European Food Safety Authority

# PT
# Proportion of diet obtained in the treated area

Joe Crocker, Central Science Laboratory; UK
Christian Wolf, RIFCON GmbH; Germany

# What is PT?

- PT is defined as 'portion of diet obtained in treated area' (ECOFRAM 1999)
- PT is estimated from the time spent (active) in the treated area
- it is assumed that the time spent (active) in a habitat is a reliable indicator of the measure of food obtained there

# What concerns are there?

- Is there a reliable relationship between the time spent (active) in an habitat and the amount of food obtained there?
- What is the uncertainty of the variation of individual PT values?
- How much does the landscape (proportion of different habitats) influence the distribution of PT in given local population?
- What is the influence of other factors (season, climate, geographical region) on the distribution of PT in given local population?

# PT & focal vs. indicator species

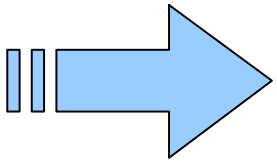
**New Guidance document is developing the following ideas:**

**Tier 1** = indicator species (screening step) = PT 100%
**Tier 2** = generic focal species = generic PT ?
**Tier 3** = realistic focal species = measured PT

**Determination of a selection of focal species (FS) necessary before starting determination of PT**

# Focal species and PT

Measured PT data may reveal that a FS (from transect or point counts) is not a FS in terms of dietary exposure (i.e. low PT for the respective species)



PT data are often necessary to define the realistic most exposed species

**(= Tier 3 assessments)**

# Proportion of diet obtained in the treated area

**Part I:**

**How to measure PT in field experiments**

**Christian Wolf (RIFCON GmbH)**

**Part II:**

**Data analysis and generation of values for risk assessments**

**Joe Crocker (CSL UK)**

# How to determine PT for a focal species?

- Landscape vs. crop specific approach

  *Animals can be trapped in a general landscape (e.g. arable) or in a specific crop ('target crop', e.g. wheat field)*

  **Depends on question from risk evaluation and protection goal (population vs. ‚consumers‘)**

- Potential foraging time vs. actual time feeding

  *PT is often measured as the 'potential foraging time' of an animal, i.e. all times of active & unknown behaviour are summed up unless there is clear evidence that the animal is NOT foraging*
  ***-> PT of an individual represents a worst case figure!***

# Methods to measure PT in the field

- 'A day in a lifetime' as a general rule
- Two approaches are commonly used:

- **Dawn to dusk continuous tracking**
  - continuous observations covering all hours in a single day during which the species may be potentially foraging
  - complete data sets on PT for one individual/day
  - sample size (no. of animals) is limited
  - requires higher resources regarding man-power in the field

- **Sample observations**
  - individuals observed 1hr in every 2hr over >1 day
  - variance of data can be higher
  - more animals can be observed with less people in the field

# Overview on field methods

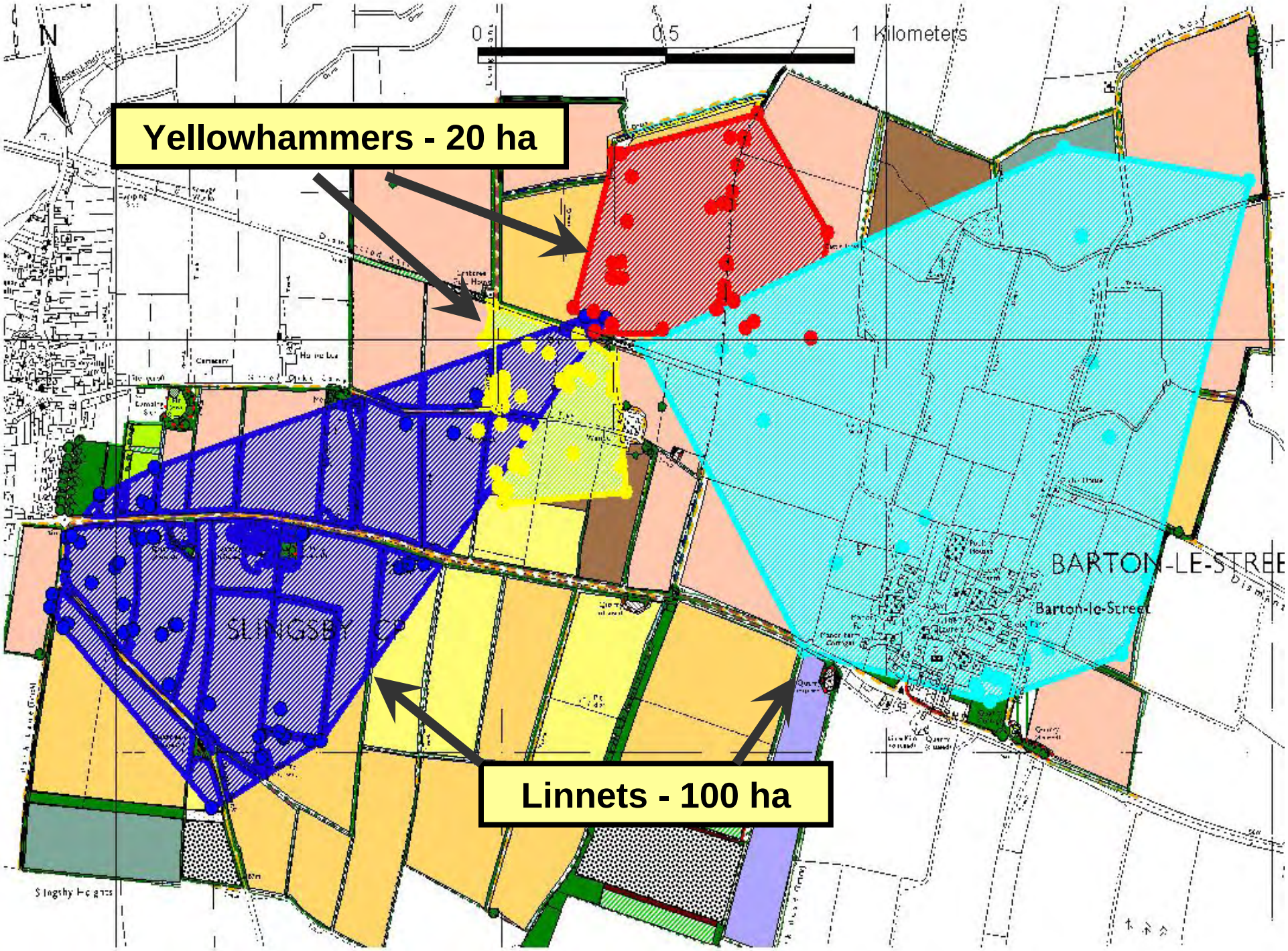
- It has not been possible so far to make direct measurements of the amount of treated food ingested by individual birds and mammals in the farming landscape
- by radiotracking, it is possible to make indirect estimates of PT
- Animals will be equipped with small radio transmitters, which allow continuous surveillance via radio signal



