Final Presentation on Hallman et al.

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22.01.2021

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)

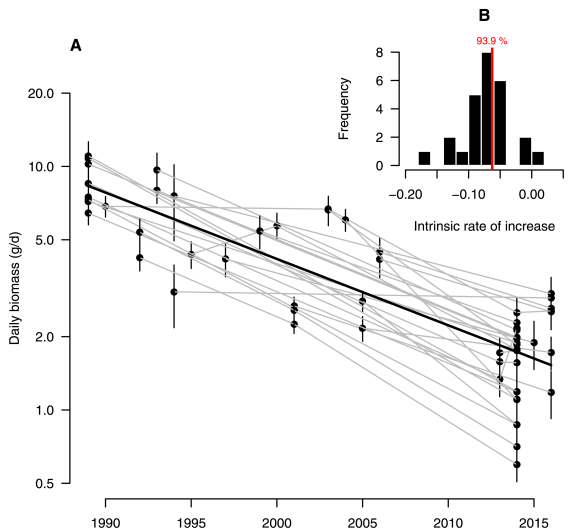
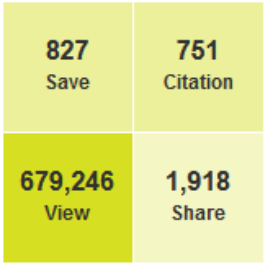


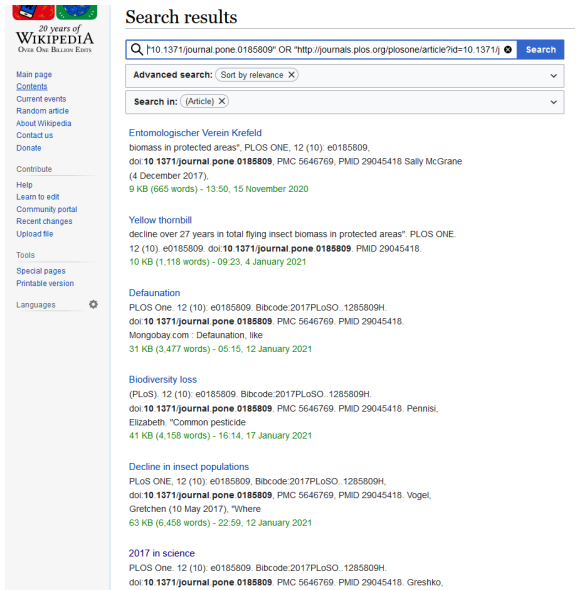
Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

