Calculating realistic long-term PT values for wildlife risk assessment – insights from telemetry field studies

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1 - Introduction

The current EFSA guidance document (GD) on risk assessment for birds and mammals (2009) assumes, if no specific data are available, that animals feed exclusively on pesticide-treated fields. One important and frequently used refinement factor of the risk to birds and mammals from pesticide exposure is a more realistic estimation of the "**P**ortion of food animals obtain from **T**reated fields". This so-called **PT** factor is equalized (according to EFSA 2009) with the portion of time animals spend 'potentially foraging' within treated fields, i.e. within the respective crop of interest. Therefore the derived PT factor could range from 0 (foraging only outside the treated crop) to 1 (default assumption/exclusively foraging in treated crop), and radio-tracking is the tool of choice to generate PT values and derive a PT factor for long-term risk assessments.

Photo: Michael Erni

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3 - Introducing Monte Carlo probabilistic approaches

To derive a PT factor for long-term risk assessments, EFSA (2009) recommends generation of species-, time-, and crop-related continuous radio-tracking data (i.e. individual PT values). The GD mentions the theoretical need for 21 such values per individual per day to cover the regulatory 'long-term exposure period'. Ludwigs et al. (2017) demonstrated how more appropriate PT data could be derived via a Monte Carlo (MC) probabilistic approach to simulate a 90th percentile 21-day PT factor for a bird data set. Here we demonstrate benefits and constraints of applying the MC probabilistic approach using a comprehensive PT data set of tracked hares to generate PT values according to the current bird and mammal risk assessment GD by EFSA (2009).

2 - Regulatory Practice

At present, PT factors derived from publicly available data (e.g. Finch et al. 2006) or specifically conducted telemetry studies resulted in retaining PT of 1 or the use of a single maximum value of a given PT dataset, if the sample size was below 10 individuals tracked. If data for more than 10 individuals were available the 90th percentile of empirical PT data (e.g. one PT value per animal) was commonly accepted. In sources like Finch et al. (2006) one individual PT value does not necessarily cover a full daily activity period as recommended by EFSA (2009) or recorded data are not crop-specific (i.e. animals were not trapped in or at the crop of concern, but somewhere in an agricultural landscape). As a result the PT factors in risk assessments derived from such PT data were based on the so-called 'consumers only' (i.e. animals with single empirical PT values > 0).

➲ European hare data set

In an extensive GPS tracking study, 23 European hares (*Lepus europaeus*) were tracked multiple times in vineyards. Altogether, 109 full-day tracking sessions were conducted with mostly 5 sessions per individual (Fig. 1).

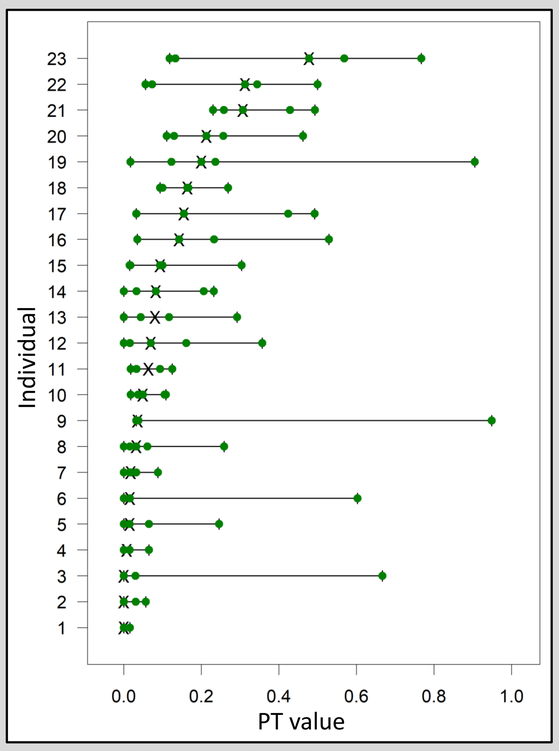

Figure 1: PT values of 23 European hares (dots). The 'X' indicates the median

Assumption for MC approach

- PT values of individuals with similar intra-individual variability can be pooled for MC sampling
- Decision on pooling can be taken based on inspection of the data set, and ecological knowledge

Visual inspection of hare data set

- Each individual could potentially realise each measured PT value
- Low PT values are generally more likely for all individuals

→ Data for all individuals can be pooled for the MC approach

➲ Issues of small data sets

Often only smaller data sets with a limited number of individuals & tracking sessions are available. In this case, resampling from the same population can yield rather different PT values (Fig. 3) resulting in considerable variability in the 90th percentile PT estimates.

