

# 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)

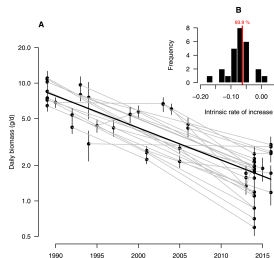


Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

# Our motivation to re-analyse the paper

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## Search results

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Entomologischer Verein Krefeld  
biodiversity loss in protected areas" PLOS ONE 12 (11): e0188808  
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Deforestation  
PLOS ONE 12 (11): e0188808 doi:10.1371/journal.pone.0188808  
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Biodiversity loss  
(PLOS ONE 12 (11): e0188808 doi:10.1371/journal.pone.0188808  
doi:10.1371/journal.pone.0188808 PMID:28043418 PNAS  
Elisabeth "Common knowledge  
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 Vogel,  
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 Goshima

## 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

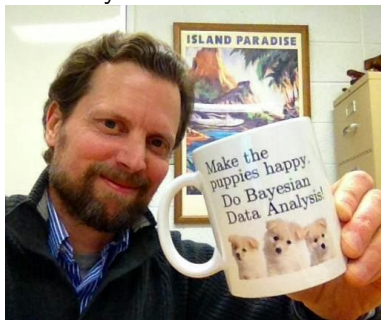
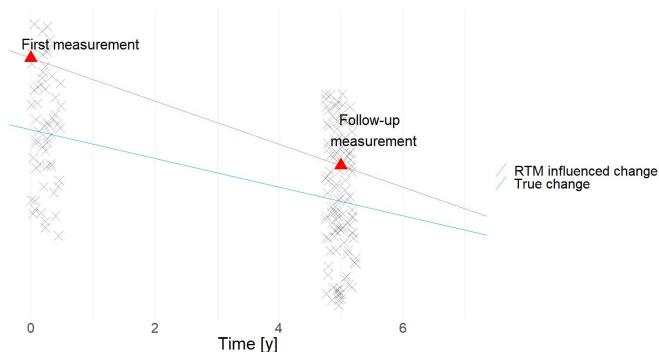


Figure 2: J. K. Kruschke amazon-page image, author of Doing Bayesian Data Analysis

# Why could there be a 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



## Further 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

# 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

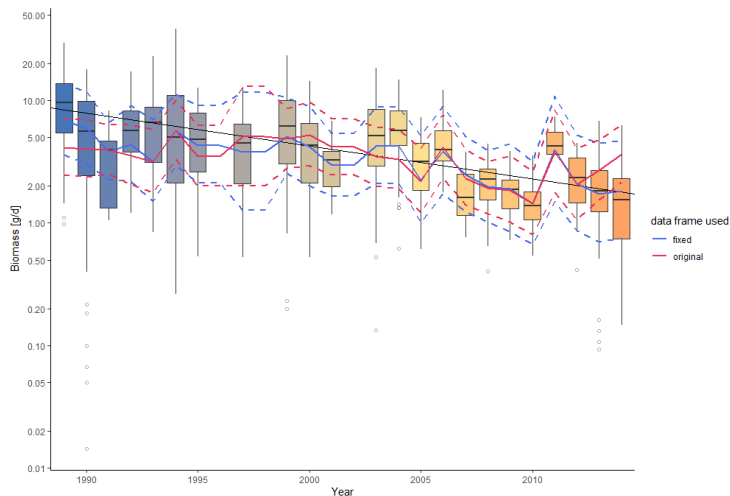


# Modelling of the insect biomass decline

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

# Results

- ▶ Our result (only first sampling of every plot)
- ▶ No Regression to the mean found



