

# TRACE documents for good modelling practice

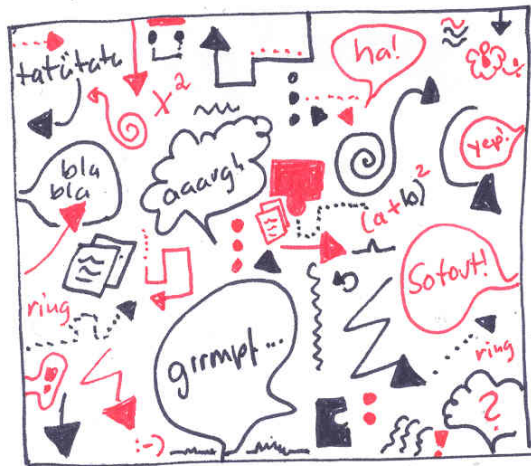


Volker Grimm

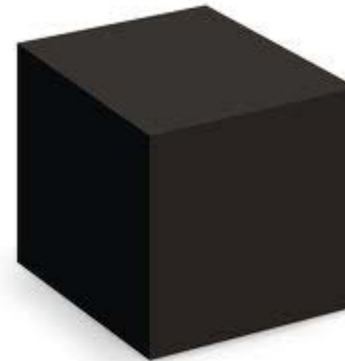
# ZEE QUESTION: IS THE MODEL GOOD ENOUGH?



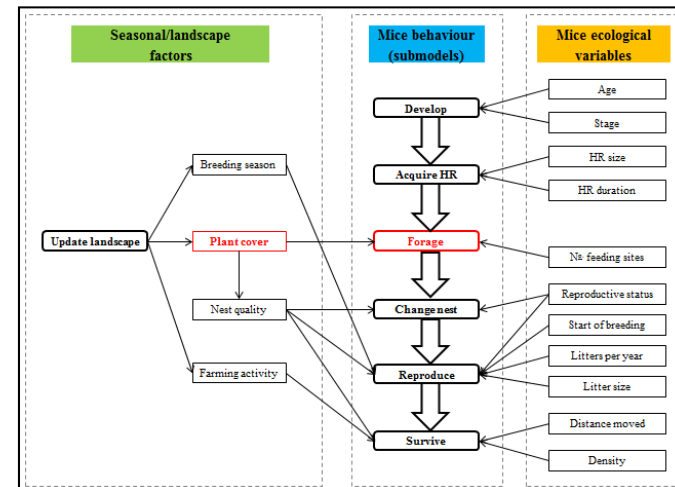
Model 1



[http://rotundschwarz-kd.blogspot.de/2010\\_05\\_01\\_archive.html](http://rotundschwarz-kd.blogspot.de/2010_05_01_archive.html)



Model 2



# GOOD MODELLING PRACTICE

## Do the right thing:

- **Communicate the model**
- **Justify underlying simplifying assumptions**
- **Document sources of biological information**
- **Document tests and understanding**
- **Provide evidence that model is realistic enough**
- **Communicate sensitivity and uncertainty**
- **Make predictions that are relevant for risk assessment**

## Review by Schmolke et al. (2010)

- Elements of Good Modelling Practice **are all there** and well-known, in principle, and not too controversial
- Very good attempts to provide guidance already exist (EPA; also in hydrological modelling)

