GPS Tracking to Estimate Exposure of Birds and Mammals to Plant Protection Products for Risk Assessments

MEET US AT BOOTH 109!

INTRODUCTION

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In the European registration process for plant protection products, a risk assessment must be conducted for birds and mammals following the guidance published by the European Food Safety Authority (2009, 2023). Exposure via contaminated food is considered to be the most important route of exposure. The initial risk assessment makes the worst-case assumption that a bird or mammal feeds entirely in the pesticide-treated area (EFSA 2023). If a potential risk is indicated, data that are more realistic are needed to support a refined assessment, such as the proportion of diet an animal obtains from a treated area (PT).
Until now, conventional VHF radio-tracking data have been used in order to provide an estimate of the PT values. We want to demonstrate the use of GPS tags as a new method to collect data for PT estimations in accordance with the EFSA (2023) recommendations.

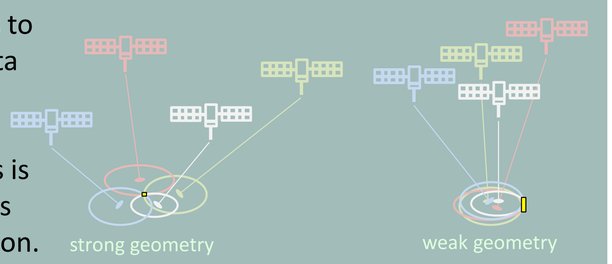
GPS tags for birds and mammals

GPS tags record positions of tagged animals at scheduled time intervals and save them on the device.

Data can be downloaded remotely without recapturing the animal.

GPS devices use a **trilateration** process to determine their location based on data received from multiple satellites.

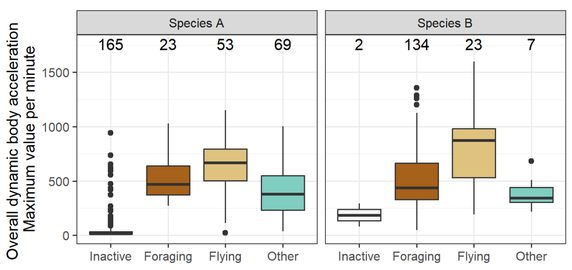
The **accuracy** of the recorded locations is influenced by the number of satellites present and their geometric configuration.



Exclusion of 'inactive' tracking records

Within the context of the pesticide exposure assessment for birds and mammals, it is assumed that the *PT estimate is equal to the proportion of active time* individuals of a relevant focal species spend in the treated area per day.

→ 'Inactive time' data (e.g. resting, hiding) should be excluded, since individuals cannot forage while they are inactive.



GPS tags with in-built accelerometers can measure the movement of the tag

→ ODBA values can be assigned to certain behaviour by exemplarily conducted behavioural observations to distinguish between 'active' and 'inactive' tracking records by the measured activity data

Figure 1 Boxplots showing the maximum ODBA value per minute per behavioural category. The values above the boxplots indicate the number of minutes assigned to a certain behavioural category.

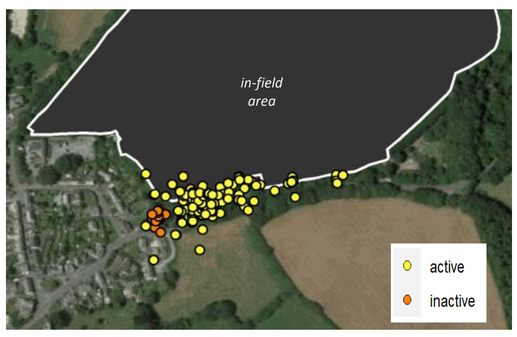


Figure 2 Map showing the recorded GPS fixes of a male Blackbird. 'Active' and 'inactive' tracking records are indicated in different colours.

The spatial distribution of locations where a tracked animal was assigned as either 'active' or 'inactive' can be used to identify areas preferred for foraging and the locations chosen for resting.

The plotted data to the left show a distinct resting location of a blackbird and its extended foraging area.

PT estimation taking uncertainty into account

Depending on the GPS device manufacturer, different measures regarding the quality of each location fix are provided (e.g. number of satellites, dilution of precision values and/or an accuracy estimate). These can be used to select data with a high confidence level regarding the accuracy according to the requirements of the study.

