

# Final Presentation Hallman

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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)

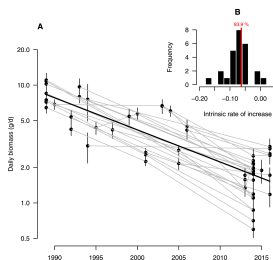


Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

# Our motivation to re-analyse the paper

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## Discussed ?



More than 75 percent decline over 27 years in total flying insect biomass in protected areas? PLOS ONE 12 (10): e0188808

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Ungef hr 260 Ergebnisse (0.32 Sekunden)

Westdeutsche Zeitung

Krefeld: Ehrenplaketten f r f nf B rger 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 ...  
11.02.2023

RP ONLINE

Krefeld: Bundespr sident ehrt Insektenforscher mit  
deutschem ...

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

Helmholtz-Gemeinschaft Deutscher Forschungszentren

Klar Soweit? #05 – Summ, summ, stumm

(2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas PLOS ONE 12(10): e0188808. Viele ...  
17.04.2019

Mein sch ner Garten

Alarmierender Insektenchwund wissenschaftlich  
best tigt

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

Mein sch ner 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

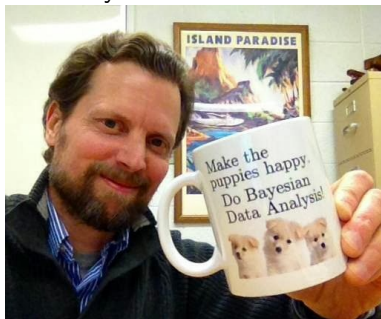


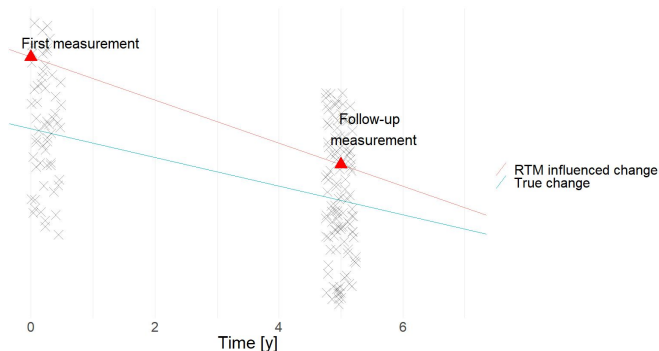
Figure 2: J. K. Kruschke's amazon-page image, author of *Doing Bayesian Data Analysis*

## Possible issues of the paper

- ▶ Years 1989 and 2014 are over-represented
- ▶ Few locations were re-sampled
- ▶ Only one trap per location
- ▶ The exposure time varies greatly among years
  - ▶ Longer 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 → exceptional high insect biomass
- ▶ Second (or third) time sampling the same location → sampled biomass closer to true mean



## Method 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



# Modelling of the insect biomass decline

- ▶ Bayesian model
- ▶ Priors
- ▶ Fixed and random 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

- ▶ Hallmann et al. did a great job
- ▶ We did a bad job
- ▶ Better explanation :-)

## Slide 12

## Varying trapping exposure intervals

- ▶ The actual catches per trapping bottle did not strongly decline, the strong decline only comes about when calculating values per day.
- ▶ 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, not 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

### **Citizen science is booming during the pandemic**

From backyard astronomy to birding, amateurs have been busy collecting data — and making real discoveries.

