Stock assessment and genetics inputs

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Outline

- ➔ Stock assessment and genetics inputs
- ➔ The costs of ignoring stock structure

Part 1

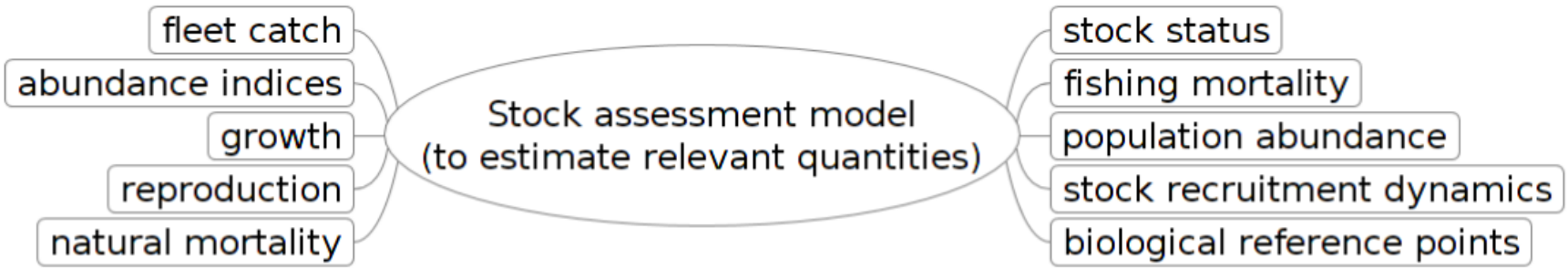
Stock assessment and genetics inputs

What's a stock assessment ?

A method to estimate the status of a stock in terms of its exploitation and conservation levels, usually in relation to reference points.

A number of ecological and statistical models are used to carry out this analysis, including a stock assessment model, stock-recruitment model, projection algorithms, capture-recapture models, ...