1. Stationary tests should be performed for the GPS tags to quantify their positional uncertainty before they are used in the PT study

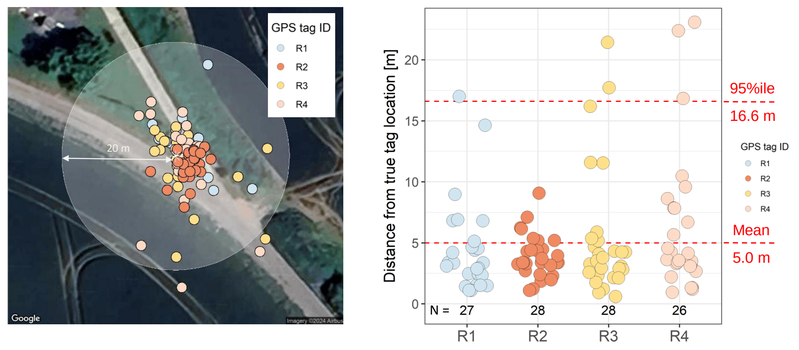


Figure 3 Distribution of locations fixes of 4 stationary GPS tags.

2. Create a buffer around each location fix (x) of a tracking session with a radius depending on the stationary test and the required level of conservatism.

Then calculate the proportion of the spatial overlap (***b***) with the treated areas for each location fix.

To perform the most conservative approach, for all fixes located inside the treated area ***b*** is assumed to be 1.

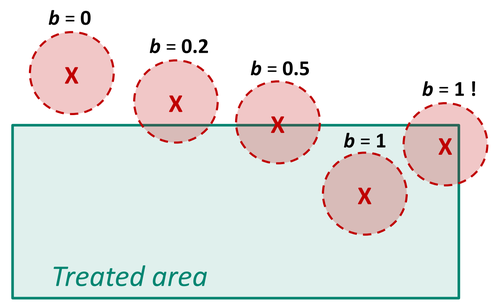


*Figure 4 Schematic illustration of deriving **b** values for each location fix (x) recorded by the GPS tags for PT estimations using the overlap of a buffer zone with the treated area.*

3. Calculate a 'Buffer PT' as mean value of ***b*** including all high quality fixes of a tracking session.

GPS tag ID	Standard PT[1]	5.0 m Buffer PT[2]	16.6 m Buffer PT[3]
R1	0.12	0.13	0.18
R2	0.07	0.09	0.18
R3	0.05	0.06	0.13
R4	0.09	0.11	0.19
MEAN	**0.08**	**0.10**	**0.17**

[1]proportion of time spent in treated area reflected by the 'proportion of GPS fixes'
[2]average proportion of spatial overlap of 5.0 m buffer zone with treated area (5.0 m according to mean value of accuracy during stationary test)
[3]average proportion of spatial overlap of 16.6 m buffer zone with treated area (16.6 m according to the 95%ile value of accuracy during stationary test)

Table 1 PT values for four GPS tagged rabbits calculated with three different approaches.

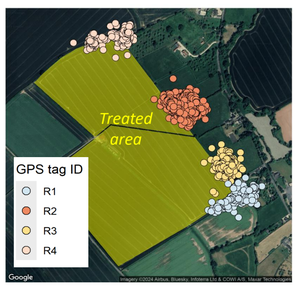


Figure 5 Map showing location fixes of four GPS tagged rabbits.

Comparison of different parameters between	VHF tracking	& GPS tracking
Gaining knowledge on animal movements	√	√
Tracking of small animals	√	x
Complete avoidance of disturbance by observer	x	√
Continuous tracking of individuals with large home ranges	x	√
Defining 'active' time periods	√	√
Positional accuracy	unknown	measurable

SUMMARY

- GPS tracking can provide a useful tool for collecting monitoring data for regulatory risk assessments
- GPS tracking is a relatively new method to be used for PT studies since so far only VHF tracking was used. Both methods can be very suitable to study home range utilisation of animals, but both have advantages and limitations.
- The most suitable tracking method to estimate PT values eventually depends on the species to be studied as well as on its home range size, landscape characteristics, the crop and other factors. Therefore, we recommend choosing between VHF and GPS tracking on a case-to-case base under consideration of these relevant factors.

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