artificial surfaces and constructions (5000 m)
Sparsely vegetated land (2500 m)
Wetland (2500 m)
Grassland (5000 m)
Low density settlement (500 m)
Arable land (100 m)
Roads (100 m)
Industrial and commercial zones (2500 m)
Roads (500 m)
Industrial and commercial zones (5000 m)
Industrial and commercial zones (500 m)
Arable land (500 m)
Built up area (100 m)
Grassland (2500 m)
Arable land (5000 m)

Figure S2: *Results of toxicity for terrestrial animals (birds, A and mammals, B) using the Boruta analysis, comparing the possible effects of all land use parameters including four different radii around the water bodies (100 m, 500 m, 2500 m, 5000 m). Box plots in green are above the chance level when compared to randomized control samples (shadow features (min, mean and max), in blue).*

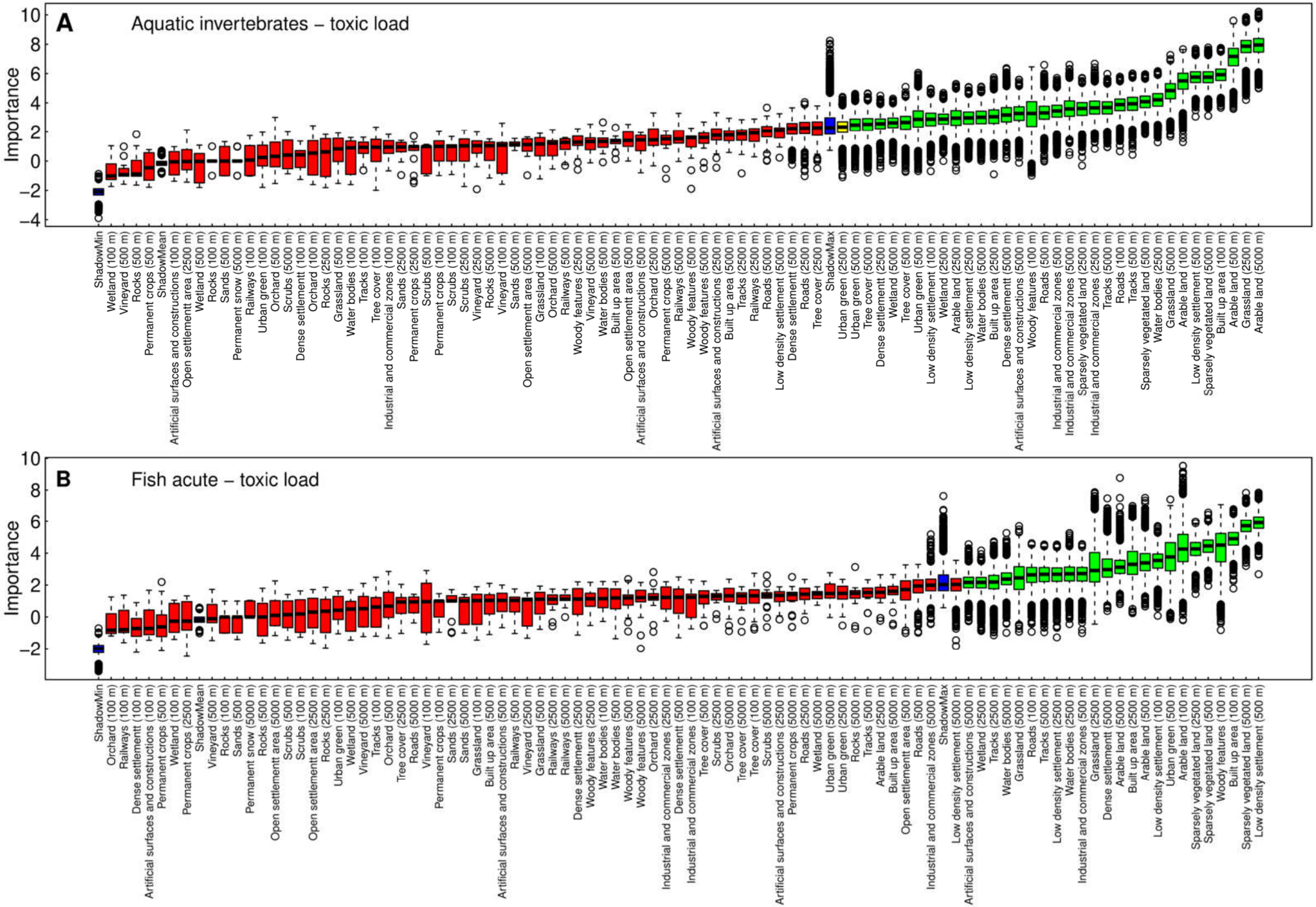

A
Aquatic invertebrates – toxic load
Importance
10
8
6
4
2
0
−2
−4
ShadowMin
Wetland (100 m)
Vineyard (500 m)
Rocks (500 m)
Permanent crops (500 m)
ShadowMean
Artificial surfaces and constructions (100 m)
Open settlementt area (2500 m)
Wetland (500 m)
Rocks (100 m)
Sands (500 m)
Permanent snow (5000 m)
Railways (100 m)
Urban green (100 m)
Orchard (500 m)
Scrubs (5000 m)
Dense settlementt (100 m)
Orchard (100 m)
Rocks (2500 m)
Grassland (500 m)
Water bodies (100 m)
Tracks (100 m)
Tree cover (100 m)
Industrial and commercial zones (100 m)
Sands (2500 m)
Permanent crops (2500 m)
Scrubs (500 m)
Permanent crops (100 m)
Scrubs (100 m)
Scrubs (2500 m)
Vineyard (2500 m)
Rocks (5000 m)
Vineyard (100 m)
Sands (5000 m)
Open settlementt area (5000 m)
Grassland (100 m)
Orchard (5000 m)
Railways (500 m)
Woody features (2500 m)
Vineyard (5000 m)
Water bodies (500 m)
Built up area (500 m)
Open settlementt area (500 m)
Artificial surfaces and constructions (500 m)
Orchard (2500 m)
Permanent crops (5000 m)
Railways (5000 m)
Woody features (500 m)
Woody features (5000 m)
Artificial surfaces and constructions (2500 m)
Built up area (5000 m)
Tracks (2500 m)
Railways (2500 m)
Roads (5000 m)
Low density settlement (5000 m)
Dense settlementt (2500 m)
Roads (2500 m)
Tree cover (2500 m)
ShadowMax
Urban green (2500 m)
Urban green (5000 m)
Tree cover (5000 m)
Dense settlementt (2500 m)
Wetland (5000 m)
Tree cover (500 m)
Urban green (500 m)
Low density settlement (100 m)
Wetland (2500 m)
Arable land (2500 m)
Low density settlement (2500 m)
Water bodies (5000 m)
Built up area (2500 m)
Dense settlementt (5000 m)
Artificial surfaces and constructions (5000 m)
Woody features (100 m)
Roads (500 m)