# Our Results and Hallmann et al.s

- ▶ The decay was calculated using

$$\log(\lambda)$$

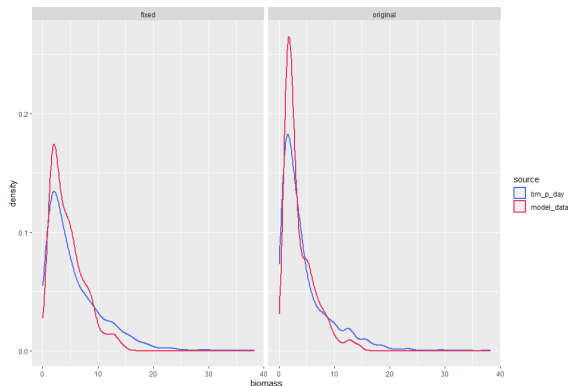
- ▶ 6.27% with the original data
  - ▶ 6.19% with one sample per site
- ▶ We calculated a decline within 27 years as follows n

$$(1 + \log(\lambda))^{26} - 1$$

- ▶ 81,4% with the original data
  - ▶ 81% with our variation of the data

# What could be the reason for this similar results

- ▶ Both statistical analyses are fine
  - ▶ Our model performed well in diagnostics



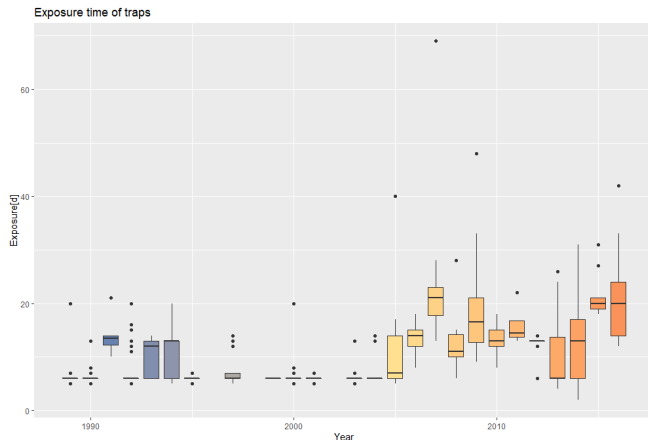
No major influence of temporal effect per plot + Leaving out the second round of sampling on locations sampled twice