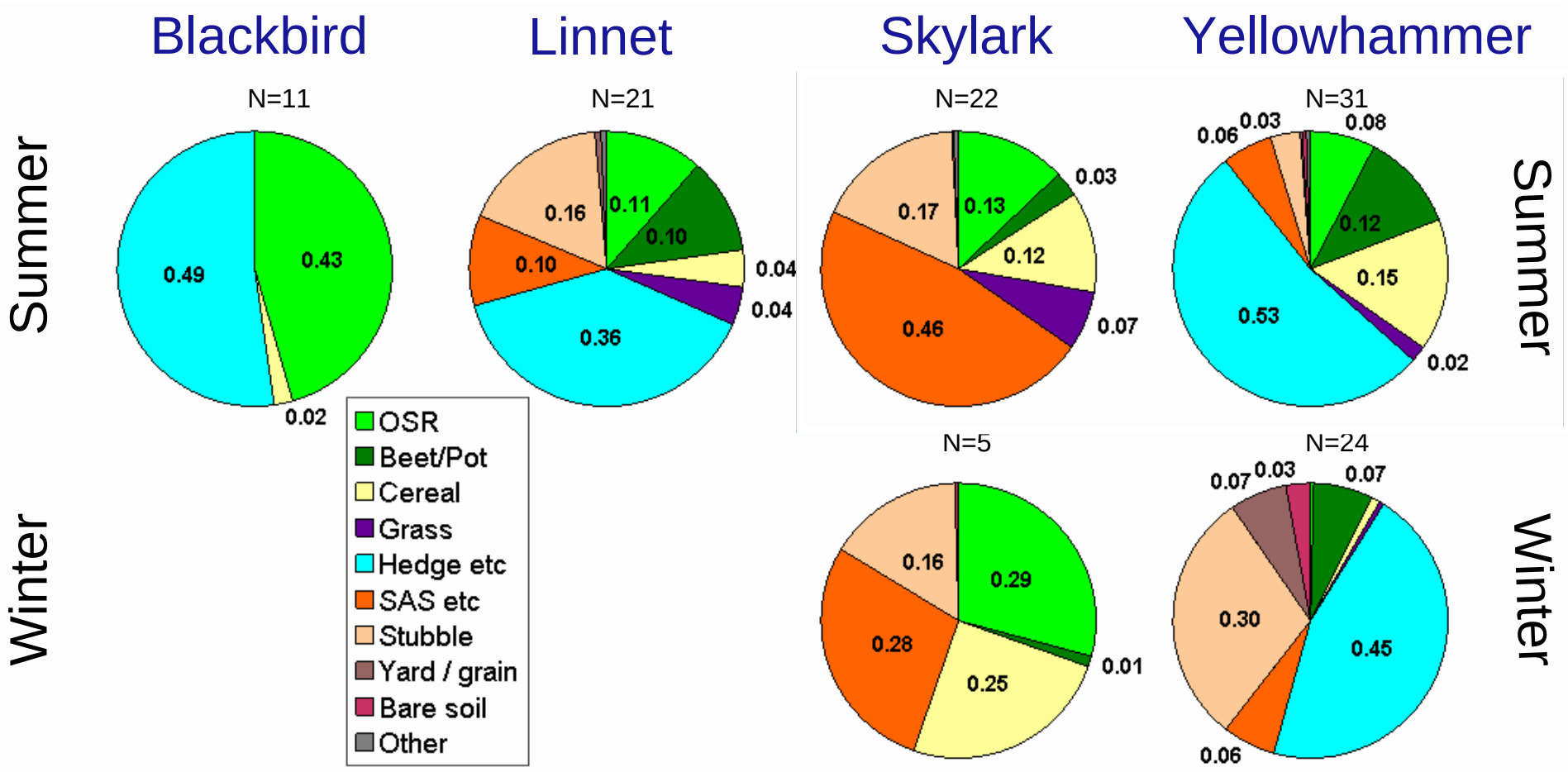
# Radiotracking - results

**Home range and habitat use of individual animals:**

- For individual birds plot radio-tracking contact points on map
- Draw minimum convex polygon (MCP) around the points
- Estimate area of polygon ≅ Home range
- Can compare crop use to crop availability


Yellowhammers - 20 ha
Linnets - 100 ha
N
0
0.5
1 Kilometers
SLINGSBY
BARTON-LE-STREE
Barton-le-Street