### **THE REAL PROBLEM IS**

- **NOT** so much defining (guidance for) Good Modelling Practice

**BUT** getting this practice – into practice

# BASIC IDEA OF TRACE

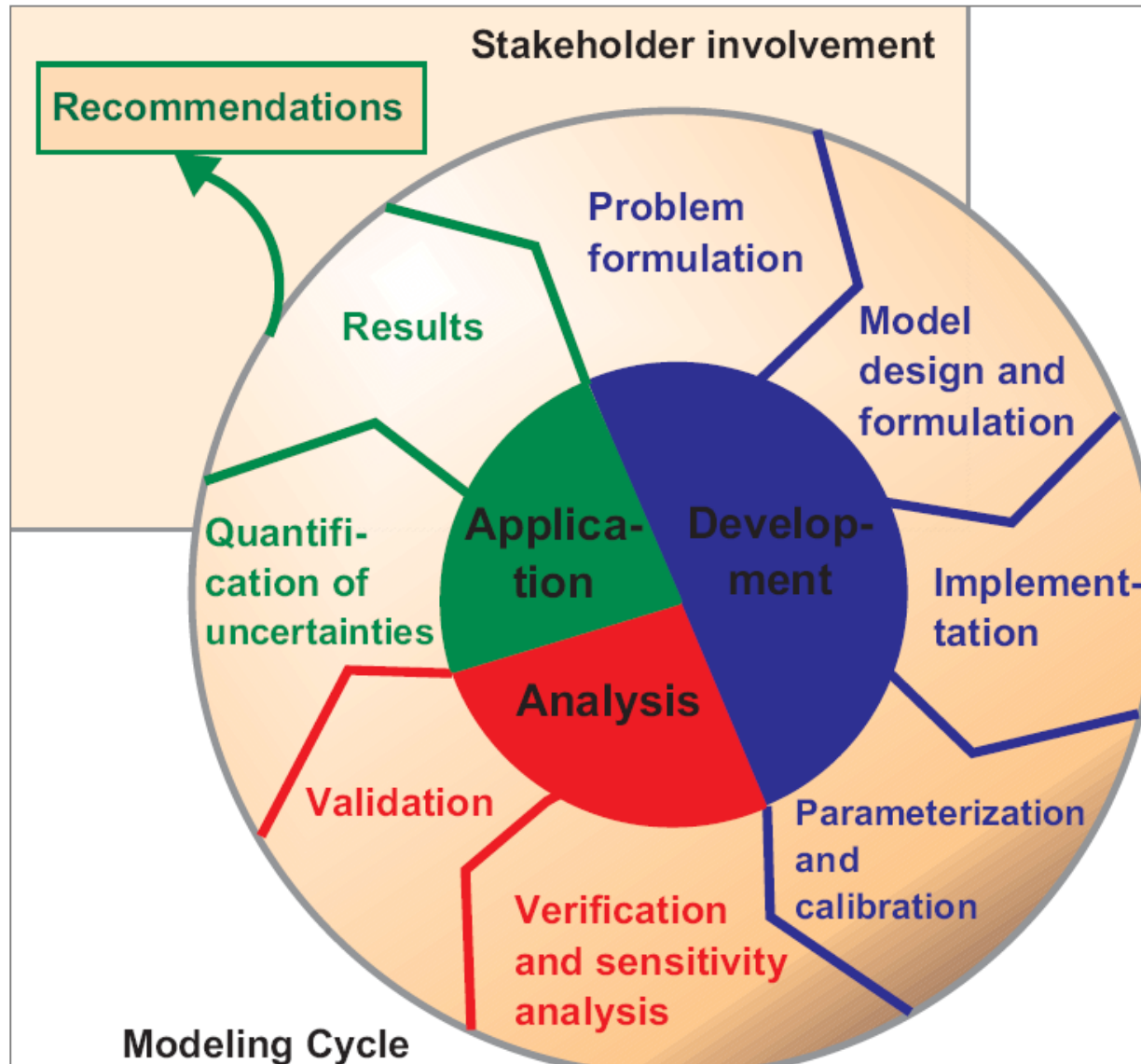
**Instead of:**

Do the right thing!

**Document** the right thing!

Establish a **standard** for documenting models, their development, and their analysis

# BASIS OF STANDARD: THE MODELLING CYCLE



## Box 1. TRACE (transparent and comprehensive ecological modeling) documentation structure

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### I. Model development

**Problem formulation:** *Context* in which the model will be used, and the type of audience addressed; *specification of the question(s)* that should be answered with the model; statement of the *domain of applicability* of the model, including the extent of acceptable extrapolations; assessment of the *availability of knowledge and data*; specification of necessary *model outputs*.

**Design and formulation:** Description of the *conceptual model*; description and justification of the *modeling approach* used and of the *complexity, entities and processes represented* in the model; most important, the applied *assumptions* about the system.

**Model description:** Detailed *description of the actual model* and how it has been *implemented* (programs, software platforms, scripts).