Industrial and commercial zones (500 m)
Industrial and commercial zones (5000 m)
Sparsely vegetated land (2500 m)
Industrial and commercial zones (2500 m)
Tracks (5000 m)
Roads (100 m)
Tracks (500 m)
Sparsely vegetated land (500 m)
Water bodies (2500 m)
Grassland (5000 m)
Arable land (100 m)
Low density settlement (500 m)
Sparsely vegetated land (5000 m)
Built up area (100 m)
Arable land (500 m)
Grassland (2500 m)
Arable land (5000 m)
B
Fish acute – toxic load
Importance
10
8
6
4
2
0
−2
ShadowMin
Orchard (100 m)
Railways (100 m)
Dense settlementt (100 m)
Artificial surfaces and constructions (100 m)
Permanent crops (500 m)
Wetland (100 m)
Permanent crops (2500 m)
ShadowMean
Vineyard (500 m)
Rocks (100 m)
Sands (500 m)
Permanent snow (5000 m)
Rocks (500 m)
Open settlementt area (5000 m)
Scrubs (500 m)
Scrubs (100 m)
Open settlementt area (2500 m)
Rocks (2500 m)
Urban green (100 m)
Wetland (500 m)
Vineyard (5000 m)
Tracks (100 m)
Orchard (500 m)
Tree cover (2500 m)
Roads (5000 m)
Vineyard (100 m)
Permanent crops (100 m)
Sands (2500 m)
Sands (5000 m)
Grassland (100 m)
Built up area (500 m)
Artificial surfaces and constructions (500 m)
Railways (500 m)
Vineyard (2500 m)
Grassland (500 m)
Railways (2500 m)
Railways (5000 m)
Dense settlementt (2500 m)
Woody features (2500 m)
Water bodies (100 m)
Water bodies (500 m)
Woody features (500 m)
Woody features (5000 m)
Orchard (2500 m)
Industrial and commercial zones (2500 m)
Dense settlementt (500 m)
Industrial and commercial zones (100 m)
Tree cover (500 m)
Scrubs (2500 m)
Orchard (5000 m)
Tree cover (5000 m)
Tree cover (100 m)
Scrubs (5000 m)
Artificial surfaces and constructions (2500 m)
Permanent crops (5000 m)
Roads (2500 m)
Wetland (5000 m)
Urban green (5000 m)
Urban green (2500 m)
Rocks (5000 m)
Tracks (500 m)
Arable land (2500 m)
Built up area (5000 m)
Open settlementt area (500 m)
Roads (500 m)
Industrial and commercial zones (5000 m)
ShadowMax
Low density settlement (5000 m)
Artificial surfaces and constructions (5000 m)
Wetland (2500 m)
Tracks (2500 m)
Water bodies (5000 m)
Grassland (5000 m)
Roads (100 m)
Tracks (5000 m)
Low density settlement (2500 m)
Water bodies (2500 m)
Industrial and commercial zones (500 m)
Grassland (2500 m)
Dense settlementt (5000 m)
Arable land (5000 m)
Built up area (2500 m)
Arable land (500 m)
Low density settlement (100 m)
Urban green (500 m)
Arable land (100 m)
Sparsely vegetated land (2500 m)
Sparsely vegetated land (500 m)
Woody features (100 m)
Built up area (100 m)
Sparsely vegetated land (5000 m)
Low density settlement (500 m)