# Where birds spend their time

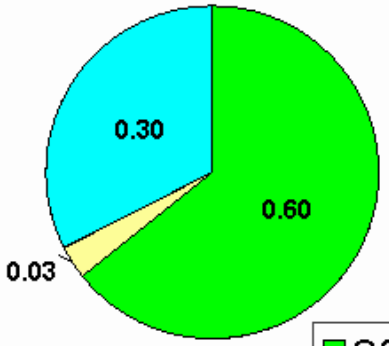


# Where birds spend their *active* time

European Food Safety Authority

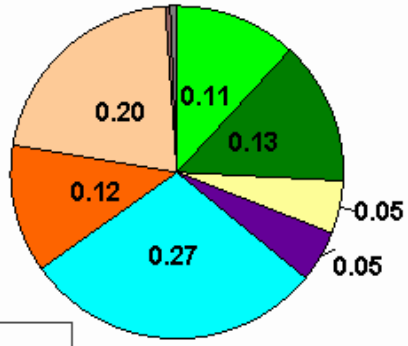
## Blackbird

N=11



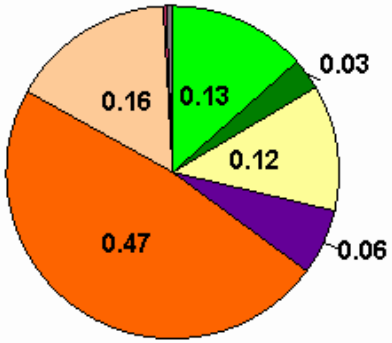

## Linnet

N=21



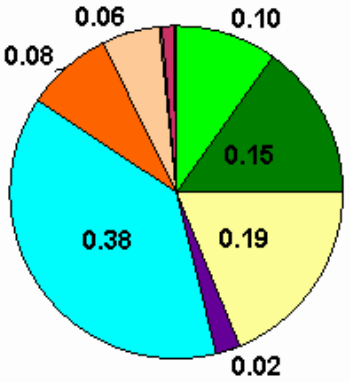

## Skylark

N=22

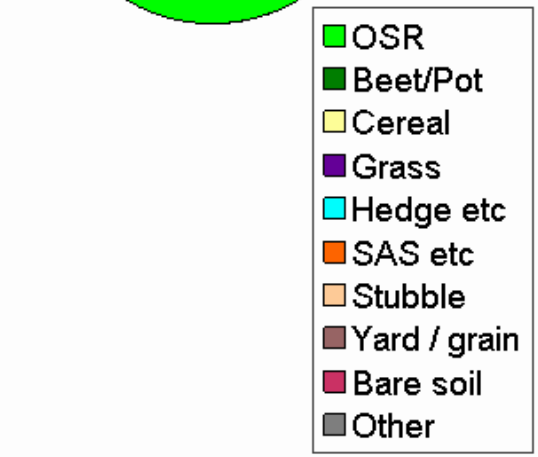



## Yellowhammer

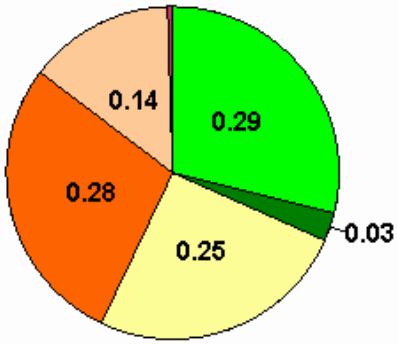
N=31



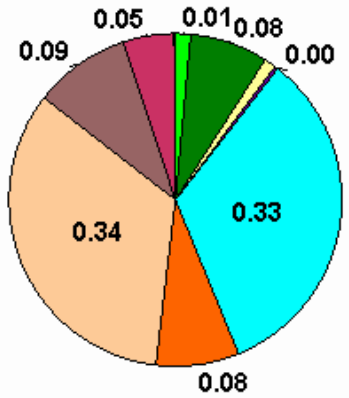

Summer




N=5




N=24




Winter

# Proportion of diet obtained in the treated area

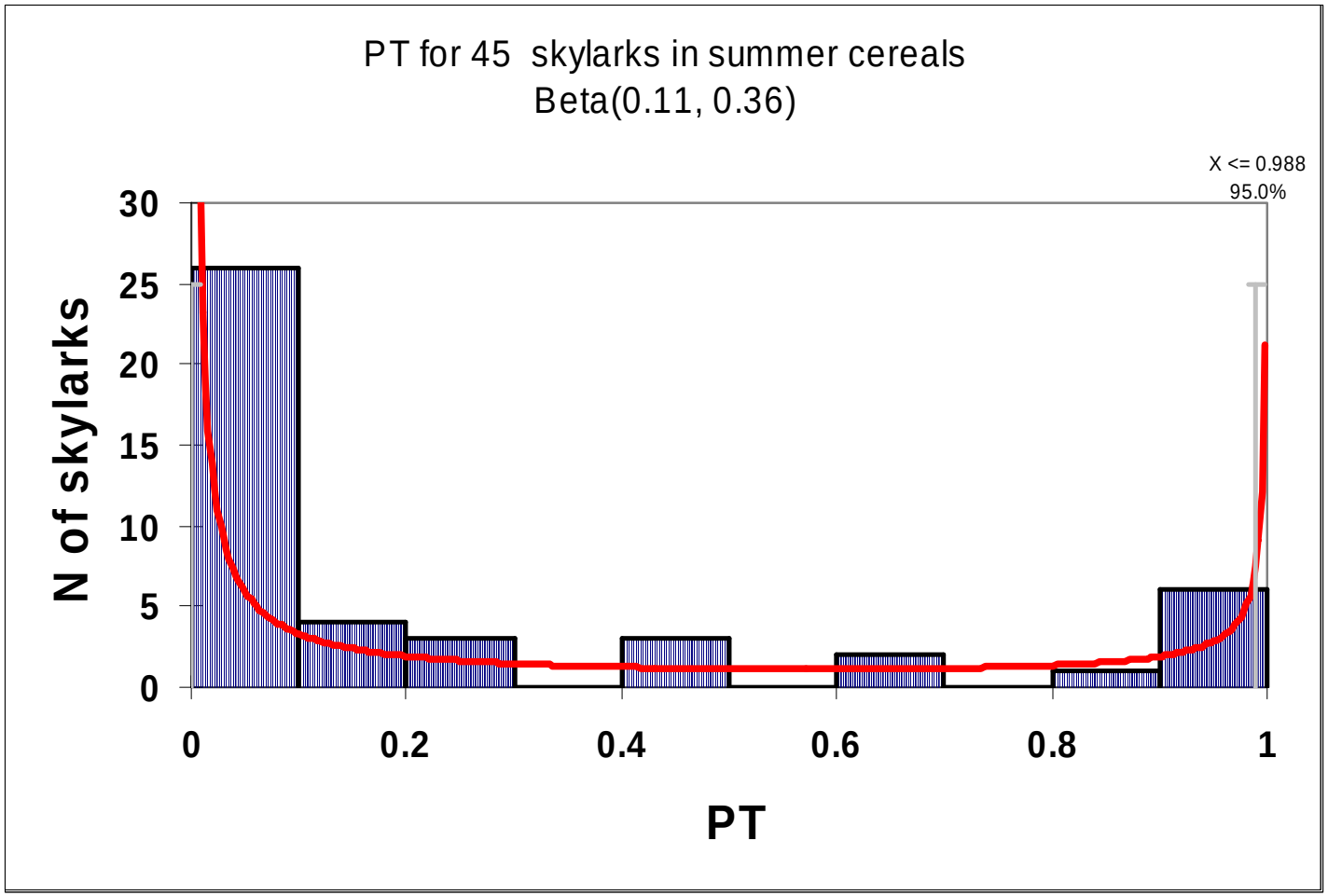
## Part II:

