

# Final Presentation on Hallman et al.

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# Introduction

- ▶ ~ 75 % decline in flying insect biomass over 27 years
- ▶ On protected sites of nature conservation
- ▶ Independent on weather, land-use, habitat characteristics
- ▶ ~ 80 % of the effects explaining declines are unknown
- ▶ Highest losses in times of highest biomass Hallmann et al. (2017)

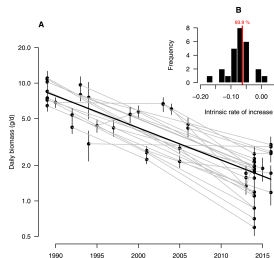


Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)



## Aim for our re-analysis

- ▶ Comprehend the methods used by this highly relevant publication
- ▶ Assess the robustness of decline
- ▶ Therefore rule out any regression to the mean effect
- ▶ Enhance our skills in bayesian statistics

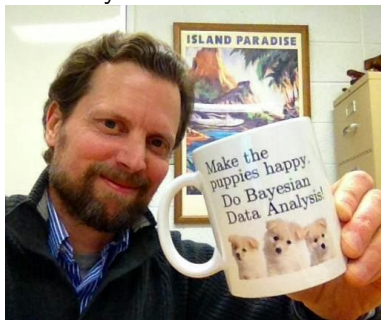


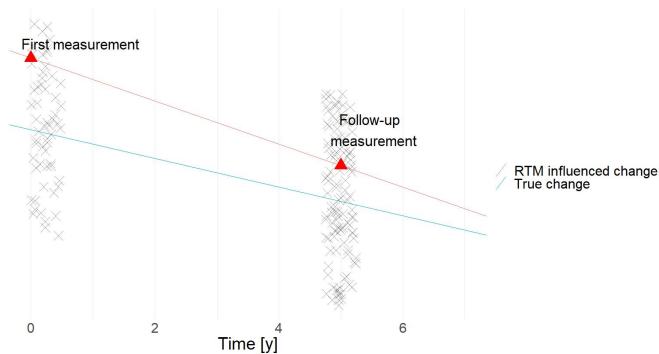
Figure 2: J. K. Kruschke amazon-page image, author of Doing Bayesian Data Analysis

## Possible issues of the paper

- ▶ Years 1989 and 2014 are over-represented
  - ▶ 1989: 162 catchment days, 2014: 348 catchment days
- ▶ Few locations were re-sampled
- ▶ 26 of 63 one third only
- ▶ Only one trap per location
- ▶ The trap exposure time varies greatly among years
  - ▶ Longer trapping intervals in the later part of the data collection
- ▶ Unknown site selection procedure
- ▶ Lack of control group

## Why could this introduce an regression to the mean (RTM) effect?

- ▶ First time sampling a location  $\rightarrow$  exceptional high insect biomass
- ▶ Second (or third) time sampling the same location  $\rightarrow$  sampled biomass closer to true mean



# Methods to prove this hypothesis

- ▶ Only use the first observation of each location
  - ▶ no follow up or baseline observations appear
- ▶ Use the basic model of Hallmann et al.
  - ▶ Which was used for the prediction of the decline
  - ▶ Replicate the model specifications with an other subset of the data
- ▶ Models diagnostics
- ▶ Compare results of both analyses
- ▶ Asses the robustness of the stated decline
- ▶ Check like this for RTM



# Modelling of the insect biomass decline

- ▶ Bayesian modeling
  - ▶ JAGS (Just Another Gibbs Sampler) and R2Jags (Su and Masanao Yajima 2020)
- ▶ Broad priors
- ▶ Plot of Log-Lambda
- ▶ Fixed and random (site specific random intercept) effects
- ▶ Latent daily (but unobserved) biomass

# Results

- ▶ Our result (only first sampling of every plot) is within xx% of the original result
  - ▶ We calculated a decline of xx% within 27 years
- ▶ No Regression to the mean found
- ▶ nice graphs

# Our Results and Hallmann et al.s

- ▶ Some other nice graphs

## What could be the reason for this similar results

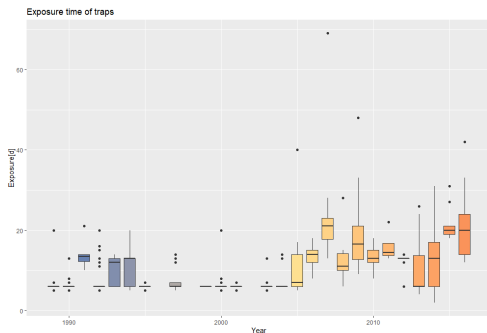
- ▶ Both statistical analyses are fine
  - ▶ Our model performed well in diagnostics
- ▶ Density plot No major influence of temporal effect per plot
  - ▶ Leaving out the second round of sampling on locations sampled twice

## So is there no RTM effect

- ▶ There is regression towards the mean
- ▶ The effect it has on the results is minor

# Varying trapping exposure intervals

- ▶ The actual catches per trapping do not strongly decline, decline appears when corrected for daily biomass
- ▶ biomass collection “saturation” phenomenon?