**Parameterization:** *List of all parameter values* used in the model, the *data sources*, and how the parameter values were obtained or calculated; *uncertainties* associated with each parameter.

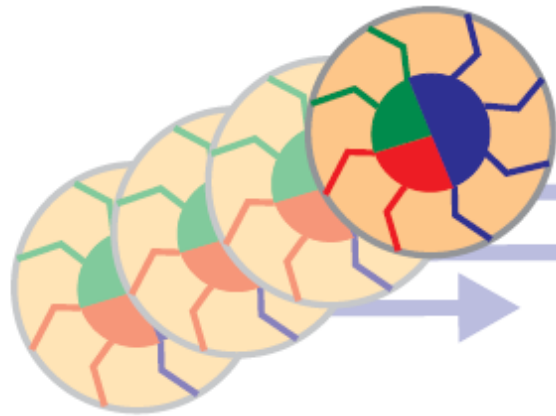
**Calibration:** Documentation of the *data sets used* for calibration; *which parameters* were calibrated; what *optimization method* was used.

### II. Model testing and analysis

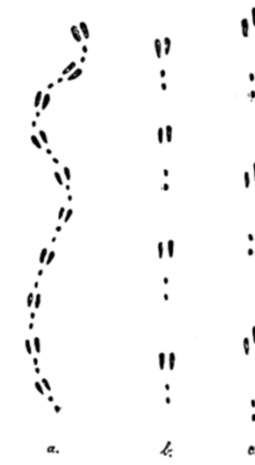
**Verification:** Assessment of whether the model is working according to its specifications; documentation of what tests have been conducted.

**Sensitivity analysis:** Exploration of the model behavior for *varying parameters*; documentation of which *parameter combinations* have

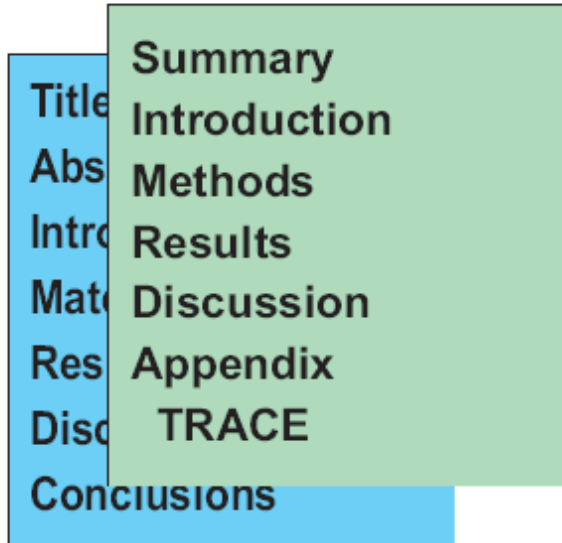
## Modeling Cycles



## Modeling Notebook

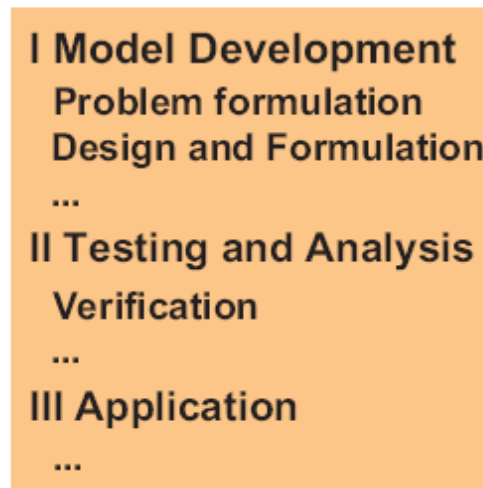


## Report or Dossier



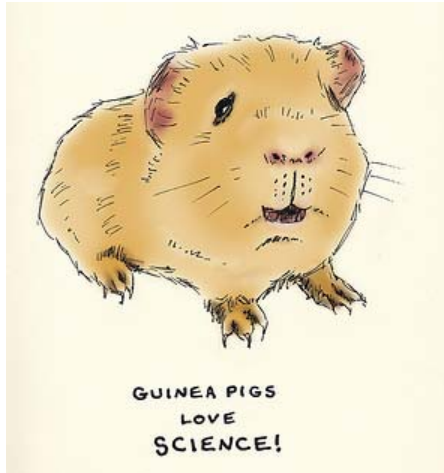
## Scientific article

## TRACE Documentation





# OK – LET US TEST THIS IDEA



- Special Issue in "Ecological Modelling": about 10 TRACE documents produced
- TRACE II article (under construction) based on lessons learned in CREAM and elsewhere