I/O

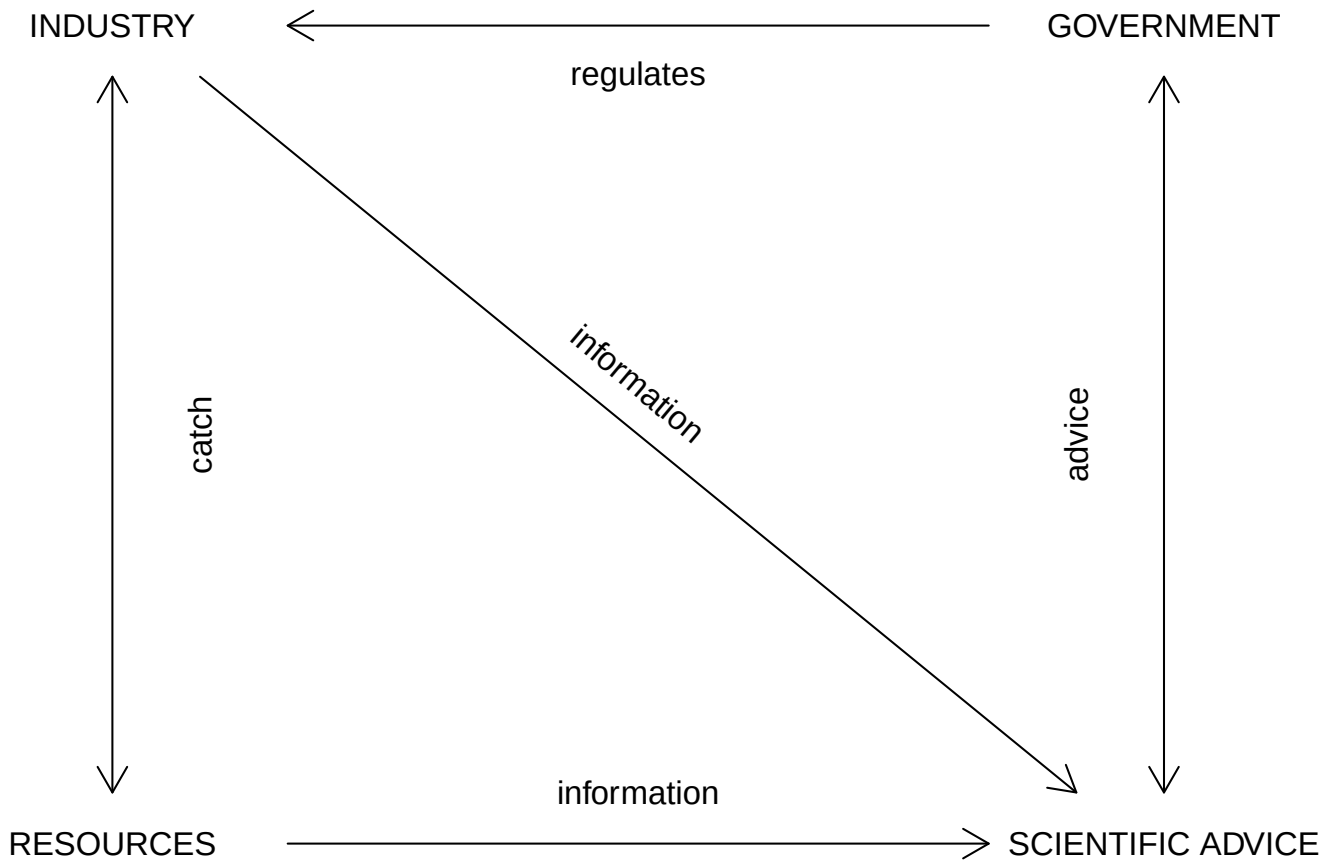

fleet catch
abundance indices
growth
reproduction
natural mortality
Stock assessment model
(to estimate relevant quantities)
stock status
fishing mortality
population abundance
stock recruitment dynamics
biological reference points

What's a MSE ?

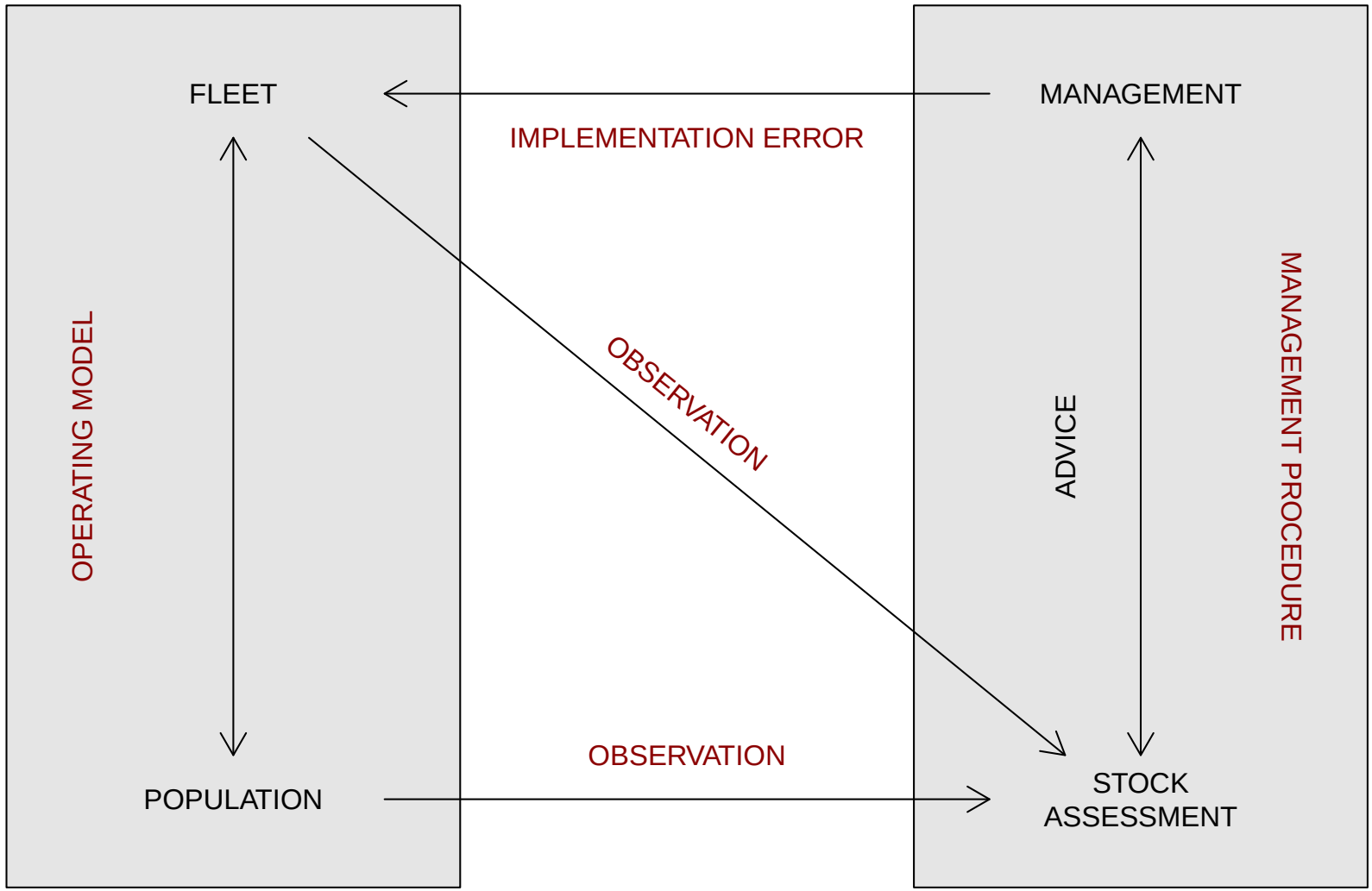
Process to test management options, also called management procedures, which includes:

