Our Approach on Hallmann 2017

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Main Results of the Paper

- $\sim$ 75 % decline in flying insect biomass over 27 years
- On protected sites of nature conservation
- Independent on weather, land-use, habitat characteristics
- $\sim$ 80 % of the effects explaining declines are unknown
- Highest losses in times of highest biomass

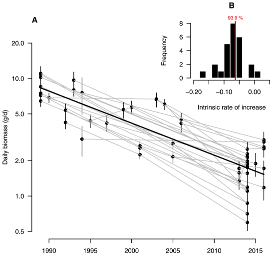


Figure 1: Temporal distribution of insect biomass at selected locations (Hallmann 2017)

Impact of the paper / relevance

- Included in 9 Wikipedia articles
- Broad media coverage
- Alone 1306 citations on Google Scholar

Data gathering

- Entomological Society Krefeld
- Standardized protocol
- Malaise traps ($\sim$ every 11 days emptied)
- Sampling between 1989 and 2016
- All locations within protected areas (Nature reserves, Natura 2000, Protected landscape areas)

(Hallmann et al. 2017)

Description of the dataset

- Data collected between 1989 and 2016 (96 unique location-year combinations)
- Mostly one sample per location
- Samples spanning from spring to autmumn, diverse sampling duration
- Predictor variables collected from various sources
- Aerial photographs, Plant inventories, 169 climate stations

The insect biomass model of Hallmann et al.

- Different exposure times of insect traps / catchinng intervals
- Induces heterodescadicity
- Biomass can take positive values
- Biomass is modeled as sum of expected latent biomass
- Mass is assumed to be normaly distributed over the sum of latent expected daily mass
- Latent daily biomass is represented by log-normal distribution

Biomass modelling part 2

- Different models fitted (basic, weather, vegetation, etc. . .)
- Final model with different covariates, to find predictors for decrease
- Basic model for main results

Bayesian Modeling

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

A, B = events

$P(A|B)$ = probability of A given B is true

$P(B|A)$ = probability of B given A is true

$P(A), P(B)$ = the independent probabilities of A and B

Frequentist	Bayesian
Probability is "long-run frequency"	Probability is "degree of certainty"
"How likely is the data given our parameters"	"How likely is the parameter given our data"
Confidence Intervals	Credibility Intervals

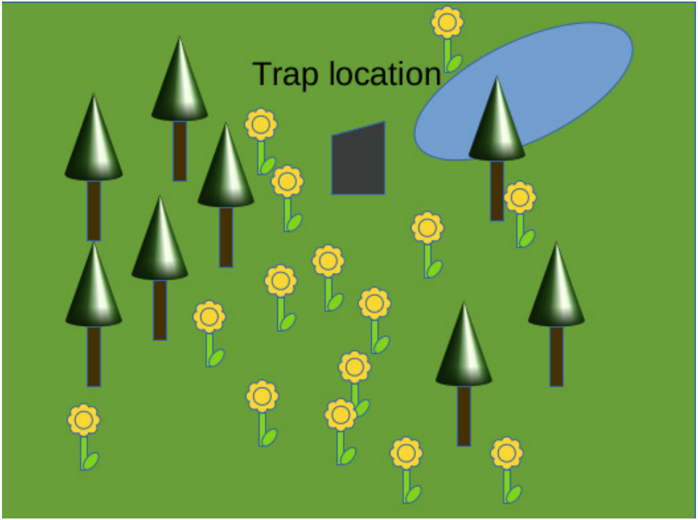
Criticism

- Years 1989 and 2014 are over-represented
- Few locations were resampled
- Only one trap per location
- The exposure time varies greatly between years

What is critical about the paper / improvement

- Unknown procedure of plot selection (stage of data collection)
- No “control” plots
- Is there a bias towards plots richer in biomass at the beginning of the study?
- Unbalanced study design, some plots are observed twice, some not
- Huge uncertainty about drivers of the decline

Our appoach



Regression towards the mean

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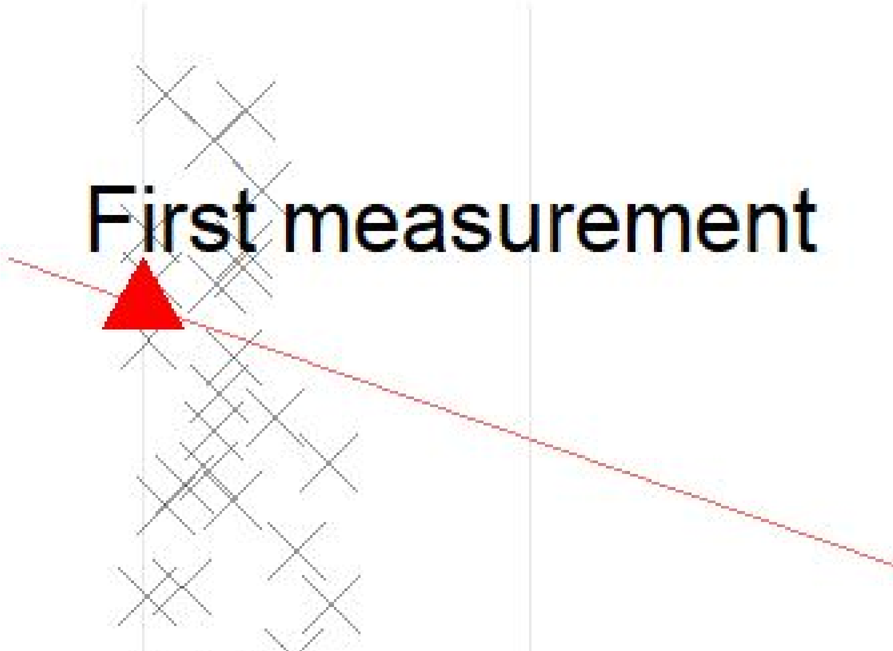
Possible RTM effect in Hallmann



Goals

- Rule out regression to the mean effect
- Assessing the quality of the stated decline on insect biomass
- Development of our skills in bayesian statistics