## So is there no RTM effect?

- ▶ Not that we could measure it
- ▶ The effect it has on the results is minor

# Varying trap 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>	
UnpublW 1.800.000 Expressions (J.R.M. Tak)		UnpublW 2.630.000 Expressions (J.R.M. Tak)	
Correcting for <b>regression to the mean</b> in behavior and ecology Q Chahy DZlibet - The American biologist, 2005 - journal article etc. 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 <b>regression effect</b> ). Thus, there is a negative correlation between an individual's ... Q Z01 Zdbot von: 121 Abitische Artikel Alle 10 Versionen	[PDF] pfor.org	<b>Regression to the mean</b> , what it is and how to deal with it AJ DeBattist AC Juchacz 2016 - Journal of epidemiology & biostatistics, 2016 - academic open.com <b>Background:</b> <b>Regression to the mean</b> (RTM) is a statistical phenomenon that can make natural variation in repeated data look like real changes. It happens when unusually large or small values are followed by measurements that are closer to the <b>mean</b> . ... Q Z01 Zdbot von: 1365 Abitische Artikel Alle 16 Versionen	[HTML] cup.com
First evidence for a significant effect of the <b>regression to the mean</b> fallacy in meta-analysis: a comment on Davies et al. E DiCiccio SJ Lloyd A Fochtmann - Behavioral Ecology - 2018 - academic map inc Davison E, Nelder S, Pinheiro A, Capaldi AM, Hothorn T, Maly-Butly S, van Renssel L, Menar M, Garzaq E et al. 2018. Cultural fixity: conformal social learning in birds predicts long-lasting male choice traditions. Science. 362: 1255–1260. Davis AD ... Q Z01 Zdbot von: 2 Fallacy 1 Versionen	[PDF] oup.com	The effect of <b>regression to the mean</b> in epidemiologic and clinical studies CE Cline - American journal of epidemiology, 1976 - Elsevier <b>Regression to the mean</b> is the phrase used to signify the phenomenon that a variable that is extreme on its first measurement will tend to be closer to the center of the distribution on a later measurement. In studies based on biological measurements, this variability can be ... Q Z01 Zdbot von: 439 Abitische Artikel Alle 8 Versionen 10	[PDF] psu.edu
Eiktorator: an expert elicitation tool for <b>regression in ecology</b> A Jarvis, B G Clark, L Koppeser - Environmental Modelling & Software, 2019 - Elsevier Communicating with experts to elicit <b>regression</b> parameters has been found useful in several contexts related to environmental applications, ranging from ecology to socio-economics. In <b>ecology</b> , <b>regression</b> the conditional means is the probability of success ... Q Z01 Zdbot von: 168 Abitische Artikel Alle 16 Versionen	[PDF] qml.edu.au	Introduction to the use of <b>regression models in epidemiology</b> R Bender - Cancer Epidemiology Biostatistics - 2009 - Springer Chapter 9 introduces the four most important <b>regression models</b> in place with a focus on applications in modern <b>epidemiology</b> ... thus their parent seeds (1). However, modern applications of <b>regression</b> methods do not only analyze such "parent" effects ... Q Z01 Zdbot von: 54 Abitische Artikel Alle 9 Versionen	[PDF] rsos.royalsocietypublishing.org
<b>Multiple regression and inference in ecology</b> and conservation biology: further comments on identifying optimal predictor variables B MacNally - Biodiversity & Conservation, 2002 - Springer ML typically is used in conservation ecology 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 [observed – mean linear transformation]/SD[untransformed] ... Q Z01 Zdbot von: 588 Abitische Artikel Alle 16 Versionen	[PDF] springer.com	<b>Regression to the mean</b> in treated versus untreated chronic pain CH Winkler, M Guo-Song, Piao, 1985 - Elsevier ... E. and Samuels, E. <b>Epidemiology</b> of signs and symptoms in temporomandibular disorders. Clinical signs and cases and controls. J. Am. Dent. Assoc., 102 (1986) 2781. Edner, P. Severe chondroclastic changes, effects of diet and <b>regression</b> toward the mean. J. Chronic Dis., 25 ... Q Z01 Zdbot von: 199 Abitische Artikel Alle 10 Versionen	
Partial least squares <b>regression</b> as an alternative to current <b>regression</b> methods used in ecology LM Camacho, I Cubiles O Quinto - Oikos, 1989 - Wiley Online Library A combination of <b>regression</b> and multiple methods, which are more commonly used in <b>ecology</b> ... probable models when analyzing datasets with eight predictor variables measured, U1, and ... summary, partial least squares <b>regression</b> analysis provides similar results to those ... Q Z01 Zdbot von: 531 Abitische Artikel Alle 16 Versionen	[PDF] wiley.com	Multiple additive <b>regression</b> trees with application in <b>epidemiology</b> AJ DeBattist AC Juchacz - Statistics in medicine, 2018 - Wiley Online Library Multiple additive <b>regression</b> trees with application in <b>epidemiology</b> ... Here 5% (meanwidth) is the <b>mean</b> of the responses y at each node S, 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 ... Q Z01 Zdbot von: 544 Abitische Artikel Alle 16 Versionen	[PDF] wiley.com
On the misuse of residuals in <b>ecology</b> : testing <b>regression</b> residuals vs. the analysis of covariance E Oliva-Bastida - Journal of Animal Ecology, 2001 - JSTOR ... in aquatic sciences: statistical shortcomings with <b>mean depth</b> and the morphological index ... Kleindam, DG, Kopper, JL, Mulvey, KE (1988) Aquatic <b>Regression</b> Analysis and other Multivariate Methods ... Journal of Animal Ecology, 28, 203–212	[PDF] jstor.org	Do lenticule telomere length dynamics depend on baseline telomere length? An analysis that corrects for ' <b>regression to the mean</b> ' S Schibye, A Awa, A Benetos, GS Denaxas - Journal of epidemiology & biostatistics, 2013 - Springer Lenticule telomere length (LTL) shortens with age. Longitudinal studies have reported accelerated LTL attrition when baseline LTL is longer. However, a confounding effect of LTL attrition on baseline LTL might stem from a statistical artifact known as <b>regression to the mean</b> . ... Q Z01 Zdbot von: 56 Abitische Artikel Alle 19 Versionen	[PDF] springer.com
	Full View		

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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