By Sigal Samuel | Jan 10, 2021, 9:00am EST

Figure 3: Headline of an online magazine



# Improvement of the paper?

- ▶ In this case, a control group could be:
  - ▶ third or fourth sampling 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		regression to the mean Epidemiology	
Ungewöhnlich 1.593.583 Ergebnisse (0,88 Sek.)		Ungewöhnlich 2.630.083 Ergebnisse (0,88 Sek.)	
<p><b>Correcting for regression to the mean in behavior and ecology</b>  C Kelly, TD Elgar. The American Naturalist. 2005 - journals.uchicago.edu  If two successive trait measurements have a less than perfect correlation, individuals or populations will, on average, tend to be closer to the <b>mean</b> on the second measurement (the so-called <b>regression effect</b>). Thus, there is a negative correlation between an individual's ...  ☆ 92 Zblat von: 121 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] jstor.org	<p><b>Regression to the mean: what it is and how to deal with it</b>  AG Barnett, JC Van Der Ende. ... journal of epidemiology. 2006 - academic.oup.com  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 measurements tend to be followed by measurements that are closer to the <b>mean</b> ...  ☆ 10 Zblat von: 1192 Abstrakte Artikel Alle 15 Versionen</p>	[HTML] oup.com
<p><b>First evidence for a significant effect of the regression to the mean fallacy in mate copying in a poikilotherm</b>  on Davies et al  E Damico, S Hubel, A Pochter. ... Behavioral Ecology. 2009 - academic.oup.com  Danchen E, Hubel S, Pochter A, Duguet AC, Derray A, Alaphant M, Remy-Naty S, van Rossum L, Myster M, Gascopo E, et al. 2010. Cultural bias, evolutionary social learning in turtles predicts long-lasting mate-choice traditions. Science. 330: 1025-1028. Davies AD ...  ☆ 99 Zblat von: 2 Alle 5 Versionen</p>	[PDF] oup.com	<p><b>The effect of regression to the mean in epidemiologic and clinical studies</b>  on  <b>Regression to the mean</b> is the phrase used to identify 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 variability can be ...  ☆ 10 Zblat von: 439 Abstrakte Artikel Alle 8 Versionen 10</p>	[PDF] psu.edu
<p><b>Elicitor: an expert elicitation tool for regression in ecology</b>  A James, SL Olay, L Mergerson. Environmental Modelling &amp; Software. 2010 - Elsevier  Communicating with experts to elicit <b>regression</b> parameters has been found useful in several contexts relevant to environmental applications, ranging from <b>ecology</b> to socio-economics ... In logistic <b>regression</b> the conditional <b>mean</b> is the probability of success ...  ☆ 92 Zblat von: 168 Abstrakte Artikel Alle 5 Versionen</p>	[PDF] qut.edu.au	<p><b>Introduction to the use of regression models in epidemiology</b>  R Bender. Cancer Epidemiology. 2009 - Springer  ... chapter, an overview of the most important multiple <b>regression</b> models is given with a focus on applications in modern <b>epidemiology</b> ... Part three passed weeks (7). However, modern applications of <b>regression</b> methods do not only analyze such <b>regression</b> to the <b>mean</b> "effect" ...  ☆ 10 Zblat von: 54 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] rbsd.de
<p><b>Multiple regression and inference in ecology and conservation biology: further comments on identifying important predictor variables</b>  B MacIsaac, Biodiversity &amp; Conservation. 2002 - Springer  MR typically is used in conservation <b>ecology</b> to model the occurrence or diversity ... The hierarchical organization in exhaustive <b>regression</b>-model building arises because of ... for each variable can be regressed as Z-cores (Hofmann - mean transformation) (SDnormalization) ...  ☆ 92 Zblat von: 189 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] springer.com	<p><b>Regression to the mean in treated versus untreated chronic pain</b>  GV Winberg, M Von Klotz - Pain. 1992 - Elsevier  ... E. and Semmers, E. <b>Epidemiology</b> of signs and symptoms in temporomandibular disorders. Clinical signs in cases and controls. J Am Dent Assoc. 100 (1998) 273-281. Edberg, F. Secure cholesterol changes: effects of diet and <b>regression</b> toward the <b>mean</b>. J Chronic Dis. 25 ...  ☆ 10 Zblat von: 159 Abstrakte Artikel Alle 10 Versionen</p>	
<p><b>Partial least squares regression as an alternative to current regression methods used in ecology</b>  LM Carrascal, L Galván, Q Gordo - Oikos. 2009 - Wiley Online Library  a combination of <b>regression</b> and multivariate methods, which are more commonly used in <b>ecology</b> ... probable models when analyzing datasets with high predictor variables (nearest 11, and ... In summary, partial least squares <b>regression</b> analysis provides similar results to those ...  ☆ 99 Zblat von: 631 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] wiley.com	<p><b>Multiple additive regression trees with application in epidemiology</b>  JTF Friedman, JJ Maslove. Statistics in medicine. 2003 - Wiley Online Library  Multiple additive <b>regression</b> trees with application in <b>epidemiology</b> ... Here <math>y</math> (response) (or <math>\mu</math>) is the <b>mean</b> of the response <math>y</math> in each region <math>R_j</math> so a tree predicts a constant value ... <b>Regression</b> trees are induced by top-down recursive splitting based on a least-squares fitting criterion ...  ☆ 10 Zblat von: 544 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] wiley.com
<p><b>On the misuse of residuals in ecology: testing regression residuals vs. the analysis of covariance</b>  E Garcia-Berdeal. Journal of Animal Ecology. 2001 - JSTOR  ... in aquatic sciences: statistical shortcomings with <b>mean</b> depth and the morphoedaphic index ... Weinbaum, DO, Kupper, LJ &amp; Muller, NE (1980) Aquatic <b>Regression</b> Analysis and other Multivariate Methods. Journal of Animal Ecology. 29, 293-293</p>	[PDF] jstor.org Full View	<p><b>Do leukocyte telomere length dynamics depend on baseline telomere length? An analysis that corrects for "regression to the mean"</b>  S Verhulst, A Aven, A Benetos, GS Densten. ... journal of epidemiology. 2013 - Springer  Leukocyte telomere length (LTL) shortens with age. Longitudinal studies have reported accelerated LTL attrition when baseline LTL is longer. However, the dependency of LTL attrition on baseline LTL might stem from a statistical artifact known as <b>regression</b> to the ...  ☆ 10 Zblat von: 56 Abstrakte Artikel Alle 10 Versionen</p>	[PDF] springer.com

Figure 4: Only two articles are actually on RTM in ecology, cited under 200 times. In Epidemiology, G. Scholar finds > 60 articles on RTM, some cited > 1000 times

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<http://www.jstor.org/stable/10.1086/497402>.