Final Presentation Hallman

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Content

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)

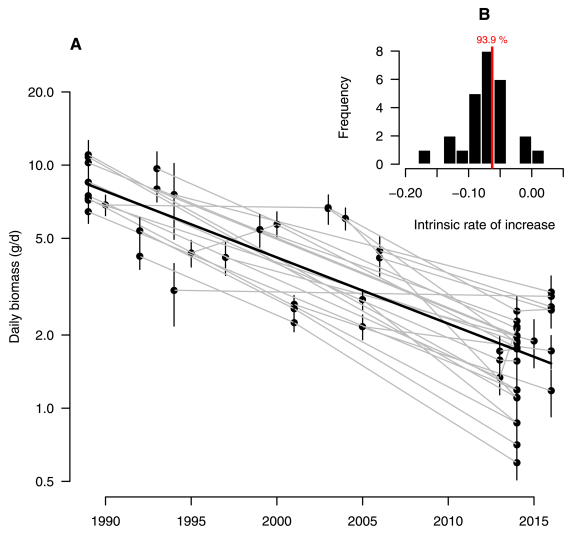
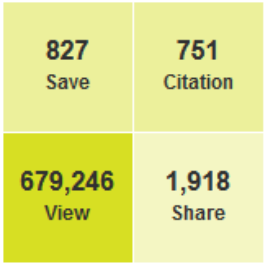


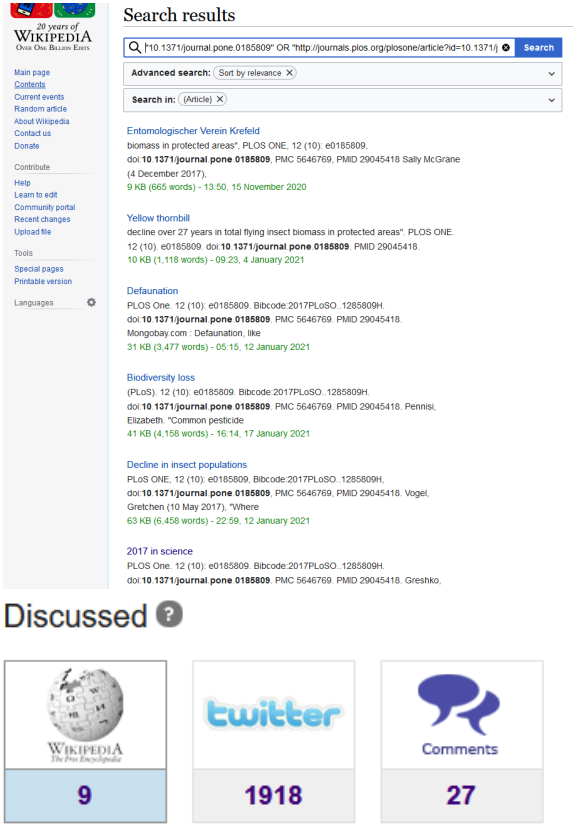
Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