<http://laikaspoetnik.files.wordpress.com/2010/05/30-5-2010-1-18-46-guinea-pigs-love-science.png>

## TRACE: FREQUENTLY ASKED QUESTIONS

- Unclear what exactly should be included in TRACE documents
- Level of detail and style of presentation very diverse
- Relation between ODD, TRACE, Modelling Notebook unclear
- Overlap of ODD and TRACE
- Overlap of TRACE categories (parameterization, calibration, sensitivity analysis)
- TRACE only for new models?
- Who is going to read 100 pages or more?
- TRACE is technical, for modellers only (Wang and Luttik 2012)

## UPDATE PAPER (under construction)

# **Towards better modelling and decision support: documenting model development, testing, and analysis using TRACE**

Running head: TRACE

Volker Grimm\*<sup>1,2</sup>, Andreas Focks, Béatrice Frank, Faten Gabsi,  
Alice S. A. Johnston<sup>3</sup>, Katarzyna Kulakowska, Chun Liu, Benjamin T. Martin,  
Mattia Meli, Viktoriia Radchuk, Amelie Schmolke, Pernille Thorbek,  
Steven F. Railsback

# TRACE: FREQUENTLY ASKED QUESTIONS

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- TRACE only for new models?
- Who is going to read 100 pages or more?
- TRACE is technical, for modellers only (Wang and Luttk 2012)
- Information that significantly adds to the credibility of your model
- More specific guidance and templates are needed
- Oh, come on!
- Ja ja. Easy to fix.
- Will be fixed.
- Of course not, Chris!
- Supplement. Hierarchical structure/reading
- Misunderstanding. Biological background IS part of TRACE!

## STILL SOMETHING FUNDAMENTALLY WRONG

TRACE provides

- a standardized structure and terminology for documentation
- a checklist for modellers and decision makers

So far, so good, but:

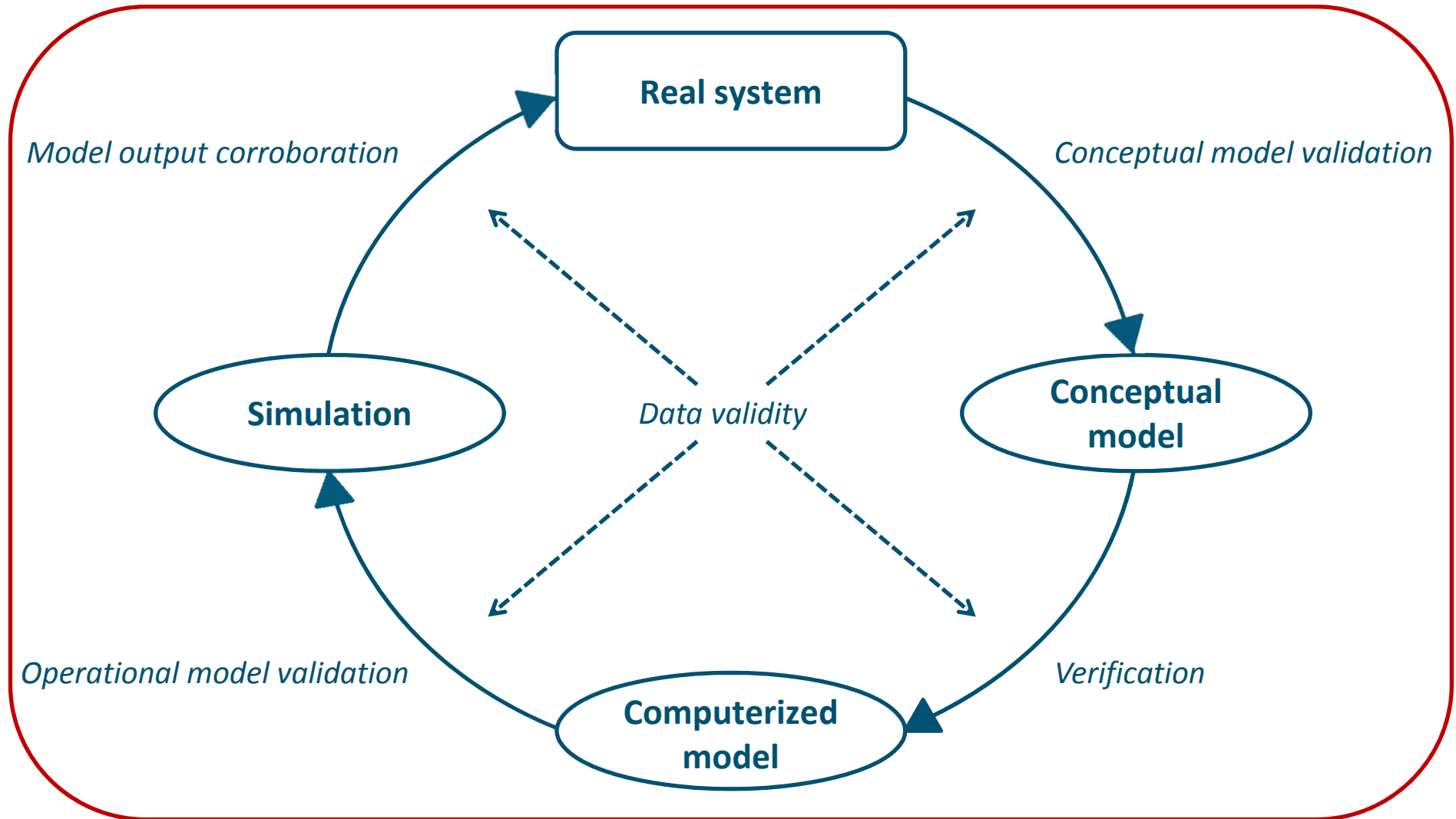
**HOW BORING IS THAT, documentation?**

**TRACE needs to be much clearer linked to a purpose or process!**

- This would make writing and reading TRACE documents much easier and more useful

# TRACE AND EVALUATION: CLOSELY RELATED

## Model evaluation



# LINKING TRACE AND EVALUATION

## EVALUATION:

‘The entire **process** of establishing model quality and credibility throughout all stages of model development and application’ (Augusiak et al., in prep.)

## TRACE:

- A standard format for organizing and documenting the five elements of model evaluation
- A means to an end: documenting to what degree and how good modelling practice was followed

**But: There is still Valery's question**

## VALERY'S QUESTION

**"But .. when IS a model good enough to base a decision on it?"**

TRACE and Evaluation do not answer this question, but:

- For each step of model evaluation/the TRACE document, we can **assemble criteria and approaches**, from **simple and not too powerful** to **complex but convincing**
- "Good enough" should then be **related to the purpose** of the model (e.g., screening, scenario assessment, quantitative predictions)



# IS THE MODEL GOOD ENOUGH: FILL IN THE SCORE SHEET

Runs and wickets at the end of each over.

Batsmen's names in batting order.

Runs scored by each batsman.

Symbol used to indicate a batsman is out.

Record the method of batsman's dismissal.

Record of progressive team's total.

When a wicket falls record -

1. Team's total
2. Name of batsman out
3. Not out batsman and his score

For the 51st and subsequent overs in Test Cricket either continue on next page or record on a separate sheet of paper.

List of bowler's names to be used by the bowling team.

How to score a complete over.

Progressive total of runs scored off a bowler.

Record of events of an individual over.

Total of overs and maidens bowled off each bowler at the end of the innings.

Wides and no balls recorded against each bowler progressively.

Record of bowler responsible for the batsman's dismissal.

Total runs scored by each batsman.

Record all extras scored.

Total of each type of extra at the end of the innings.

Total score at end of the innings.

Record of each unsuccessful review.

Total of runs scored off each bowler at the end of the innings.

Total of wickets taken by each bowler at the end of the innings.