## Data analysis and generation of values for risk assessments

**Joe Crocker (CSL UK)**

# Distribution of PT data

## Proportion of active time spent by skylarks in cereal crops:



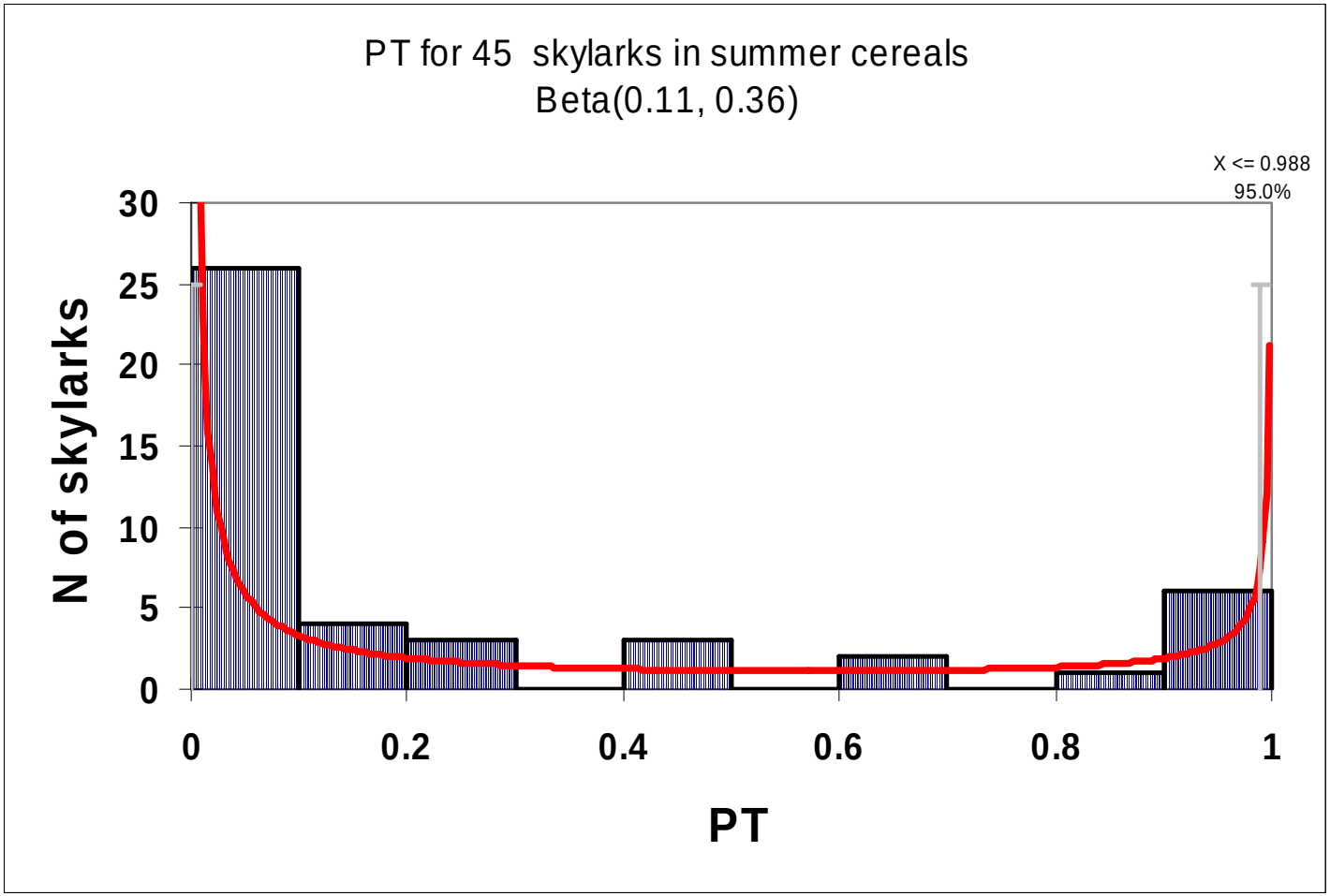
# How to analyse PT data?

## Percentiles and Confidence bounds

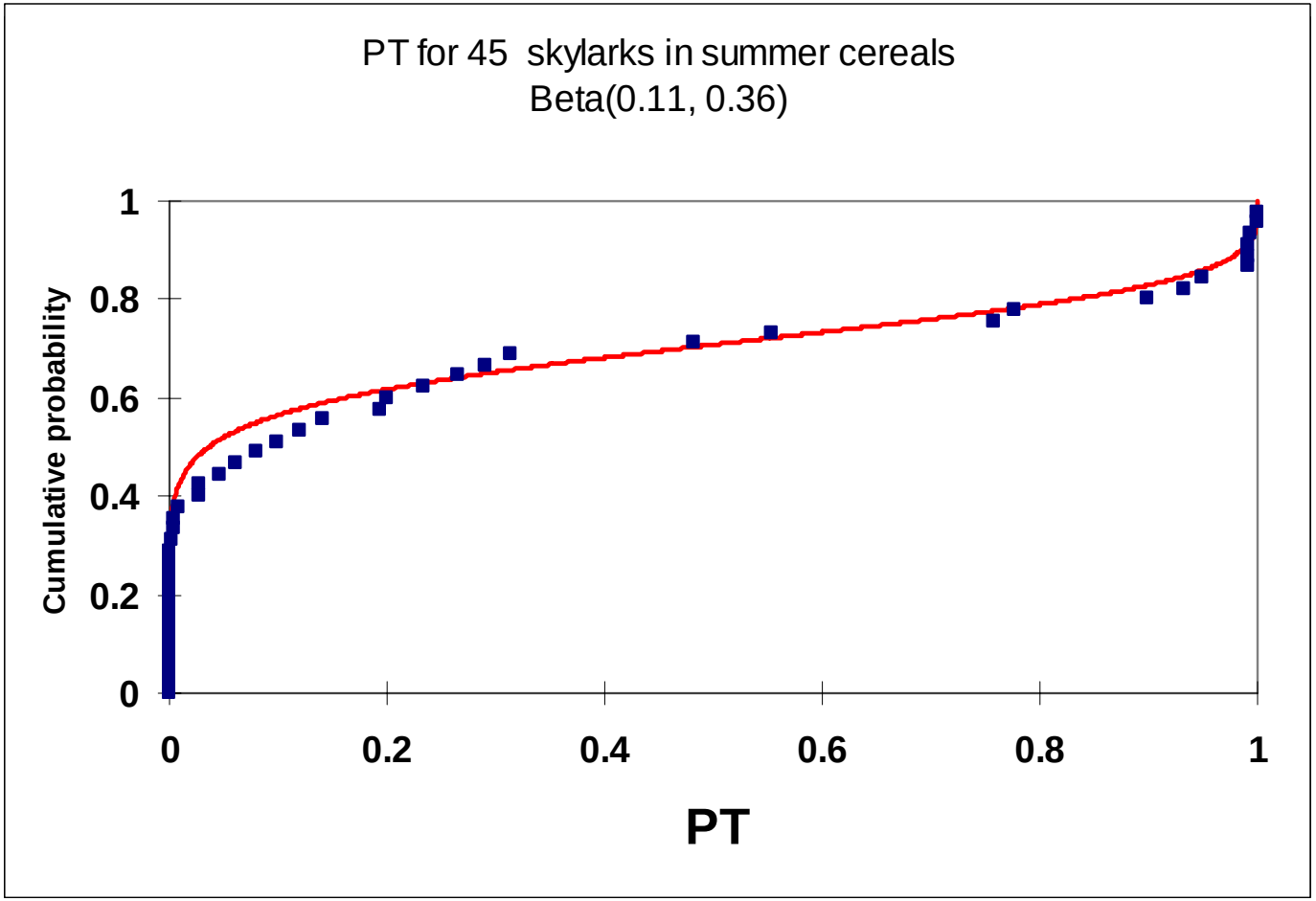
- Because we wish to be protective in our risk assessments, we tend to use higher centiles ($90^{th}$ or $95^{th}$) rather than median values ($50^{th}$)
- Radio-tracking is expensive, labour-intensive, and restricted by law. So sample size is often small
- But estimating $90^{th}$ centile from a small sample (say 10-20) entails a high degree of uncertainty
- We need to take this into account
- Use parametric bootstrap