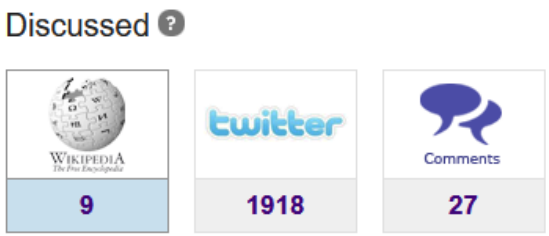
Our motivation to re-analyse the paper

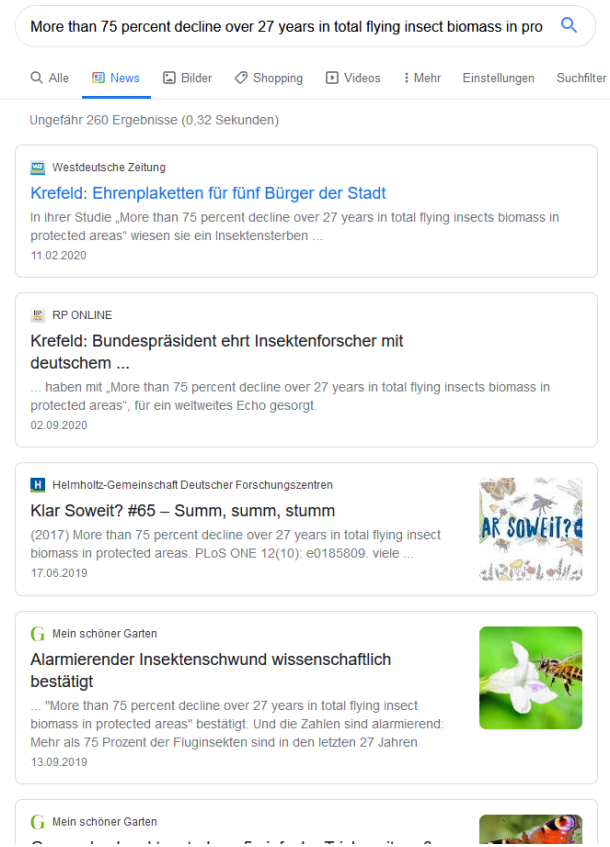


Included in the Following Collection

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

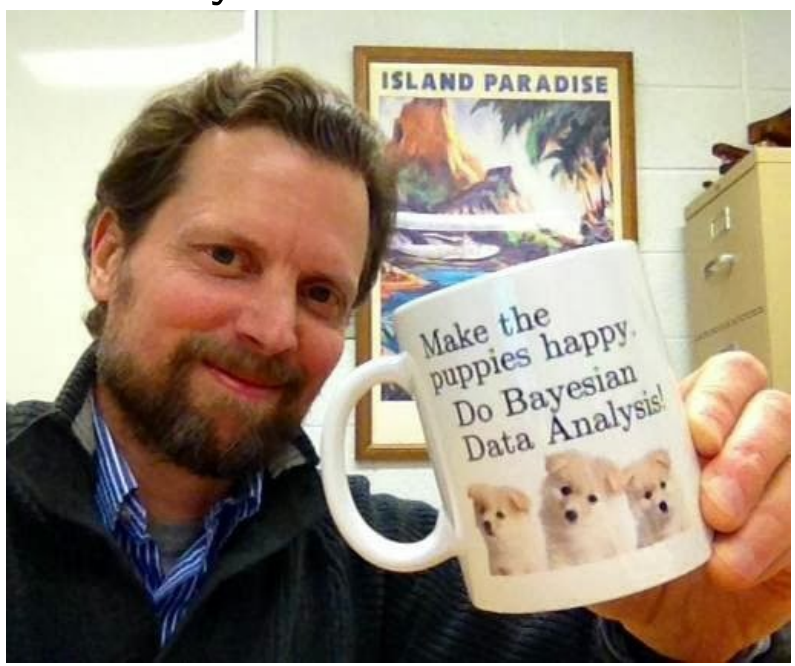
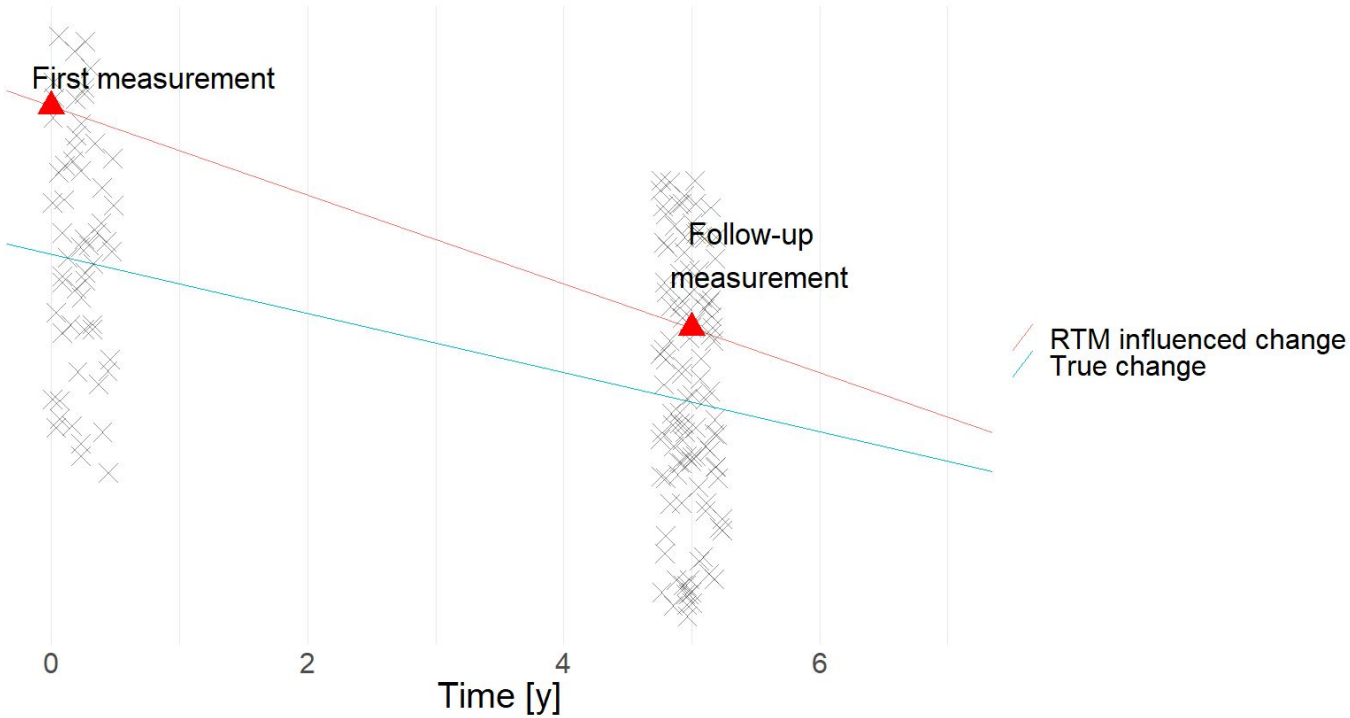