## Weak explanation of insect biomass decline

- ▶ Negative relationship between trees/forest and flying insect biomass
  - ▶ Insects might be flying higher
  - ▶ further succession of land (from arable to shrubland/forest) affects flying insects
- ▶ Only relevant drivers of decline could potentially only alter behavior, but must not affect abundance of insects

# Overall performance of the analysis

- ▶ The statistical methods were reasonable for the dataset given
- ▶ Most of the criticized issues were introduced by the sampling procedure
- ▶ Although the sampling was carried out by trained amateurs and experts, it was not designed by statisticians, let alone the team around Hallmann
- ▶ Problem of designing or gaining ecological long term data



# Improvement of the paper?

- ▶ In this case, a control group could be:
  - ▶ third or fourth sampling round on each location
- ▶ Blomqvist (1987) emphasized the need to include control groups
  - ▶ make adjustments for the RTM effect possible
- ▶ needs to be further included in environmental sciences
  - ▶ “For example, birds feeding nestlings lose weight, but initially heavier birds lose more weight than lighter birds, a result expected from the regression effect.” (Kelly et al. 2005; Gebhardt-Henrich 2000)

## RTM in ecology

|   |                                    |   |                                 |
|---|------------------------------------|---|---------------------------------|
| <a href="#">regression to the mean ecology</a>  |                                    | <a href="#">regression to the mean epidemiology</a>   |                                 |
| Ungerleider 1.855.003 Expressions (R&M Sek.)  |                                    | Ungerleider 2.635.003 Expressions (R&M Sek.)  |                                 |
| Correcting for <b>regression to the mean</b> in behavior and <b>ecology</b><br>Q Hely, DZebau – <i>The American Naturalist</i> , 2005 – journal.unl.edu<br>If two successive trait measurements have a less than perfect correlation, individuals or populations will, on average, tend to be closer to the mean on the second measurement (so-called <b>regression effect</b> ). Thus, there is a negative covariate between an individual's...<br>Q Zöfel 2007 von: 121 Abstrakte Artikel Alle 10 Versionen   | <a href="#">PDF   jstor.org</a>    | <b>Regression to the mean:</b> what it is and how to deal with it<br>Q Barnett, JS – <i>Statistical Science</i> , 2006 – journal.amstat.org<br>Background <b>Regression to the mean (RTM)</b> is a statistical phenomenon that can make natural variation in repeated data look like real change. It happens when unusually large or small values are followed by measurements that are closer to the <b>mean</b> ...<br>Q Zöfel 2007 von: 1355 Abstrakte Artikel Alle 16 Versionen   | <a href="#">HTML   oup.com</a>  |
| First evidence for a significant effect of the <b>regression to the mean</b> tautasy in male copying: a comment on Davies et al.<br>E Dancus, S Jülicher, A Fuchsmann – <i>Behavioral Ecology</i> , 2012 – academic.oup.com<br>Davison E., Nager S., Pechelmann A., Casagrandi R., Montoya-Baily G., van Rossum L., Menner M., Garzanti E. et al.: 2018, Culture fact: conformist social learning in wild predators long-lasting male-choice traditions. <i>Science</i> . 362, 12105–1205. DOI: 10...<br>Q Zöfel 2007 von: 4 Abstrakte Artikel Alle 5 Versionen   | <a href="#">PDF   oup.com</a>      | ren The effect of <b>regression to the mean</b> in epidemiologic and clinical studies<br>CE Davis – <i>American journal of epidemiology</i> , 1976 – Elsevier<br><b>Regression to the mean</b> is the phrase used to identify the phenomenon that a variable that is measured at one time point will tend to be closer to the center of the distribution at a later measurement. It studies based on biological mechanisms, this variability can be ...<br>Q Zöfel 2020 von: 429 Abstrakte Artikel Alle 5 Versionen 10  | <a href="#">PDF   psu.edu</a>   |