# Confidence bounds & bootstrap

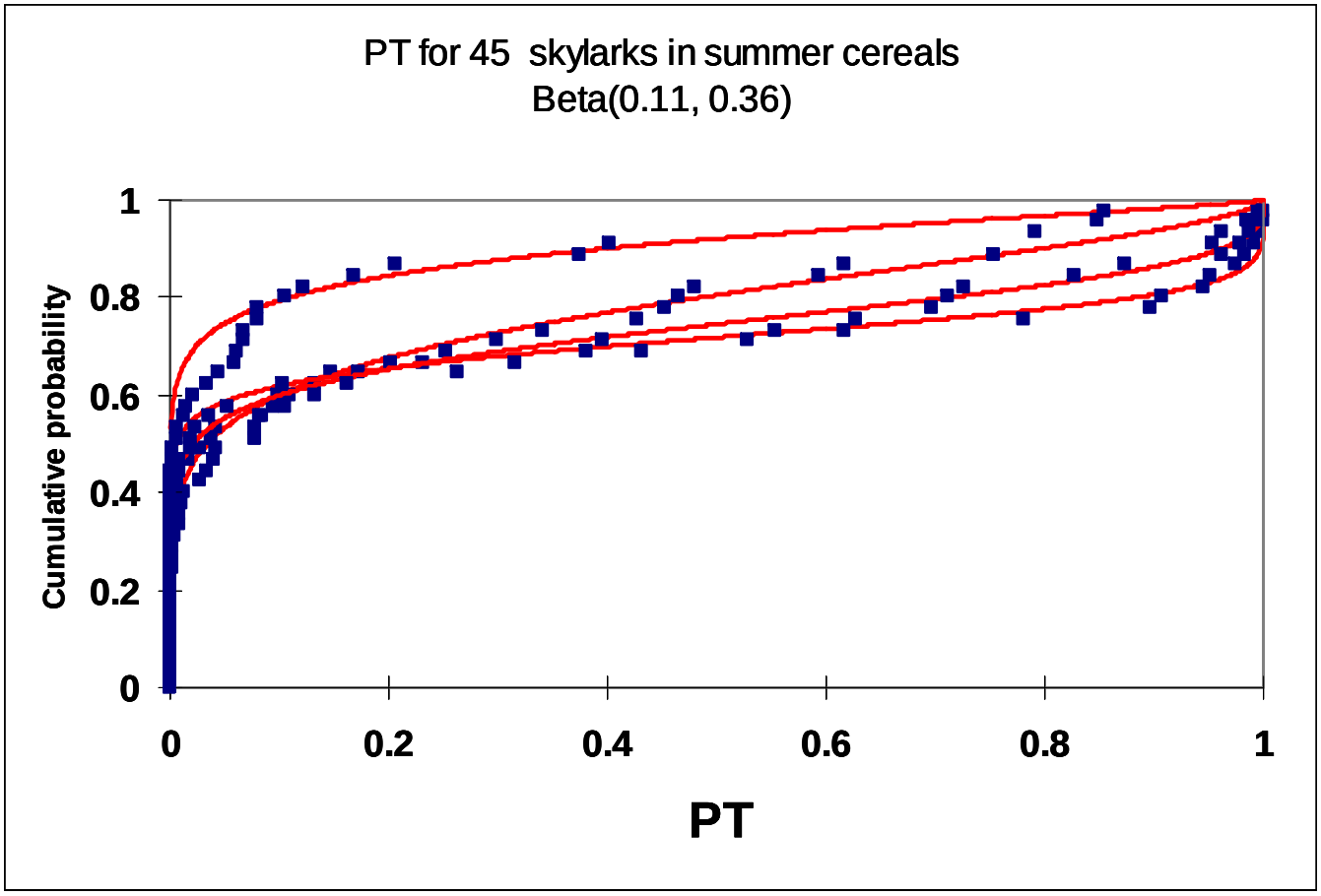
## Proportion of active time spent by skylarks in cereal crops:



# Confidence bounds & bootstrap

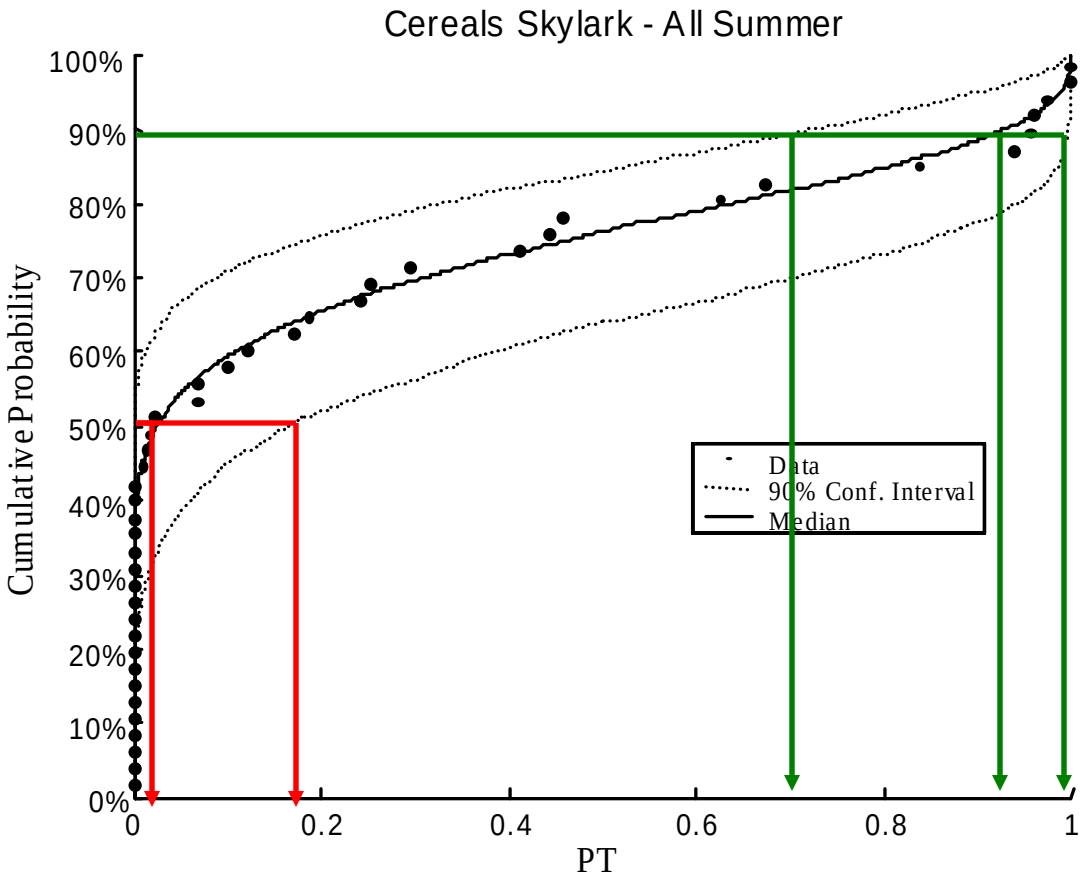


# Confidence bounds & bootstrap



# Distribution of PT data

## Cumulative plot of active time spent by skylarks in cereals




- Plot PT values in rank order, evenly spaced on y axis
- Fit a beta distribution
- Bootstrap to get confidence bounds
- Median skylark spends 3% (0-18% of time in cereals
- 90$^{th}$ centile birds spends 92% (73-100%) of time in cereals