Figure 2: J. K. Kruschkes amazon-page image, author of Doing Bayesian Data Ananlysis

Why could there be a 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



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

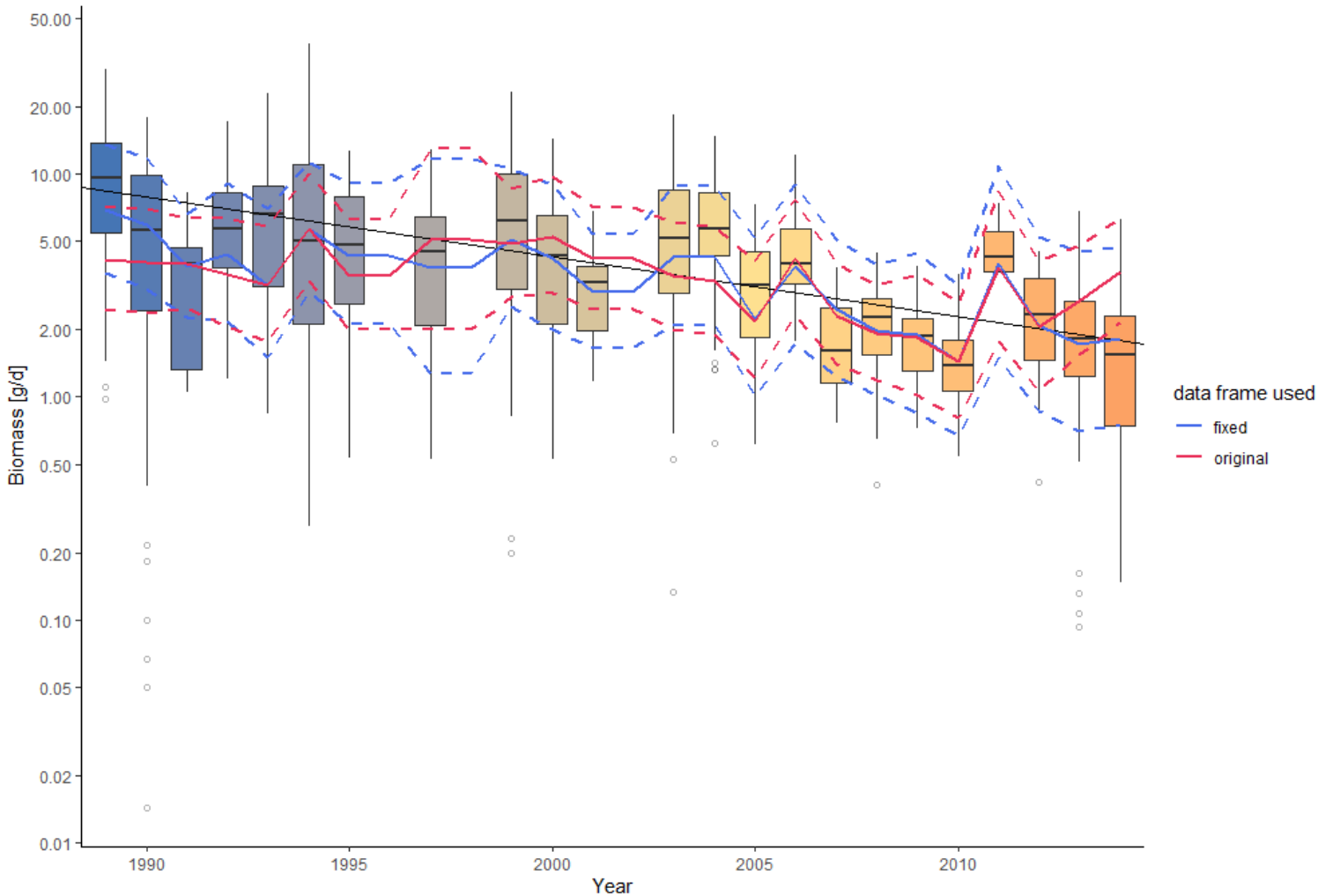
- Only use the first observation of each location
  - no follow up or baseline observations appear
- Use the basic model of Hallmann et al.
  - Which was used for the prediction of the decline
  - Replicate the model specifications with an other subset of the data
- Models diagnostics
- Compare results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