→ Small data sets can cause particular difficulties in deciding whether and how the MC approach can be applied without considering ecological and biological expert knowledge

➲ Summary

- PT data quality and quantity need to be considered in more detail than currently
- Multiple tracking sessions per individual are important to decide if inter- and intra-individual variability is similar
- Intra-individual variance is an important aspect of exposure in the long-term
- 90th percentile PTs derived from Monte-Carlo simulations are a reasonable step forward to apply refinement
- However, based on a small empirical data set one cannot derive a strong MC PT value
- If and how data can be pooled is a point of discussion and needs to be assessed on a case-by-case basis

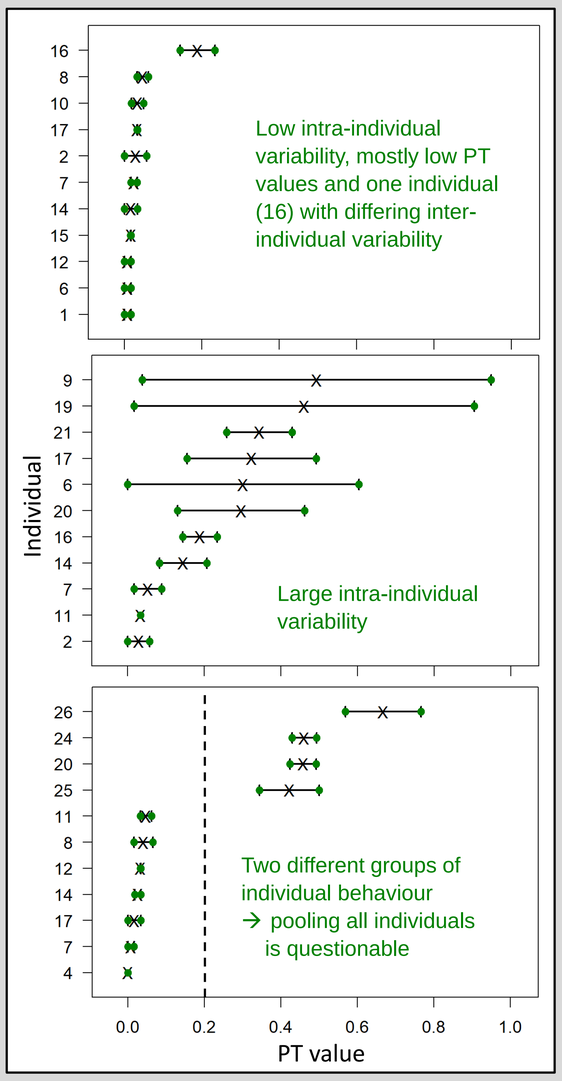

Figure 3: Three selections of 11 individuals with two tracking sessions from original data set. The plots visualise potential issues of less extensive data sets

➲ Results

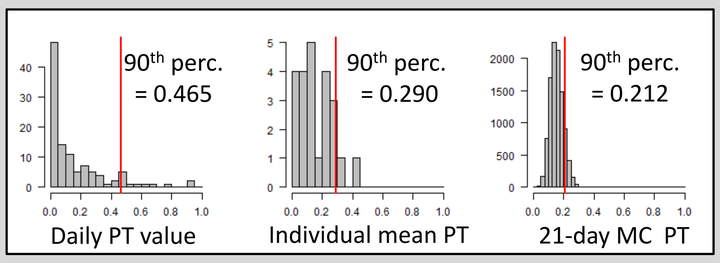

Figure 2: Distribution and 90th percentile of daily measured PT values (left), individual mean of observed PT values (mid), and 21-day individual mean PT values derived by Monte Carlo simulations (right)

- 90th perc. of all daily PT values does not consider intra-individual variability
- 90th perc. of individual mean PTs considers intra-individual variability for the number of tracking sessions per individual (up to 5)
- 90th perc. of mean 21-day MC PT values accounts for long-term intra-individual variability

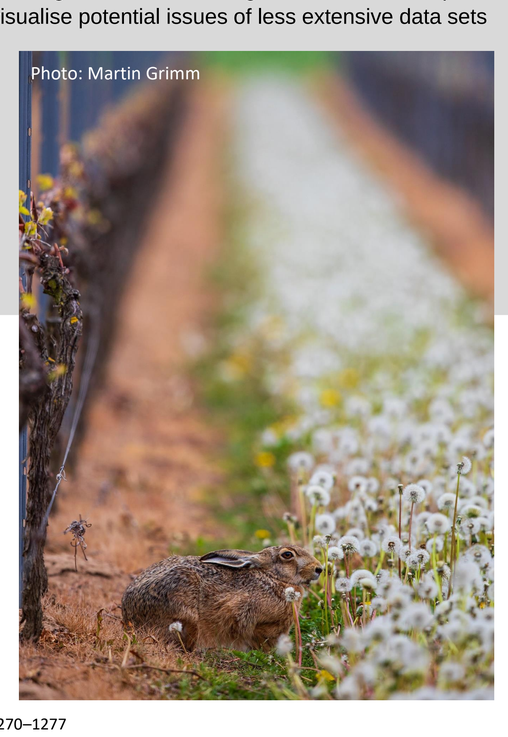

Photo: Martin Grimm

➲ Conclusion

Considering intra- and inter-individual variability can help in deriving more representative PT values. The biology of the tracked species and the quantity and quality of the respective radio-tracking data set at hand need to be considered. Lessons learned from various, also less comprehensive datasets give guidance on how species ecology could be considered when analyzing telemetry data and how new tracking data should be collected. A follow up paper comparing several PT datasets for different species and sample sizes is in preparation.

Modelled PT values following Monte Carlo probabilistic approaches could be a further refinement to current approach in higher assessments, where PT refinement is typically restricted to the 90th percentile of the empirical data and a 'consumer only' selection. Hence, Monte Carlo probabilistic approaches should be considered in the revision of the current EFSA Bird & Mammal GD (2009).

EFSA - European Food Safety Authority (2009). Guidance of EFSA—Risk assessment for birds and mammals on request of EFSA. EFSA J 7:1438. Parma, Italy. Available from: http://www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/1438.pdf

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