| Elicitator: an expert elicitation tool for <b>regression in ecology</b><br>A Jarvis, JB Chou, K Schaeffer – <i>Environmental Modelling &amp; Software</i> , 2019 – Elsevier<br>... Communicating with experts to elicit <b>regression</b> parameters has been found useful in several contexts related to environmental applications, ranging from <b>ecology</b> to socio-economics. In <b>ecology</b> , <b>regression</b> the conditional <b>mean</b> is the probability of success...<br>Q Zöfel 2007 von: 168 Abstrakte Artikel Alle 5 Versionen  | <a href="#">PDF   qtu.edu.au</a>   | Introduction to the use of <b>regression models in epidemiology</b><br>R Bender – <i>Cancer Epidemiology</i> , 2019 – Springer<br>Chapter 8, one of the most important multiple <b>regression</b> models is given with a focus on applications in modern <b>epidemiology</b> ... that their percent tests [5]. However, modern applications of <b>regression</b> methods do not only analyze each <b>regression</b> model's "main effects" ...<br>Q Zöfel 2020 von: 54 Abstrakte Artikel Alle 3 Versionen   | <a href="#">PDF   rsos.de</a>   |
| <b>Multigene regression and inference in ecology and conservation biology: further comments on identifying optimal predictor variables</b><br>B MacIsaac – <i>Biodiversity &amp; Conservation</i> , 2002 – Springer<br>Many typically used in conservation <b>ecology</b> to model the occurrence as density ... The hierarchical organization in multivariate <b>regression</b> model building arises because of ... for each variable can be expressed as a Z-score ( $\text{observed} - \text{mean}$ ) / standardization) / SD (standardization)...<br>Q Zöfel 2007 von: 588 Abstrakte Artikel Alle 16 Versionen | <a href="#">PDF   springer.com</a> | <b>Regression to the mean in treated versus untreated chronic pain</b><br>CW Whitney, M vonKorff, Pam. 1988 – Elsevier<br>... E. and Sommer, E. <b>Epidemiology</b> of signs and symptoms in temporomandibular disorders. Clinical signs in cases and controls. <i>J Am Stat Assoc.</i> 100 (1995) 373-281. Edberg, J. Sexua chondylar changes, effects of first and <b>regression</b> toward the <b>mean</b> . <i>J Chronic Dis.</i> 25...<br>Q Zöfel 2007 von: 189 Abstrakte Artikel Alle 10 Versionen  |                                 |
| Partial least squares <b>regression</b> as an alternative to current <b>regression</b> methods used in <b>ecology</b><br>LM Cameron, C Quilty – <i>Oikos</i> , 1989 – Wiley Online Library<br>... a combination of <b>regression</b> and multiple methods, which are more commonly used in <b>ecology</b> ... problems when analyzing datasets with eight predictor variables (measured, lit, ...). In summary, partial least squares <b>regression</b> analyses provide similar results to those ...<br>Q Zöfel 2007 von: 531 Abstrakte Artikel Alle 16 Versionen  | <a href="#">PDF   wiley.com</a>    | <b>Multiple additive regression trees with application in epidemiology</b><br>Alt Edwards, JM Mullinec – <i>Statistics in medicine</i> , 2003 – Wiley Online Library<br>Multiple additive <b>regression</b> trees with application in <b>epidemiology</b> ... Here 15 (main effect) (is) the <b>mean</b> of the response y in each hypercube, so a tree partitioned a certain value ... <b>Regression</b> trees are induced by top-down recursive splitting based on a least-squares fitting criterion...<br>Q Zöfel 2020 von: 544 Abstrakte Artikel Alle 5 Versionen                       | <a href="#">PDF   wiley.com</a> |
| On the misuse of residuals in <b>ecology</b> : testing <b>regression</b> residuals vs. the analysis of covariance<br>E Olsson-Björk – <i>Journal of Animal Ecology</i> , 2001 – JSTOR<br>... in aquatic systems: statistical shortcomings with <b>mean depth</b> and the morphological index ... Kleindam, DS, Kappes, LA & Miller, KC (1998) <b>Regression Analysis</b> and other Multivariate Methods ... <i>Journal of Animal Ecology</i> , 28, 393-399  | <a href="#">PDF   jstor.org</a>    | Do de leukocyte telomere length dynamics depend on baseline telomere length? An analysis that corrects for <b>regression to the mean</b><br>S Mulvihill, A Avic, A Benetos, GS Deaton ... – <i>Journal of epidemiology</i> , 2013 – Springer<br>Leukocyte telomere lengths (TL) shorten with age. Longitudinal studies have reported inconsistent TL attrition when baseline TL is longer. However, a certain value of TL attrition on baseline TL might stem from a statistical artifact known as <b>regression</b> to the ...<br>Q Zöfel 2020 von: 56 Abstrakte Artikel Alle 10 Versionen | <a href="#">Full View</a>       |

Figure 3: Only two articles are actually on RTM in ecology, cited under 200 times. In Epidemiology, G. Scholar finds  $> 6$  articles on RTM, some cited  $> 1000$  times

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