$$log(\lambda)$$

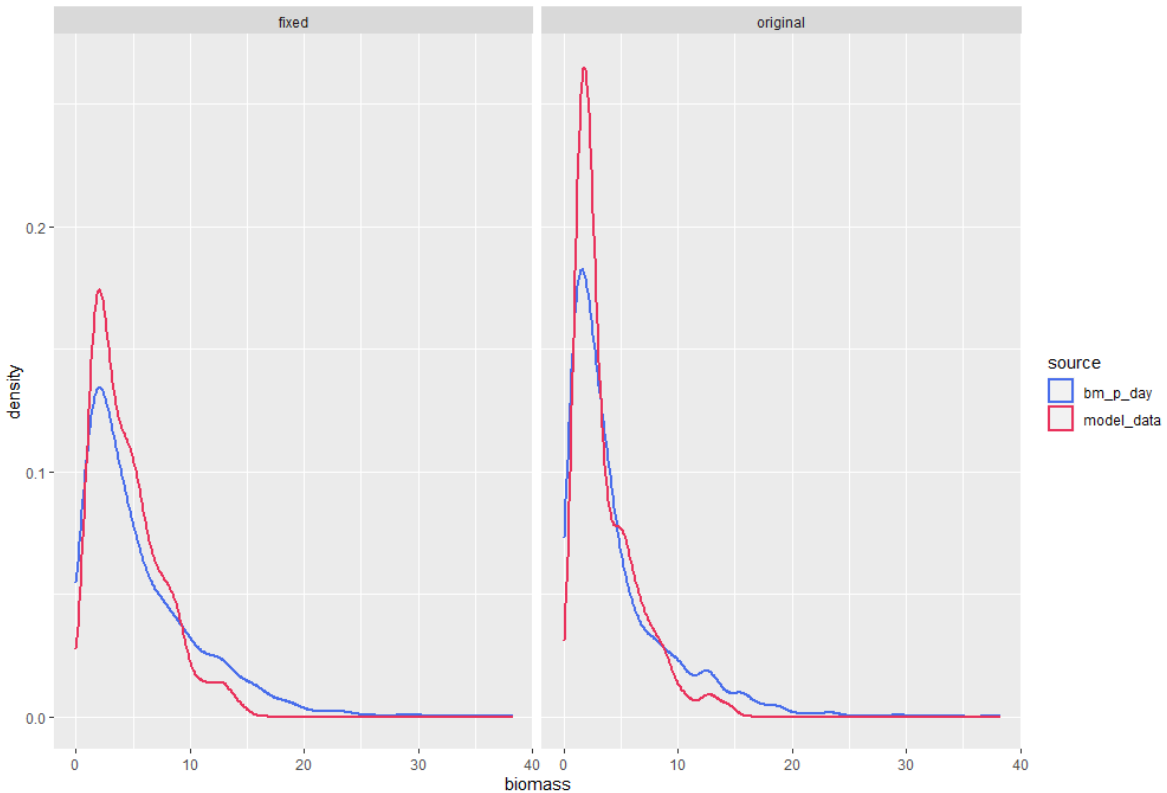
  - 6.27% with the original data
  - 6.19% with one sample per site
- We calculated a decline within 27 years as follows n

