

# Final Presentation on Hallman et al.

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# Content

1. Introduction
2. Our motivation to re-analyze the paper
3. Our aims and objectives
4. Crucial points in the analysis
5. Methods
6. Results
7. Discussion

# 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)

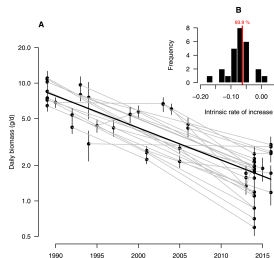


Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

# Our motivation to re-analyse the paper

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biodiversity loss in protected areas? PLOS ONE 12 (11): e0188808  
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(4 December 2017).  
9 KB (802 words) - 13:55, 15 November 2017

Yellow-bellied  
decline over 27 years in total flying insect biomass in protected areas? PLOS ONE  
12 (11): e0188808 doi:10.1371/journal.pone.0188808 PMID:28043418  
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doi:10.1371/journal.pone.0188808 PMID:28043418  
Mongolian bee  
31 KB (3,477 words) - 08:16, 12 January 2018

Biodiversity loss  
PLOS ONE 12 (11): e0188808 doi:10.1371/journal.pone.0188808  
doi:10.1371/journal.pone.0188808 PMID:28043418  
Elasticity: Common practice  
41 KB (4,108 words) - 16:14, 17 January 2018

Decline in insect populations  
PLOS ONE 12 (11): e0188808 doi:10.1371/journal.pone.0188808  
doi:10.1371/journal.pone.0188808 PMID:28043418  
Gretchen (10 May 2017). "Others"  
60 KB (6,408 words) - 22:58, 12 January 2018

2017 in science  
PLOS ONE 12 (11): e0188808 doi:10.1371/journal.pone.0188808  
doi:10.1371/journal.pone.0188808 PMID:28043418  
Gretchen

## Discussed



More than 75 percent decline over 27 years in total flying insect biomass in pro

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Ungefähr 260 Ergebnisse (0,32 Sekunden)

Westdeutsche Zeitung

Krefeld: Ehrenplaketten für fünf Bürger der Stadt

In ihrer Studie „More than 75 percent decline over 27 years in total flying insects biomass in protected areas“ wiesen sie ein Insektensterben ...  
11.02.2019

RP ONLINE

Krefeld: Bundespräsident ehrt Insektenforscher mit  
deutschem ...

... haben mit „More than 75 percent decline over 27 years in total flying insects biomass in protected areas“, für ein weltweites Echo gesorgt.  
02.09.2020

Helmholtz-Gemeinschaft Deutscher Forschungszentren

Klar Sowelt? #65 – Summ, summ, stumm

(2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLOS ONE 12(11): e0188808. viele ...  
17.09.2019



Mein schöner Garten

Alarmierender Insektenschwund wissenschaftlich  
bestätigt

„More than 75 percent decline over 27 years in total flying insect biomass in protected areas“ bestätigt. Und die Zahlen sind alarmierend: Mehr als 75 Prozent der Fluginsekten sind in den letzten 27 Jahren ...  
13.09.2019



Mein schöner Garten



## 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

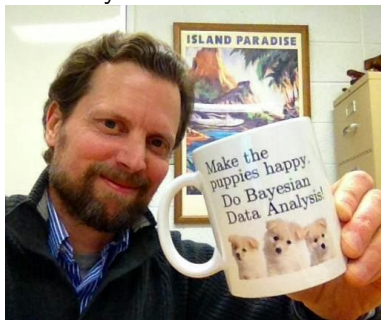


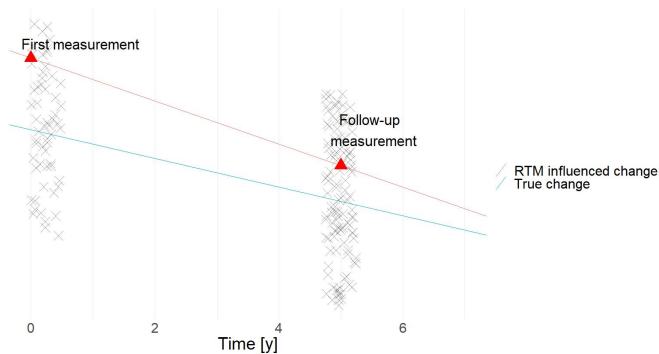
Figure 2: J. K. Kruschke amazon-page image, author of Doing Bayesian Data Analysis