OVERS	BATSMAN	Runs	Wickets	Method	Bowler	Runs	Wickets
1	Hayden	11	0		McGrath	0	0
2	Boycott	12	0		Garner	0	0
3	Gower	11	0		Trueman	0	0
4	Bradman	21	0		Imran	0	0
5	Sobers	0	1	LBW	Dev	0	1
6	Richards	0	1	Caught Behind	Imran	0	1
7	Gilchrist	0	1	Caught Behind	Imran	0	1
8	Hadlee	0	1	Caught Behind	Imran	0	1
9	Flintoff	0	1	Caught Behind	Imran	0	1
10	Warne	0	1	Caught Behind	Imran	0	1
11	Lille	0	1	Caught Behind	Imran	0	1
TOTAL						474	

# EXAMPLE

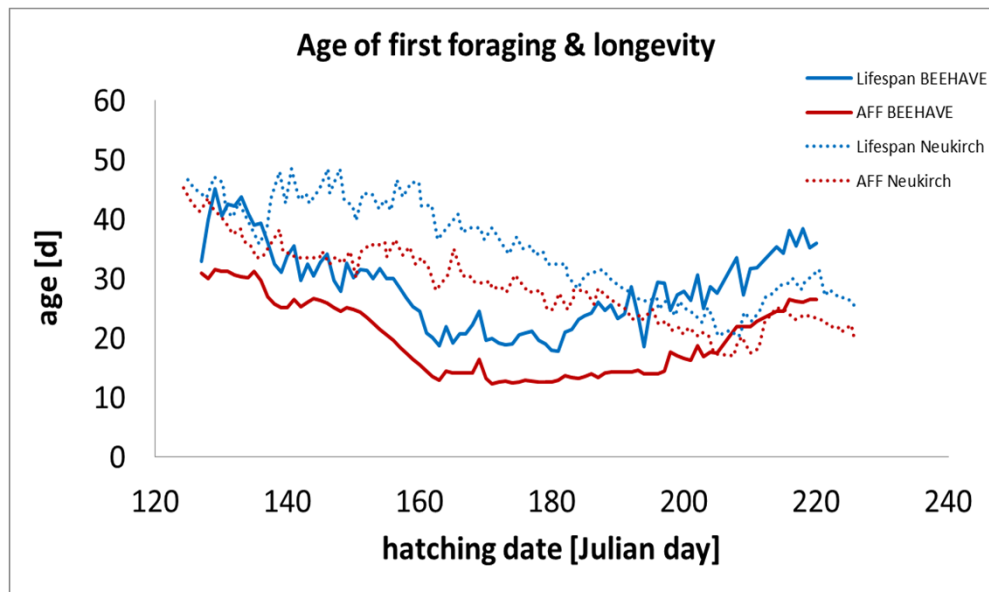
**Table 1.** Comparison of experimental data and model results for average age of onset of foraging (AAOF) and lifespan.

Colony	Flightspan (days)	Deathrate, $m$ (days <sup>-1</sup> )	AAOF		Lifespan	
			Observed	Model	Observed	Model
1 (Large)	7.5	0.133	18.6	19.4	22.8	26.9
2 (Large)	6.5	0.154	18.4	17.7	22.3	24.2
3 (Small)	6.7	0.149	23.8	17.6	26.6	24.3
4 (Small)	8.8	0.114	22.2	20.4	26.4	29.2

Experimental data is from Rueppell et al [33] and model results were obtained by running the model for 40 days (approximately the observational period used by Rueppell et al). At the start of each model run  $H=9000$  for large colonies and 4500 for small colonies and  $F=0$ . The parameters were  $L=2000$ ,  $w=27000$ ,  $\alpha=0.25$  and  $\sigma=0.75$ .

doi:10.1371/journal.pone.0018491.t001

Khoury et al. 2011. PLoS ONE 6(4): e18491.



BEEHAVE, Becher et al., in prep.

How much does this information add to the credibility of the models?

# SUMMARY

- **How can decision makers assess and use models?**
- **Idea of TRACE still good, but**
- **Update needed**
- **Link TRACE and Evaluation**
- **On the basis of this, define assessment criteria ("score sheet")**