- ➔ an interactive discussion with stakeholders and policy makers, and
- ➔ a simulation study of the impacts of those management options in the stock, including the decision making process.

MSE: The management cycle



MSE: overview

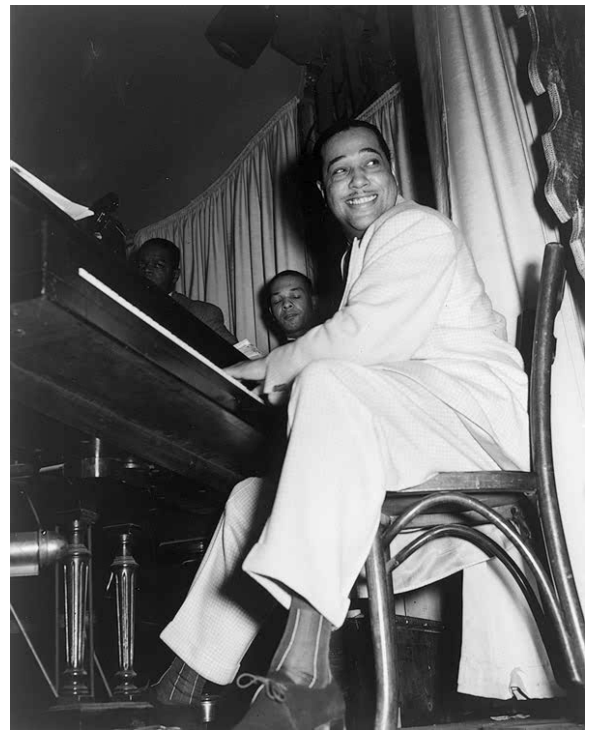


How can things be added to a stock assessment process:

- ➔ Integrate in models by plugging into their structure, e.g. an environmental index is used to extend a stock recruitment relationship and better estimate the stock's productivity;
- ➔ As external covariates which partitions the data into more precise subsets, e.g. allocating TACs taking into account sub-populations;
- ➔ Set scenarios for forecasting or testing management options, e.g. taking into account effective population size.

When does genetics matter ?

It Don’t Mean a Thing
(If It Ain’t Got That Swing)



When does it matter ?