## 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

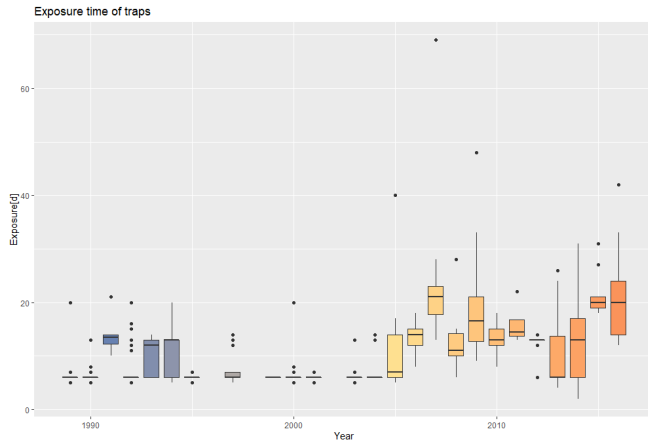
- ▶ Both statistical analyses are fine
  - ▶ Our model performed well in diagnostics
- ▶ Density plot No major influence of temporal effect per plot
  - ▶ Leaving out the second round of sampling on locations sampled twice

## 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

regression to the mean ecology



Ungültig 1.892.088 Ergebnisse (8,88 Sek.)

**Correcting for regression to the mean in behavior and ecology**

C Kelly, III *Ecology* - The American Naturalist, 2005 - journals.schickel.de

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 (the so-called regression effect). Thus, there is a negative correlation between an individual's ...

☆ 99 Zitat von: 121 Ähnliche Artikel Alle 5 Versionen

**First evidence for a significant effect of the regression to the mean fallacy in meta-copying: a comment on Davies et al**

E Glasziou, S Hedges, A Sucksmith - *Behavioral Ecology*, 2009 - academic.sage.com

Danchin E, Nöbel S, Pockwinse A, Dugall AC, Denay L, Alkhami M, Ranty-Ruby S, van Renswoude L, Stone M, George E et al. 2018. Cultural Rite, conformist social learning in buffles predicts long-lasting mate-choice traditions. *Science*, 362: 1025-1028. Davis AD ...

☆ 99 Zitat von: 2 Ähn 5 Versionen

**Elicitator: an expert elicitation tool for regression in ecology**

A Jones, SL Clay, G Margopou - *Environmental Modelling & Software*, 2010 - Elsevier

Communicating with experts to elicit regression parameters has been found useful in several contexts relevant to environmental applications, ranging from ecology to socio-economics ... In logistic regression the conditional mean is the probability of success ...

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**Multiple regression and inference in ecology and conservation biology: further comments on identifying important predictor variables**

B Mag, Italy - *Biodiversity & Conservation*, 2002 - Springer

MR typically is used in conservation ecology to model the occurrence or density ... The hierarchical organization in evaluative regression-model building states because of ... for each variable can be expressed as  $Z_{\text{score}}(\text{observed} - \text{mean transformation}) / \text{SD}(\text{transformation})$  ...

☆ 99 Zitat von: 688 Ähnliche Artikel Alle 14 Versionen

**Partial least squares regression as an alternative to current regression models used in ecology**

LM Carroll, L Galletti, S Galletti - *Oikos*, 2009 - Wiley Online Library

... a combination of regression and multivariate methods, which are more commonly used in ecology ... probable models when analyzing datasets with high predictor variables (response Y) ... In summary, partial least squares regression analysis provides similar results to those ...

☆ 99 Zitat von: 531 Ähnliche Artikel Alle 75 Versionen

**On the misuse of residuals in ecology: testing regression residuals vs. the analysis of covariance**

E Glasziou *Ecology* - Journal of Animal Ecology, 2001 - jstor.org

... in aquatic sciences, statistical shortcomings with mean depth and the morphological index ...

