SIGNIFICANCE OF THE 90th PERCENTILE
How to reach a realistic PT value for long-term exposure?

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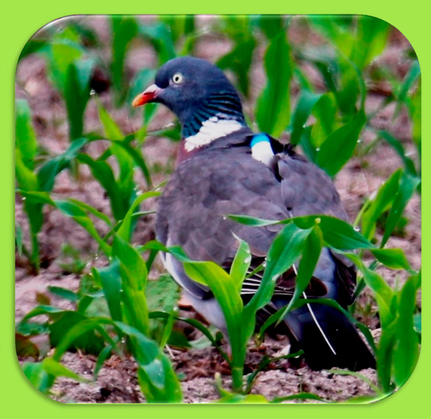
INTRODUCTION

The magnitude of exposure of birds to pesticides depends on spatial and temporal movement and behaviour, which radio-tracking can elucidate. Such radio-tracking studies estimate the Proportion of an animal's daily diet obtained in a Treated habitat (**PT**) [1].

Current practice between Member States is to use, for the risk assessment, the 90th percentile PT value of the recorded dataset[2]. However, for the **long-term** reproductive assessment this approach may result in **unrealistic high mean exposure values**. Therefore, Ludwigs *et al.* (2017) proposed a way to estimate such a long-term PT using an existing dataset (for woodpigeon). Our work contributes to the ongoing discussion, increases the understanding of inter- and intra-individual variability in behaviour and takes up some of the actual critics[2].



From left to right: radio-tracking procedure; radio-tagged woodpigeon

MATERIALS & METHODS

First, the woodpigeon dataset by Ludwigs *et al.* (2017) was analysed with respect to the inter- and intra-variability of estimated PT values. The dataset contains PT values for the use of stubble crops by woodpigeons (n = 20), including repeated tracking of individuals, over either one or two instances of three consecutive days (= sessions).

Second, using **nine datasets** of PT values from different species in orchards or cereal in Spain and UK, the cumulative frequency distributions were explored. Additionally, the intra-individual variability of PT values (repeated sessions) was analysed.

Based on the results, a **new approach to estimate the long-term PT** is proposed, which could be a surrogate parameter until the underlying variability in behaviour can be accurately described.

RESULTS & DISCUSSION

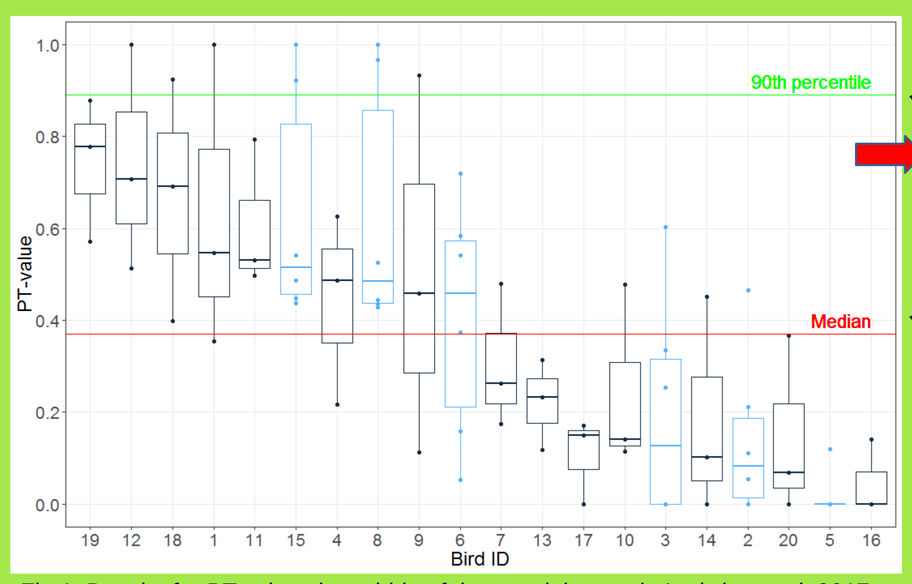
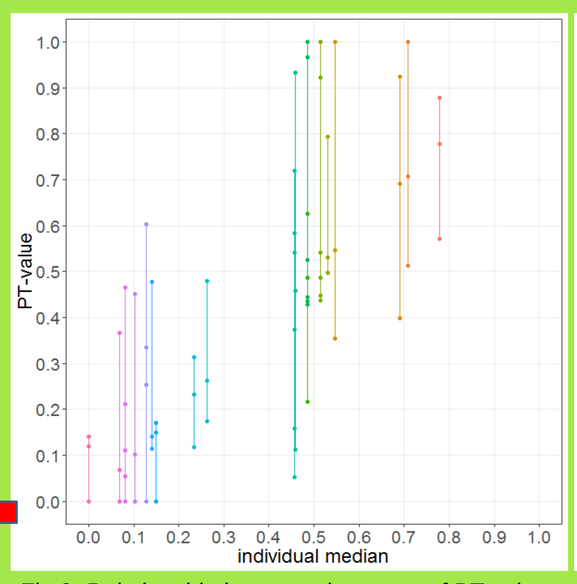