# Which birds to include in analysis

**Birds selected for radio-tracking should:**

1. represent the local population?
    - So, catch birds where they are most likely to be found in the farming landscape (not necessarily in the target crop)

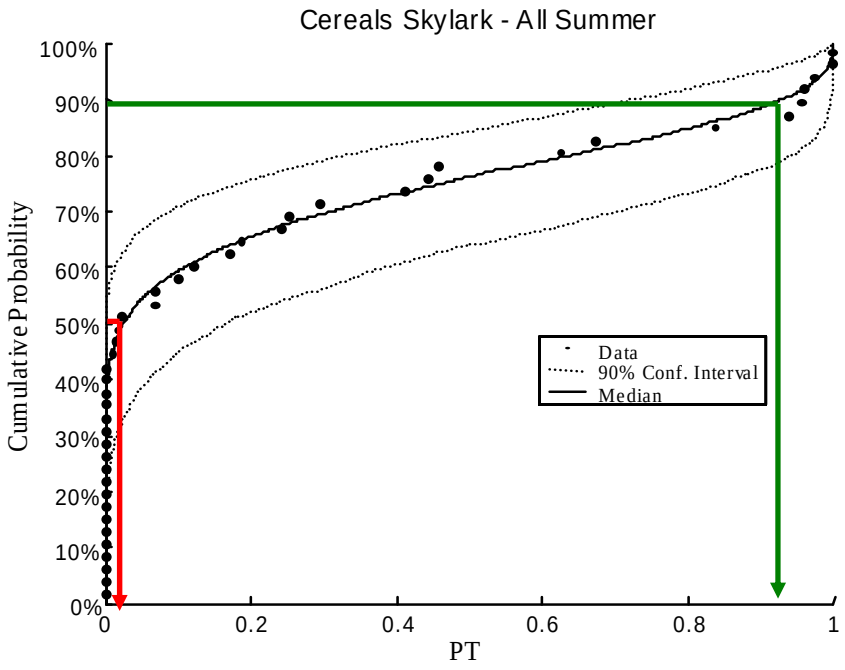
2. represent the population most likely to use the crop?
    - So, catch birds in the target crop

3. represent typical crop users from the local population?
    - Catch birds where they are most abundant…. but exclude from analysis those that did not use the target crop.. “consumers only”

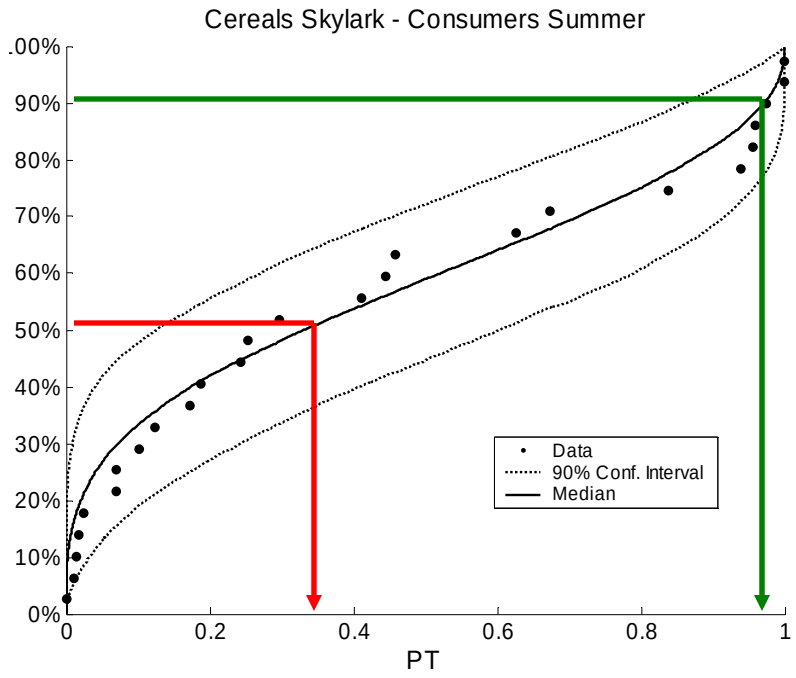
Options 2 & 3 options likely to give similar results

# Which birds to include in analysis

## Local population




## Consumers only




For skylarks in summer in cereals excluding non-consumers can make big difference to median but much less to 90$^{th}$ centile

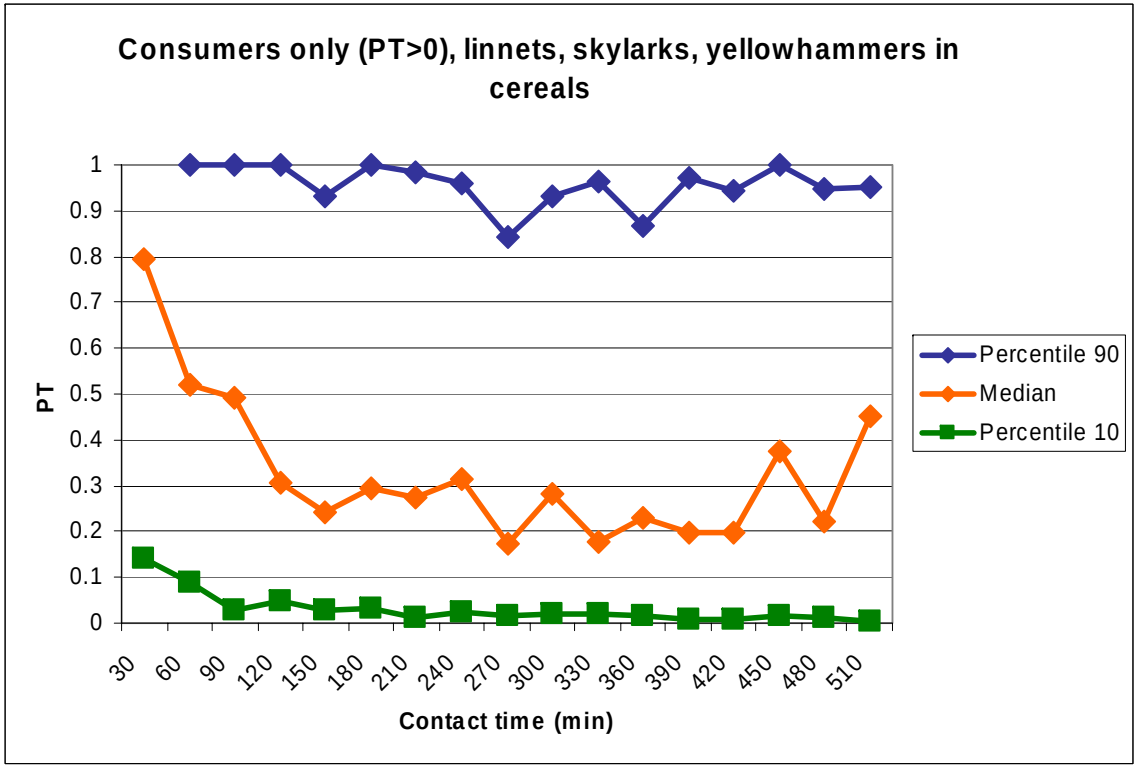
# How to analyse PT data?