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

  - 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



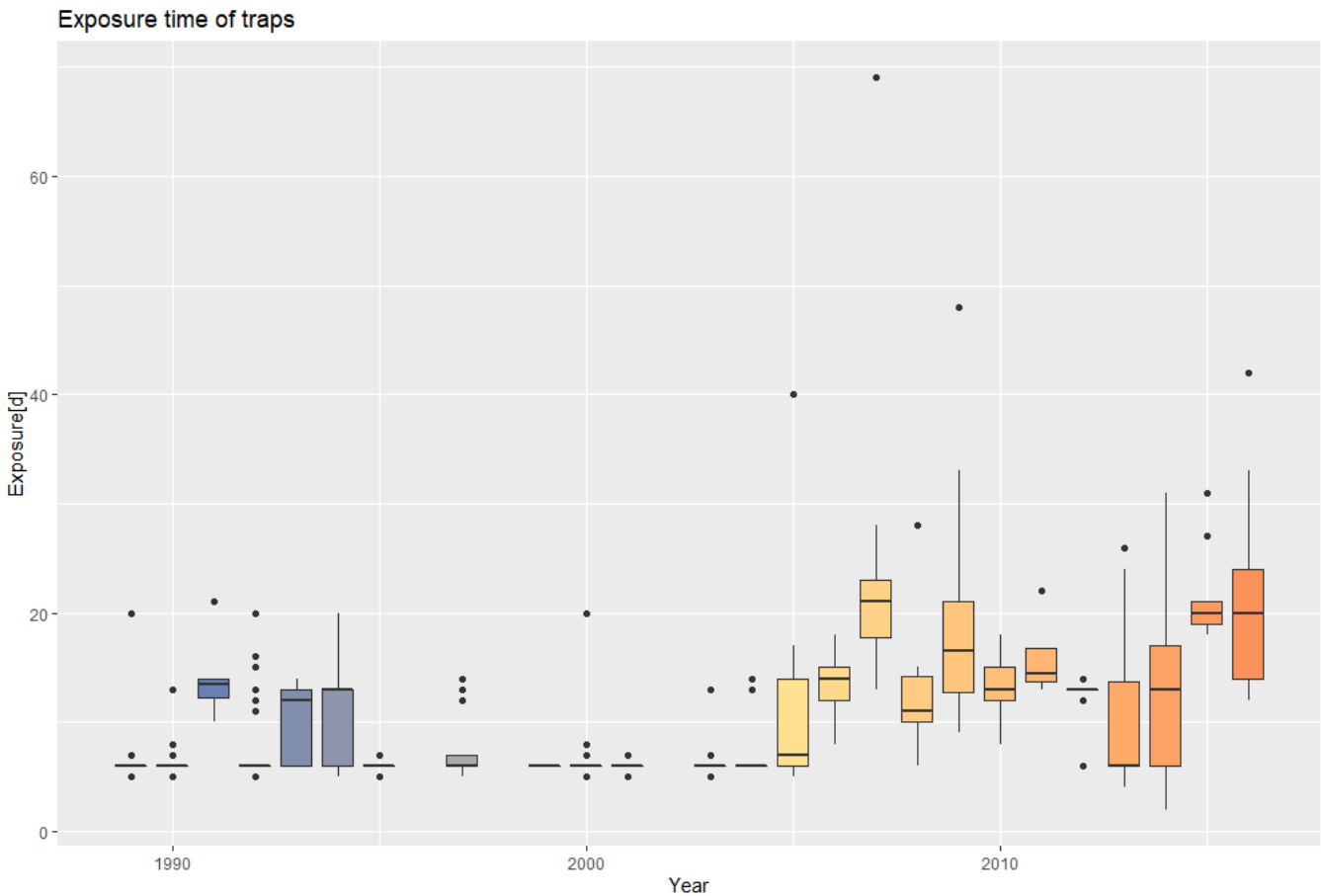
No major influence of temporal effect per plot + Leaving out the second round of sampling on locations sampled twice