Fig.1: Boxplot for PT-values in stubble of the woodpigeons in Ludwigs et al. 2017.
(black/blue = 3/6 sessions, the dots represent the data points)

✓ 90th percentile PT value overestimates the individual average exposure already in a period of 3 days (Fig. 1)

✓ For consecutive sessions, the higher the mean or median PT value is, the greater is the variability of daily PT values (Fig. 2). Individual habitat preference shows high flexibility in the short term.



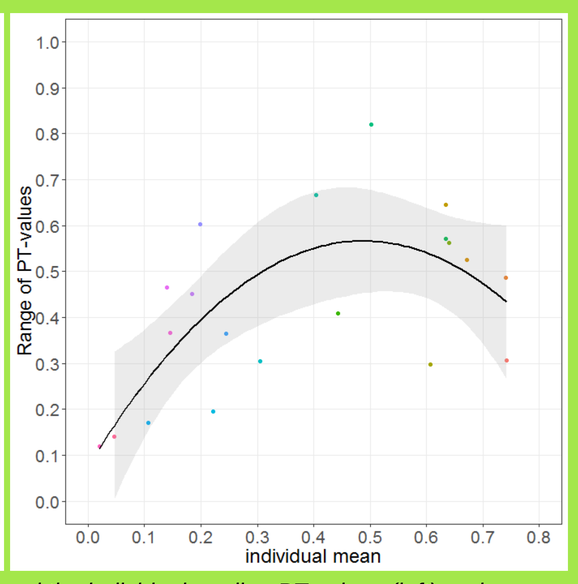


Fig.2: Relationship between the range of PT values and the individual median PT values (left) and individual mean PT values (right) of the woodpigeon individuals in Ludwigs et al. (2017)

