



METIER Graduate Training Course
“Ecological Modelling”

22 May – 2 June 2008, Leipzig & Bad Schandau (Germany)

Lecture 1: **Introduction into Ecological Modelling**

Part I: General concept and methodology

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I. Modelling - The general concept

Central question: What is a model?

The answer:

A first project: How many cylinders will go in this room???



First lessons learnt about modelling

- „Rule No. 1“: Role of the question to be answered
- Focus on the relevant factors
- But: Way of abstraction also depends on:
 - conceptual ideas on how to describe the problem (theory, concepts, underlying assumptions etc.)
=> may be specific for the different disciplines involved!
 - available data, resources (e.g. time, equipment)

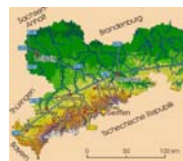
I. Modelling - The general concept

A second example: Maps

Saxony,
Germany



political organisation



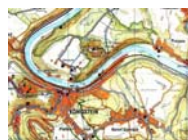
topography



river catchments

One system – different topics – different models

Note: Never a model for a system, only for a question!



Importance of the scale of the question

- => relevant factors, entire model structure;
- => planning of experiments, data sampling etc;

II. Different purposes of modelling

Incomplete list

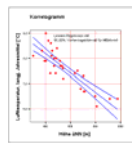
- **Forecast**
- Mechanistic **understanding** of system's dynamics
- **Management** recommendations
- **Generalization** (esp. range und limitations of applicability);
not for every new situation a new study, rough orientation
for a broader range of cases
 - => basic principles, new hypotheses
 - => theory building & experimental design
 - => tools for decision-support
- **Communication** with the society

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III. Different approaches of modelling

Statistical modelling



- Important class of models, esp. in empirical research
- Data-based, descriptive, correlations
- Supports extrapolation / prediction
- BUT: „black box“,
no understanding of mechanisms and causality



Shortcoming: Ecological dynamics in face of change processes

Process-based dynamic modeling

- Factors, mechanisms/processes, causal relationships
- Time-development of complex systems
- Insight into the „clockwerk“



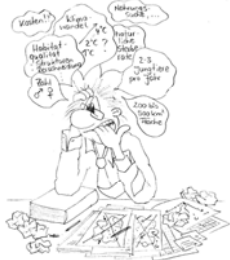
Special focus of this course:
Role of organisms' interaction and response to their environment

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IV. Dynamic modelling: When is it useful?

Two typical situations



Caricature: Doris Böhme, UFZ

Case A

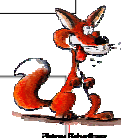
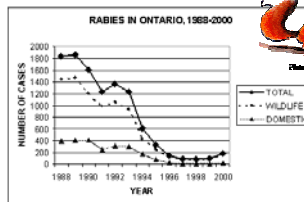
Available data on various details

BUT: No idea about their interplay and the long-term effects on the overall system

Case B

Certain pattern to explained (exp. waves for spread of rabies)

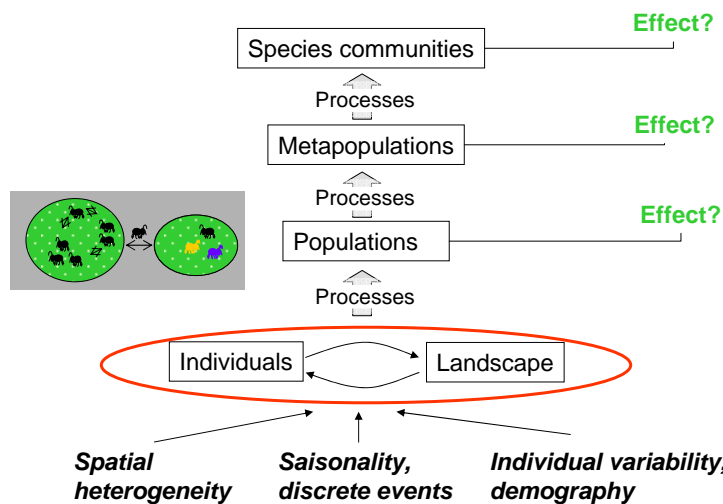
BUT: Missing information on details
=> Test of hypotheses



Models = Tools for thinking!

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V. Challenges of modelling ecological systems



Complex organismic interactions and biological variability

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***One way to approach this problem:
Rule-based modelling***