When genetic based variation [translates] into ecologically-significant traits (Carvalho, *dixit*)

Stock assessment example

Part 2

The cost of ignoring population structure in stock assessment

PLOS ONE

RESEARCH ARTICLE

Testing spatial heterogeneity with stock assessment models

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Paper

- Simulation study
- Atlantic sardine
- North Sea cod (**focus**)

Theoretical base

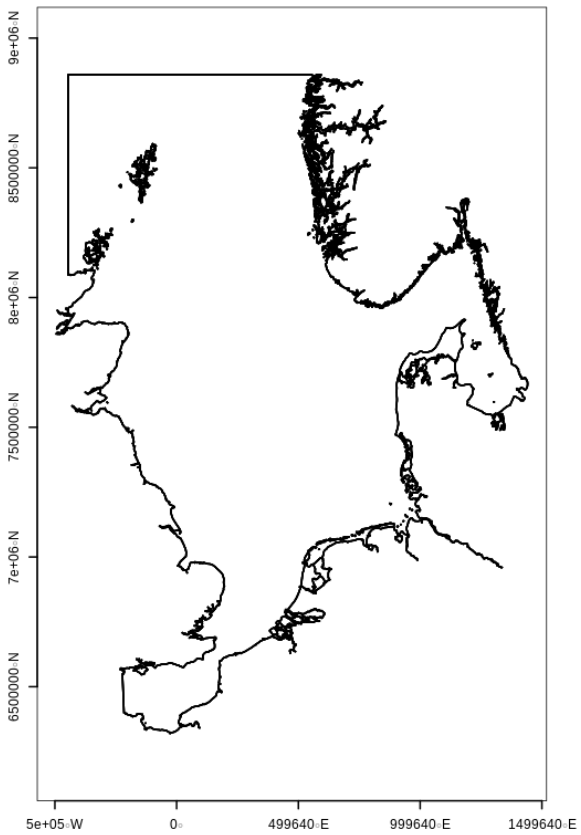
$$N = \sum_{j=1}^{m} N_j$$

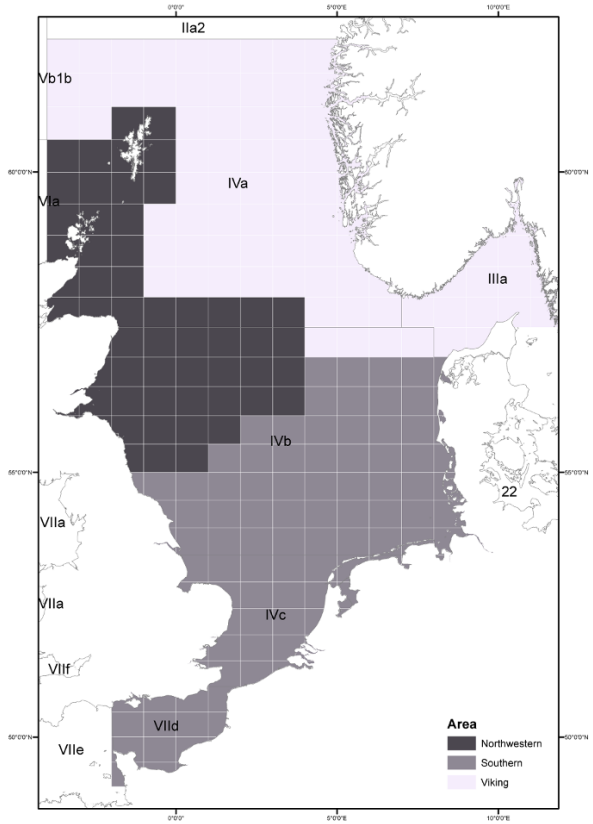
where N is abundance and j indexes sub-populations

