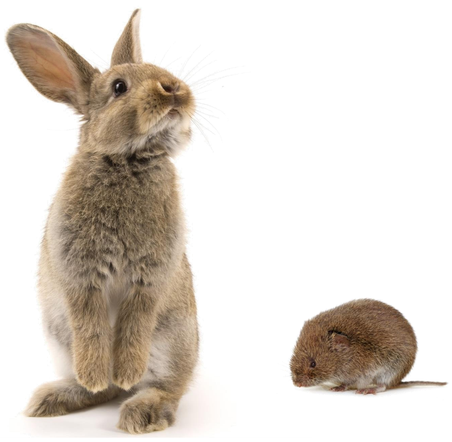

Higher tier field effect studies in practice and the benefits and drawbacks of MDDs to evaluate them

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INTRODUCTION

Statistical assessments of field studies are requested by the current guidance document on birds and mammals as well as by the draft for the new B&M GD. For standardised study designs, a power analysis *a priori* to the study is the best option. For studies tailor made to a specific species and application this is usually not possible and, thus, the new draft GD mentions *a posteriori* calculation of Minimum Detectable Differences (MDD) as a viable option. While the result of a power analysis applies to all studies of the same design, MDDs apply only to the one study they are calculated for. This requires a definition of what is a good or less good MDD value for each study. Here we provide MDDs for two different designs and discuss a way to evaluate them.

Minimum Detectable Differences

The MDD concept was first developed by Brock et al. (2014) for aquatic mesocosm/microcosm studies using t-tests. Peters et al. (2016) provided in the supplementary material to their article a method to apply the MDD concept to linear mixed models. The idea of MDDs is to calculate the minimal difference between the control value (e.g. population size) and the treatment that could be identified as a significant difference for the data set at hand. A MDD, however, applies only to the one data set (one specific study) for which it was calculated and cannot be extrapolated to other studies.

Design 1: Population development of common vole

- 6 field effects studies of chronic effects of PPPs on small herbivorous mammals using common voles, *Microtus arvalis*
- 6 + 6 study design in grassland fields
- regular trapping sessions, at least two of such trapping sessions before the (first) application of the test product
- using a capture-mark-recapture (CMR) design to estimate the population size as Minimum Number Alive (MNA)

Design 2: Reproductive performance of wild rabbits

- 3 field effect studies of PPPs on small herbivorous mammals using European wild rabbits, *Oryctolagus cuniculus*
- automatic camera observation of the area in front of rabbit warrens
- count of juvenile and adult rabbits to calculate the reproductive output as proportion of juveniles

Method

- Natural variability of control sites as deviation from the mean in percent for each study and session
- GLMMs for each study
  - MNA: Poisson family with log-link, Proportion of juveniles: binomial family with logit-link
  - Different model formulas tested, all including interactions between the treatment groups and the time variable,
  - Random intercept site for vole data or warren nested in the site for rabbit data
- MDDs in percent for each study and session

RESULTS

Variability	Voles	Rabbits
Minimum	9%	60%
Maximum	110%	170%
Mean	44%	116%
Session with %MDD lower than mean	44 out of 50	15 out of 22

CONCLUSIONS

We found a substantial variation of MDDs in the two study designs but also variation between different years and locations using the same design. This is not surprising but it clearly demonstrates that a single MDD benchmark does not cover all field effect study designs.

A study that can identify MDDs of the magnitude of the natural variation of the control sites or even smaller should therefore be able to detect adverse effects that may cause any long-term repercussions for abundance and biodiversity.

Benefit: This is a simple but practical approach as every field study has the key for its evaluation in its own MDDs. **Drawback**: There is no external benchmark used to evaluate the study.

A meta-analysis of data from similar studies or, even better, a set of field studies to identify this benchmark of natural variation could overcome this drawback but for the price of additional research.

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