Figure S3: *Results of toxicity for aquatic animals (invertebrates, A and fish, B) using the Boruta analysis, comparing the possible effects of all land use parameters including four different radii around the water bodies (100 m, 500 m, 2500 m, 5000 m). Box plots in green are above the chance level when compared to randomized control samples (shadow features (min, mean and max), in blue).*

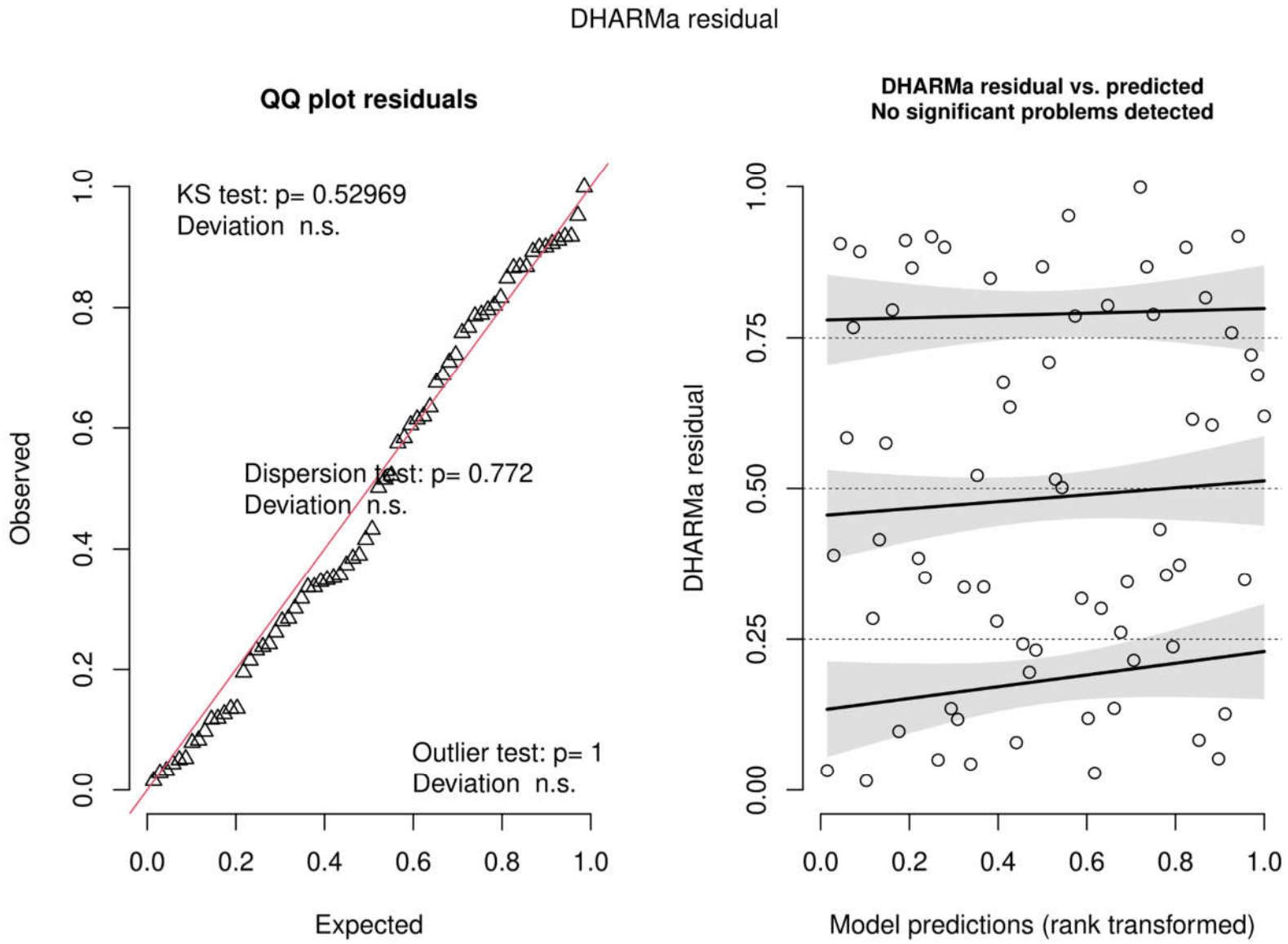


Figure S4: *Results of the evaluations of the model fit for the final model for pesticide number, showing the QQ plot as well as the Kolmogorov–Smirnov (KS) test, Dispersion test and outlier test. The residuals did not significantly deviate from the expected distribution.*