## How long to radio-track?

- If we aim to capture a typical ‘day in the life’ of a bird then radio-tracking from dawn to dusk would be ideal.
- Depending on species this may not always be practical or efficient
- When observing birds for shorter time periods we are more likely to obtain extreme PT values (value closer to 0 or 1)
- Hence, the 90th percentile of daily PT (and its upper confidence limit) may be exaggerated for observation periods < 1 day
- Thus, for datasets < 1 day total observation time need some evidence that PTs are not exaggerated

# How to analyse PT data?

## How long to radio-track?




- Combined dataset for all species & all crops suggests that sampling 1hour in every 2 gives stable estimate of percentiles after first few hours
- For individual species & crops picture is similar but more variable

# Radiotracking - results

Radio-tracking PT data are publicly available for a range of UK crop/species scenarios

(Finch, Payne & Crocker, 2006 http://www.pesticides.gov.uk/approvals.asp?id=1183)

| | | | *All birds (local population)* | | | *Consumers only* | | |
|---|---|---|---|---|---|---|---|---|
| ***Crop*** | Season | Species | n | Mean | 90th percentile | n | mean | 90th percentile |
| ***Orchard*** | (April-September) | Blackbird | 40 | 0.23 | 0.69 | 28 | 0.33 | 0.75 |
| | | Blue tit | 20 | 0.21 | 0.55 | 16 | 0.27 | 0.58 |
| | | Chaffinch | 33 | 0.32 | 0.74 | 29 | 0.36 | 0.76 |
| | | Robin | 29 | 0.21 | 0.53 | 24 | 0.25 | 0.56 |
| ***Cereals*** | Summer (Apr-Aug) | Skylark | 44 | 0.25 | 0.92 | 26 | 0.42 | 0.97 |
| | | Yellowhammer | 28 | 0.21 | 0.77 | 17 | 0.34 | 0.87 |
| | Winter (Sep-Mar) | Skylark | 24 | 0.14 | 0.67 | 10 | 0.34 | 0.94 |
| ***Beet-Potatoes*** | Summer (Apr-Nov) | Skylark | 59 | 0.11 | 0.47 | 18 | 0.35 | 0.88 |
| | | Yellowhammer | 50 | 0.12 | 0.56 | 13 | 0.46 | 0.94 |
| | | Linnet | 21 | 0.13 | 0.43 | 11 | 0.25 | 0.59 |
| ***OSR*** | Summer (Apr-Jul) | Skylark | 41 | 0.05 | 0.18 | 7 | 0.33 | 0.57 |
| | | Yellowhammer | 28 | 0.11 | 0.6 | 7 | 0.45 | 0.86 |
| | | Linnet | 22 | 0.12 | 0.62 | 6 | 0.44 | 0.99 |
| | | Blackbird | 10 | 0.56 | 0.98 | 9 | 0.44 | 0.98 |
| | Winter (Aug-Mar) | Skylark | 27 | 0.05 | 0.1 | 4 | 0.36 | 0.98 |
| | | Yellowhammer | 44 | 0.01 | 0 | 2 | 0.01 | 0.61 |

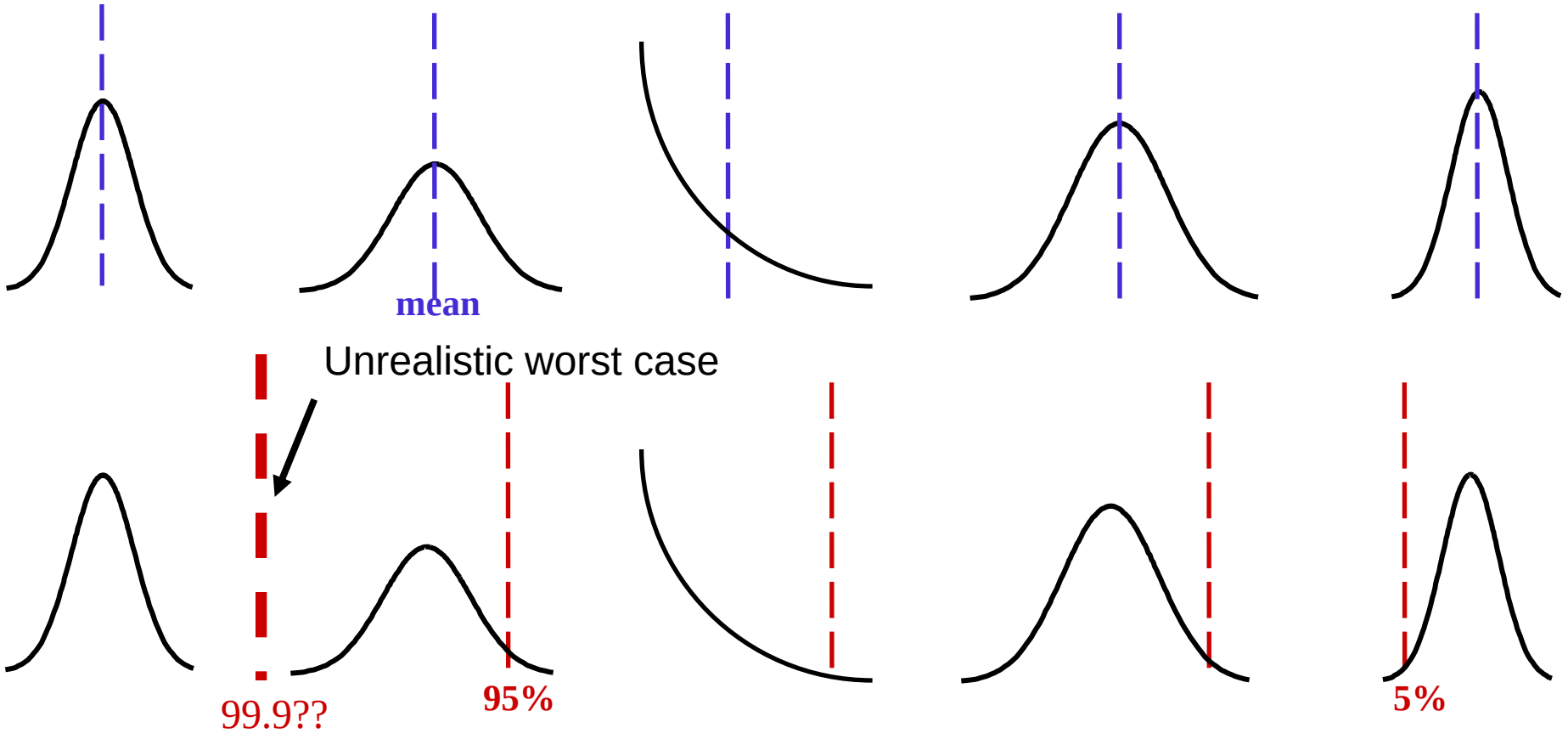
Also wood mice in cereals, hare and greylag goose in arable