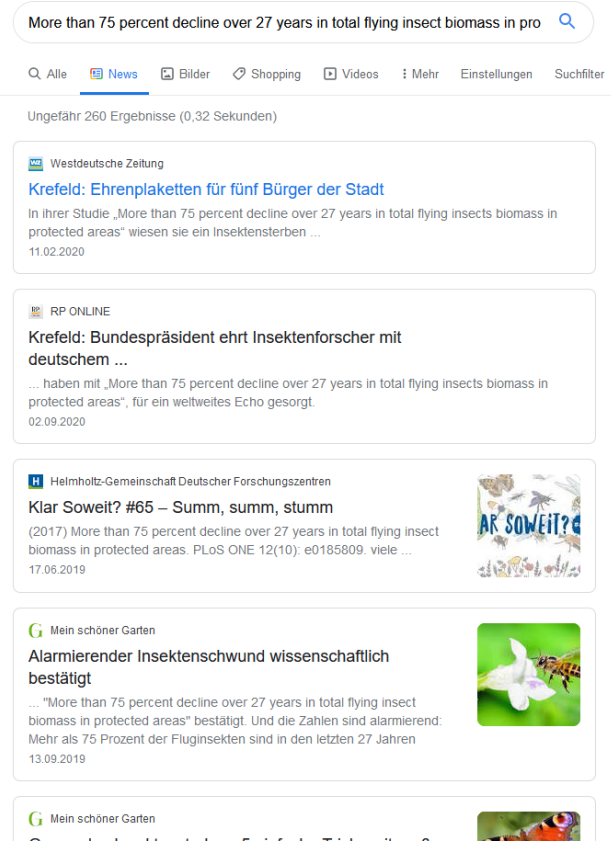
Our motivation to re-analyse the paper



Included in the Following Collection

PLOS ONE 10 Year Anniversary Collection: Editorial Board Favorites





Aim for our re-analysis

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

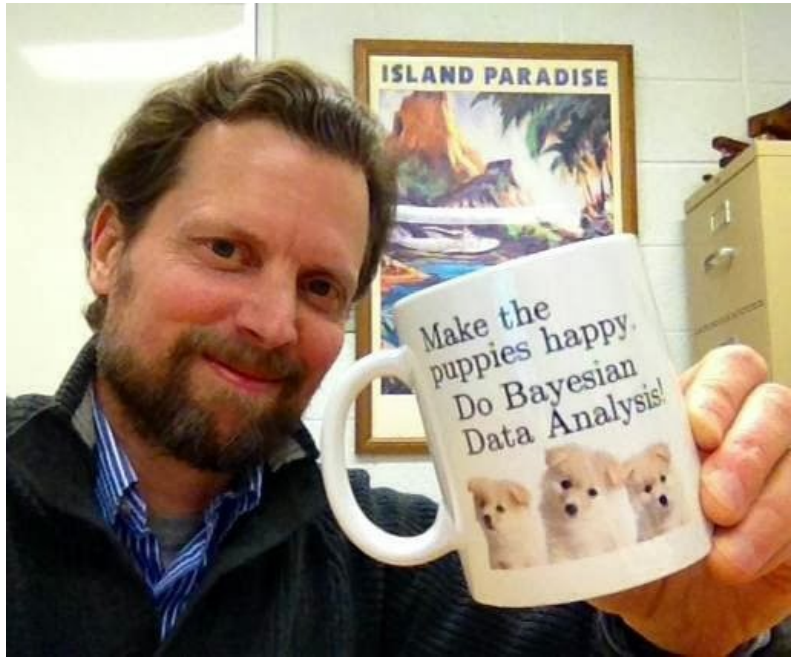


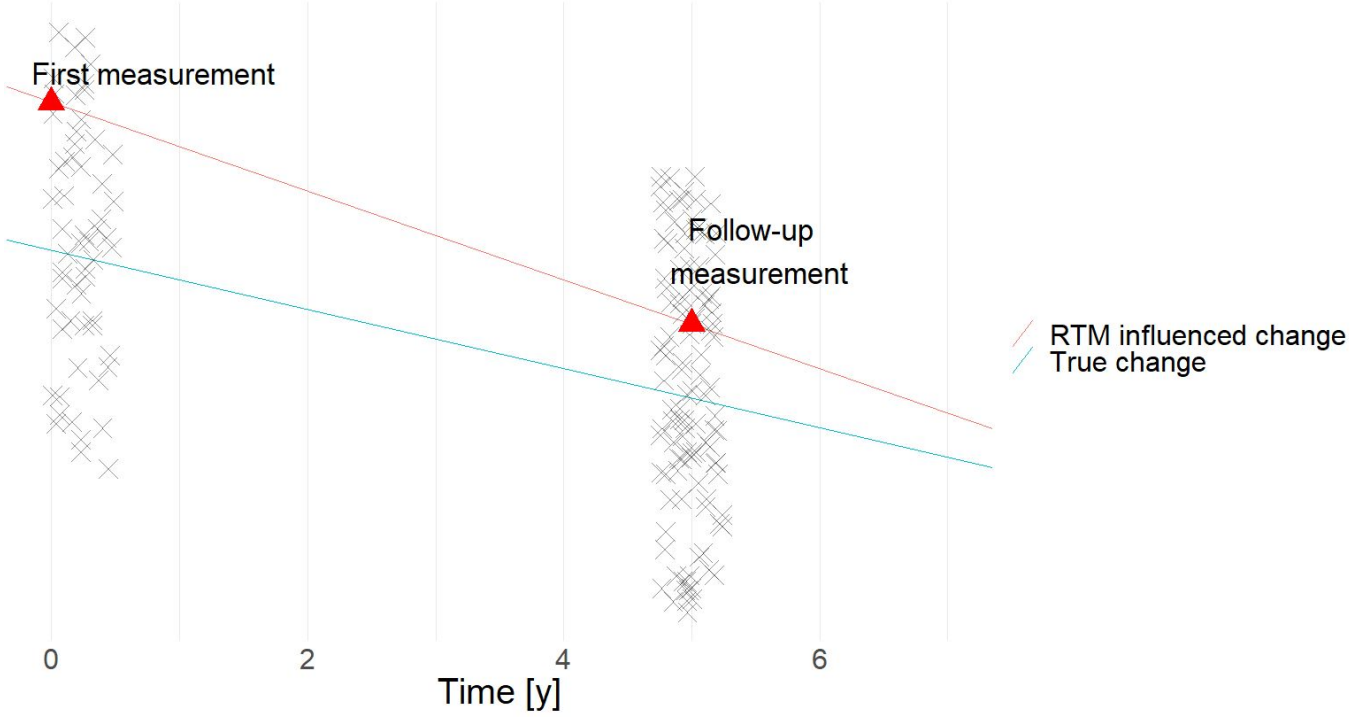
Figure 2: J. K. Kruschkes amazon-page image, author of Doing Bayesian Data Ananlysis