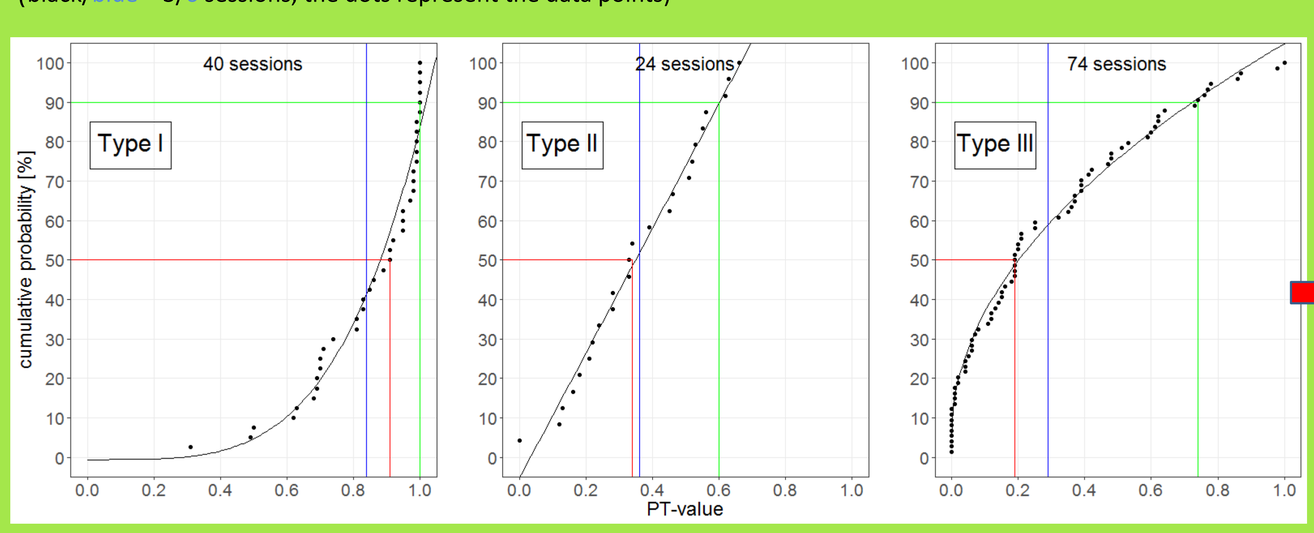


Fig.3: Cumulative probabilities of the PT values with a fitted function for the test data sets. From left to right: omnivorous species in citrus orchard, omnivorous species in cereal and insectivorous species in pome fruit orchard.
(Lines: blue = Mean, red = Median, solid green = 90thile of data)

✓ The type of cumulative probability distribution of PT values shows the general relevance of the crop for individuals of the studied population (Fig. 3).

a) Three main patterns could be identified:
Type I: crop is used to a great extent by whole population
Type III: crop is used rarely by most individuals
Type II: crop use is evenly distributed among individuals
Taking the 90%ile PT, this difference is not accounted for.

b) For more than four repeated sessions, the PT values seem to cover the whole possible range or just part of it depending on species/crop combination.

Radio-tagged great tit

NEW Long-term PT estimation

No agreed approach how to reach a long-term PT. A surrogate parameter is suggested, based on:

1) the 90th percentile PT (PT_{90}): as agreed value reflecting a "reasonable worst case"
2) the mean PT value (PT_{mean}): as measure of the average exposure
3) the difference between mean PT and 90th percentile PT: as measure of the overall relevance of the crop for the studied population

The following formula is proposed:

zero PT values should be included and all repeated sessions of each individual (no estimation of individual mean PT).

$$Long\ term\ PT = PT_{90} - (PT_{90} - PT_{mean})^2$$

✓ The proposed formula needs to be verified with additional data.

✓ Individual habitat preferences can shape the mean exposure of a population of farmland birds; therefore repeated session of individuals should be included.

Table 1: Estimation of the proposed long-term PT for the woodpigeon dataset (Ludwigs et al. 2017)

Parameter	Day		
	1	2	3
90th percentile[1]	0.794	0.890	0.928
Mean[1]	0.412	0.407	0.411
Proposed long-term PT[1]	0.648	0.657	0.660
Proposed long-term PT averaged over 3 days =			**0.655**
90th percentile per bird[2], all data & average per bird =			**0.678**

[1]including zero PT values as all individuals were consumers, which is more appropriate in general

✓ The proposed long-term PT seems to be robust to individual variation in daily sessions (Table 1); to be further tested by simulations.

✓ just two of 20 individuals with an the average PT values greater than the proposed long term PT

CONCLUSIONS

✓ Using just the 90th percentile PT for pesticide risk assessment neglects valuable information.
✓ Relevance of the crop for the population should be explored through cumulative probability distributions of PT values.
✓ Omitting zero PT values by default is not supported by the available data.
✓ An estimation of the long-term PT based on the 90th percentile and the mean PT value could be a surrogate parameter until an agreed approach is found.
✓ Further analysis of the underlying variability in bird behaviour will be helpful to reach a convincing method for the estimation of the long-term PT.

References:
1. EFSA 2009. Guidance Document on Risk Assessment for Birds & Mammals. EFSA Journal 2009; 7(12):1438.
2. HSE position paper on the use of Monte-Carlo simulated PT value (2018), Chemical Regulation Division, UK Health and Safety Executive. Distributed at 18th International Fresenius ECOTOX Conference, Mainz.
3. Ludwigs et al. (2017). Appropriate exposure estimates for wildlife risk assessments of crop protection products based on continuous radio telemetry: A case study with woodpigeons. Environmental Toxicology and Chemistry, Vol. 36, No. 5, pp. 1270–1277

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