# Use of PT in refined risk assessments

- Implications for acute vs. long-term assessments
  - *90$^{th}$ centile for acute scenarios?*
  - *50$^{th}$ centile for long-term scenarios?*
- Consideration of uncertainty
  - *How confident do we wish to be?*
  - *Which Confidence Limit covers "worst case"?*
- Other sources of conservatism
  - *PT assumes all active time is foraging time*
  - *Animal visits newly sprayed crop*
  - *All food eaten in crop is contaminated with pesticide*

# Which centile?

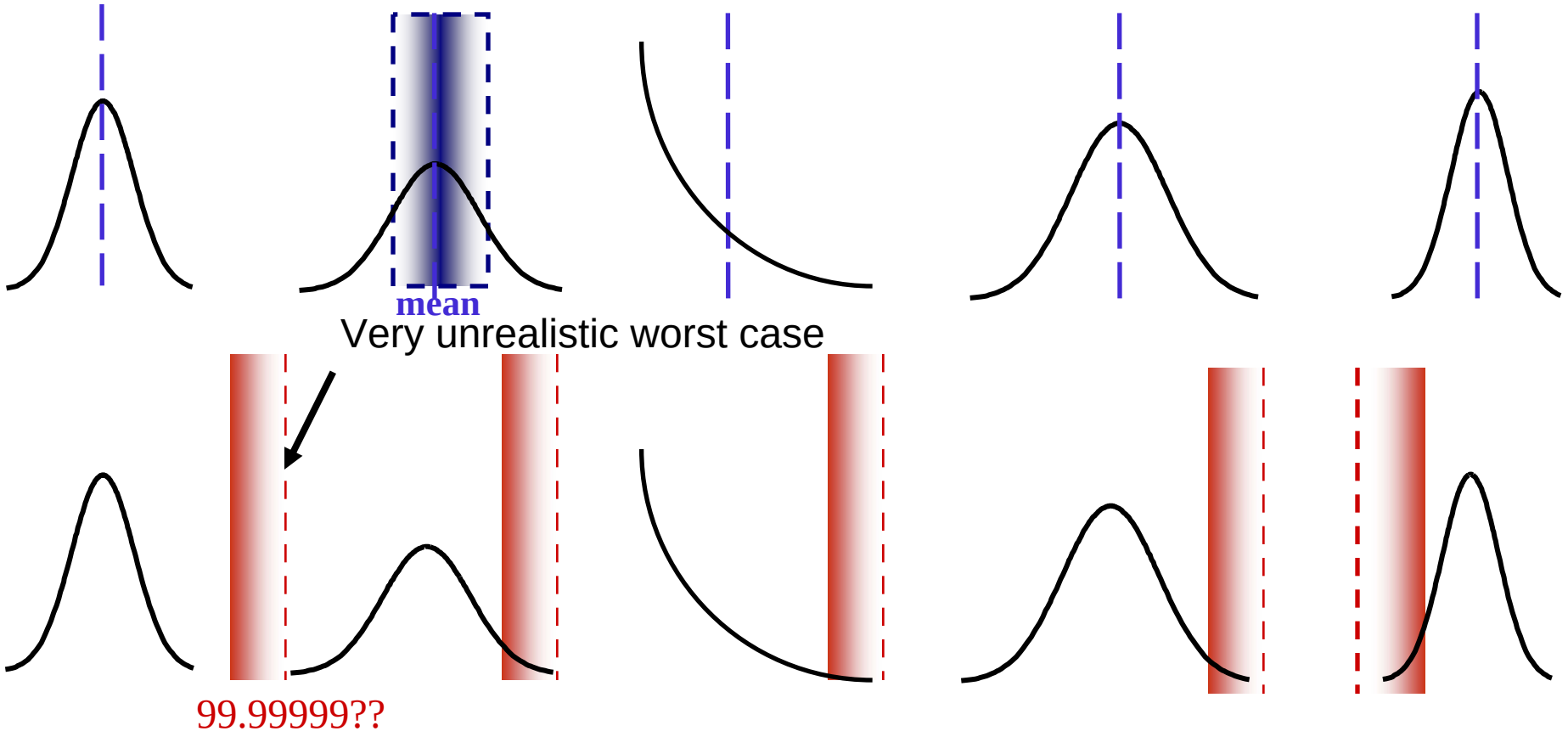
$$\underset{(mg/kg)}{ETE} = \underset{(kg)}{Food\ Intake} \times \underset{(0\text{-}1)}{P\ Treated} \times \underset{(mg/kg)}{Concn} \times \frac{1}{BWt_{\ (kg)}}$$



# Which confidence bound?

European Food Safety Authority

$$\underset{(mg/kg)}{ETE} = \underset{(kg)}{Food\ Intake} \times \underset{(0\text{-}1)}{P\ Treated} \times \underset{(mg/kg)}{Concn} \times \frac{1}{BWt_{\ (kg)}}$$



# Future development

## Alternatives to setting “worst case” values

- Conduct a probabilistic risk assessment
  - Use whole distribution of risk input variables, rather than arbitrary centiles ($90^{th}$, $95^{th}$, $99^{th}$) for each variable
  - Obtain a distribution of risk outcome and then decide on protection level
  - WEBFRAM.com
- Revise current EU guidance to predict likely pesticide impacts in field
  - Provide calibration factor which will allow MS to see and manage the likely trade-off between impacts on wildlife populations and proportion of pesticides that fail first tier risk assessment.
  - See talks by A Hart & Modelling group (Day 3)

# Conclusion

- **Use of measured PT data can add realism in exposure estimation to higher tier assessments**

- **Experiments to measure PT of free living animals need clear objectives**
  ***(which species, where from, how many, how long to track?)***

- **Suitable statistical analysis of the data can assure a high level of conservatism in PT-data also from relatively small data sets**