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 biomas
- 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

- Bayseian 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 fling 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 controll group could be:
  - third or fourth sampling on each location
- Blomqvist (1987) emphasized the need to 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

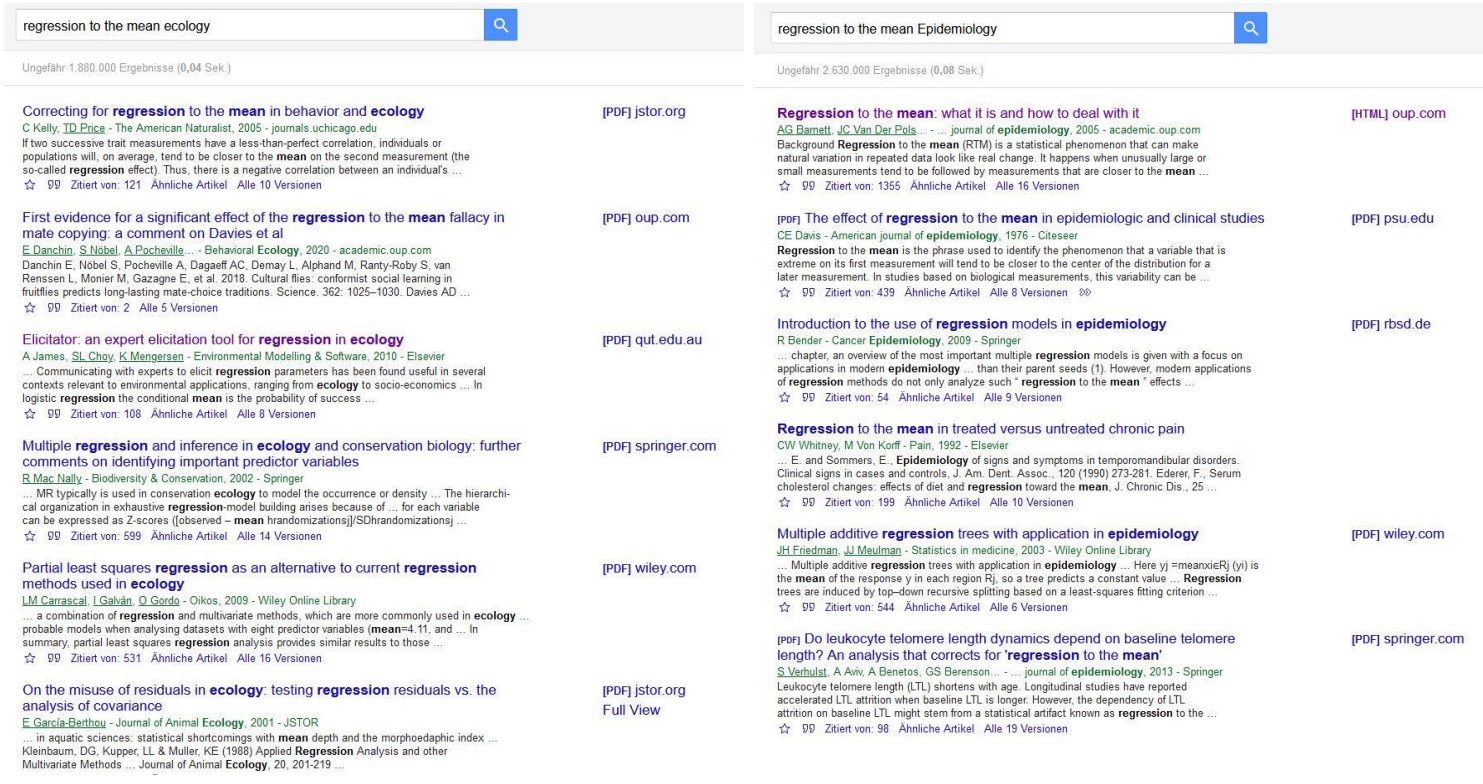


Figure 4: Only two articles are actually on RTM in ecology, cited under 200 times. In Epidemiology, G. Scholar finds $>$ 6 articles on RTM, some cited $>$ 1000 times

References

Blomqvist, Nils. 1987. "On the Bias Caused by Regression Toward the Mean in Studying the Relation Between Change and Initial Value." *Journal of Clinical Periodontology* 14 (1): 34–37. 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.

Hallmann, Caspar A., Martin Sorg, Eelke Jongejans, Henk Siepel, Nick Hofland, Heinz Schwan, Werner Stenmans, et al. 2017. "More Than 75 Percent Decline over 27 Years in Total Flying Insect Biomass in Protected Areas." *PLOS ONE* 12 (10): 1–21. https://doi.org/10.1371/journal.pone.0185809.

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.