Kleinbaum, DG, Kupper, LL & Muller, NE (1988) *Applied Regression Analysis and other Multivariate Methods* - Journal of Animal Ecology, 25, 203-213

[PDF] jstor.org

[PDF] oup.com

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[PDF] springer.com

[PDF] wiley.com

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Full View

regression to the mean Epidemiology



Ungültig 2.632.088 Ergebnisse (8,88 Sek.)

**Regression to the mean: what it is and how to deal with it**

AG Baroni, J Van Der Ende - *Journal of epidemiology*, 2005 - academic.sage.com

Background **Regression to the mean** (RTM) is a statistical phenomenon that can make natural variation in repeated data look like real change. It happens when unusually large or small measurements tend to be followed by measurements that are closer to the mean ...

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**pen: The effect of regression to the mean in epidemiologic and clinical studies**

CE Davis - *American journal of epidemiology*, 1976 - Elsevier

**Regression to the mean** is the phrase used to clarify the phenomenon that a variable that is extreme on its first measurement will tend to be closer to the center of the distribution for a later measurement. In studies based on biological measurements, this capability can be ...

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**Introduction to the use of regression models in epidemiology**

R Bender - *Cancer Epidemiology*, 2003 - Springer

... chapter, an overview of the most important multiple regression models is given with a focus on applications in modern epidemiology ... But their parent needs (1). However, modern applications of regression methods do not only analyze such "regression to the mean" effects ...

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**Regression to the mean in treated versus untreated chronic pain**

CM Whitney, M Von Korf, Pam, 1992 - Elsevier

E. and Sommers, E. **Epidemiology** of signs and symptoms in temporomandibular disorders. Clinical signs in cases and controls. *J. Am. Dent. Assoc.*, 120 (1989) 273-281. Edsberg, F. Serum cholesterol changes: effects of diet and regression toward the mean. *J. Chronic Dis.*, 25 ...

☆ 99 Zitat von: 199 Ähnliche Artikel Alle 10 Versionen

**Multiple additive regression trees with application in epidemiology**

dt, Friedberg, J, Meisner - *Statistics in medicine*, 2003 - Wiley Online Library

Multiple additive regression trees with application in epidemiology ... Here  $y$  (response) is the mean of the response  $y$  in each region  $S_j$ , and  $x$  is a tree predicts a constant value ... Regression trees are induced by top-down recursive splitting based on a least-squares fitting criterion ...

☆ 99 Zitat von: 544 Ähnliche Artikel Alle 6 Versionen

**pen: Do leukocyte telomere length dynamics depend on baseline telomere length? An analysis that corrects for regression to the mean**

S, Vachani, A, Kim, A, Bennett, GS, Bennett, ... *Journal of epidemiology*, 2013 - Springer

Leukocyte telomere length (TL) shortens with age. Longitudinal studies have reported accelerated TL attrition when baseline TL is larger. However, the dependency of TL attrition on baseline TL might stem from a statistical artifact known as regression to the ...

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[HTML] oup.com

[PDF] psu.edu

[PDF] rsos.royal-society.org

[PDF] wiley.com

[PDF] springer.com

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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<https://doi.org/10.1111/j.1600-051X.1987.tb01510.x>.
- Gebhardt-Henrich, Sabine G. 2000. "When Heavier Birds Lose More Mass During Breeding: Statistical Artefact or Biologically Meaningful?" *Journal of Avian Biology* 31 (2): 245–46.  
<https://doi.org/10.1034/j.1600-048X.2000.310216.x>.
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- Kelly, Colleen, Trevor D. Price, Associate Editor: Stuart A. West, and Editor: Michael C. Whitlock. 2005. "Correcting for Regression to the Mean in Behavior and Ecology." *The American Naturalist* 166 (6): 700–707.  
<http://www.jstor.org/stable/10.1086/497402>.
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<https://CRAN.R-project.org/package=R2jags>.