Theoretical base

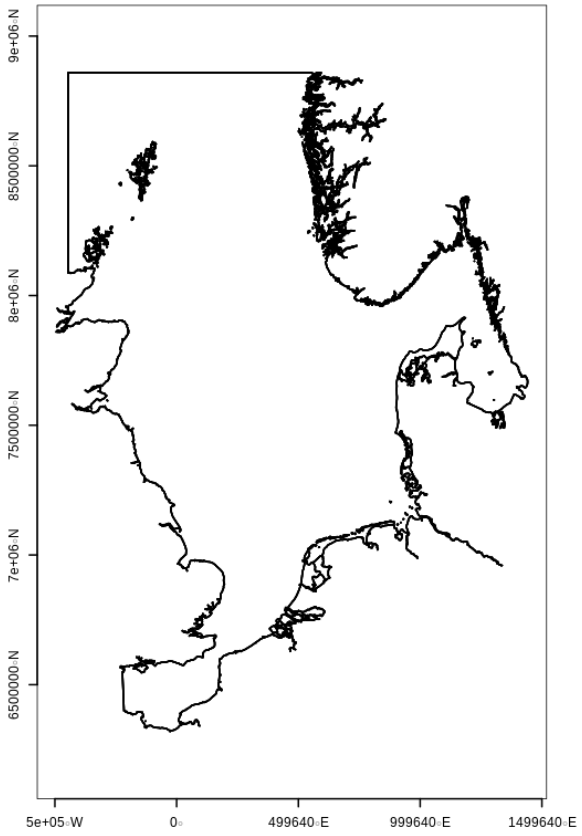
If each sub-population is closed, in the sense of not having significant migrations across sub-populations, the estimates of **abundance** obtained from stock assessment models fitted to each sub-population will **add up** to the estimates obtained from the meta-population fits.