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 fling 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 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

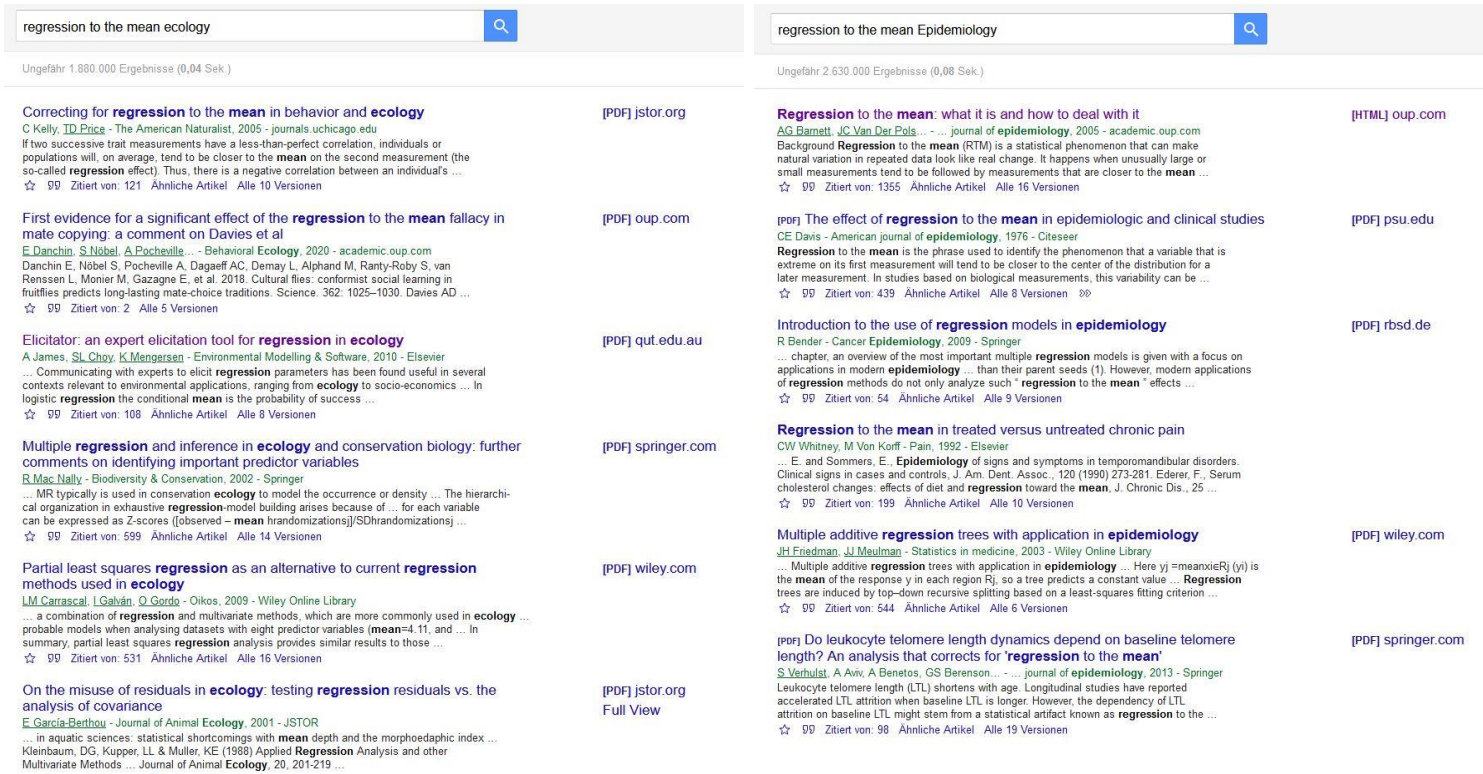


Figure 3: Only two articles are actually on RTM in ecology, cited under 200 times. In Epidemiology, G. Scholar finds $>$ 6 articles on RTM, some cited $>$ 1000 times

References

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