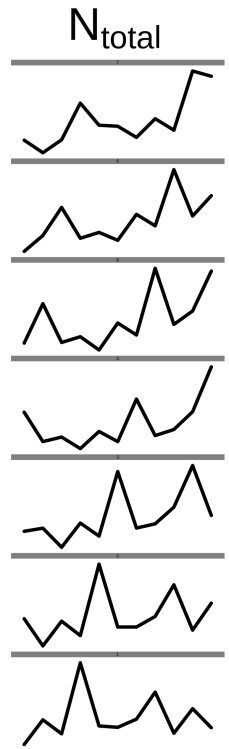
Meta-population and sub-populations



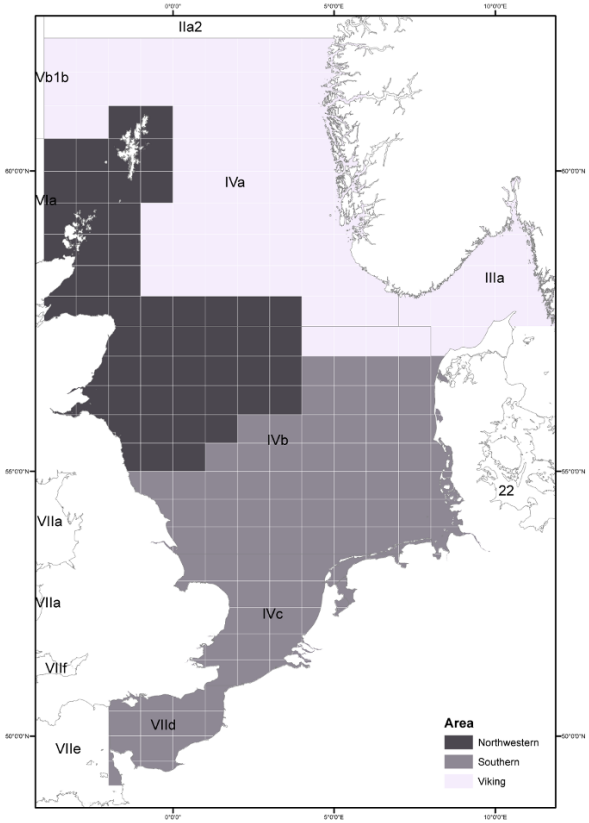


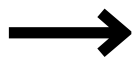
Meta-population abundance

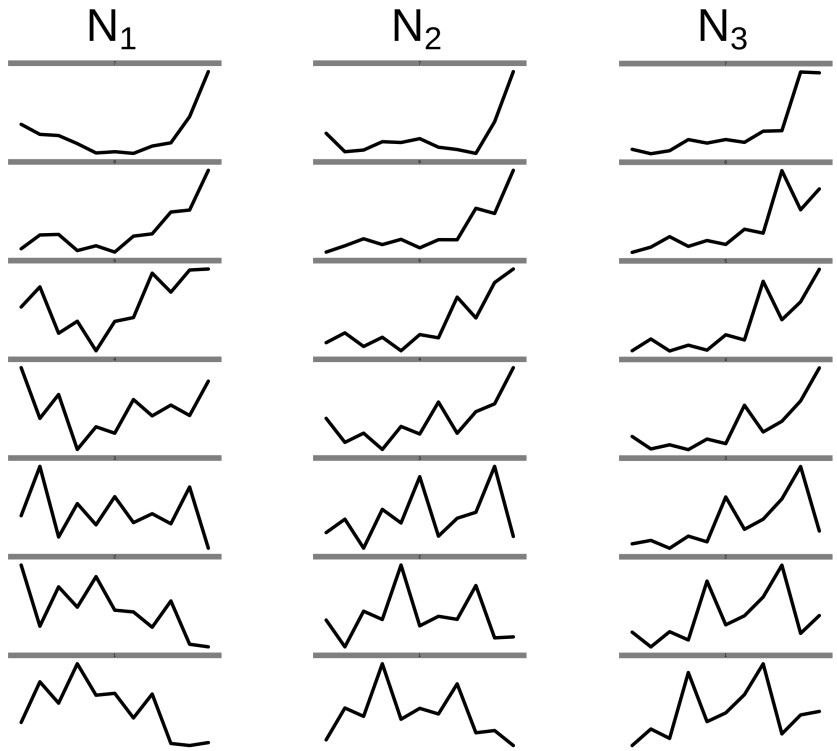




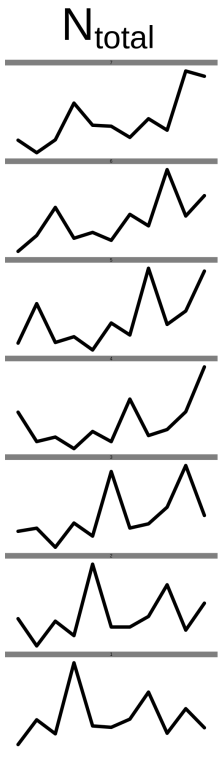
Sub-populations abundance







Compare ?



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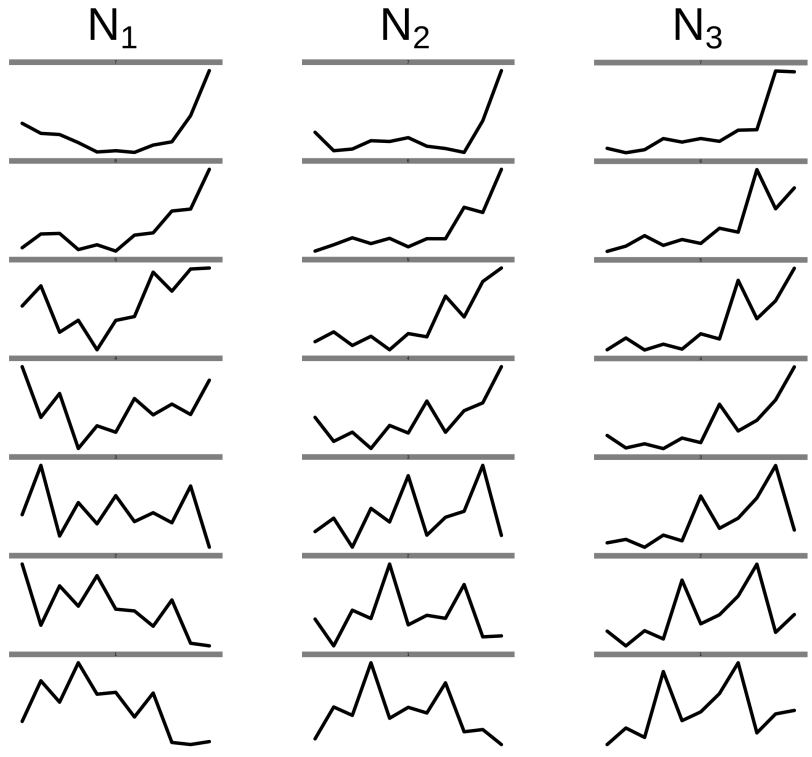
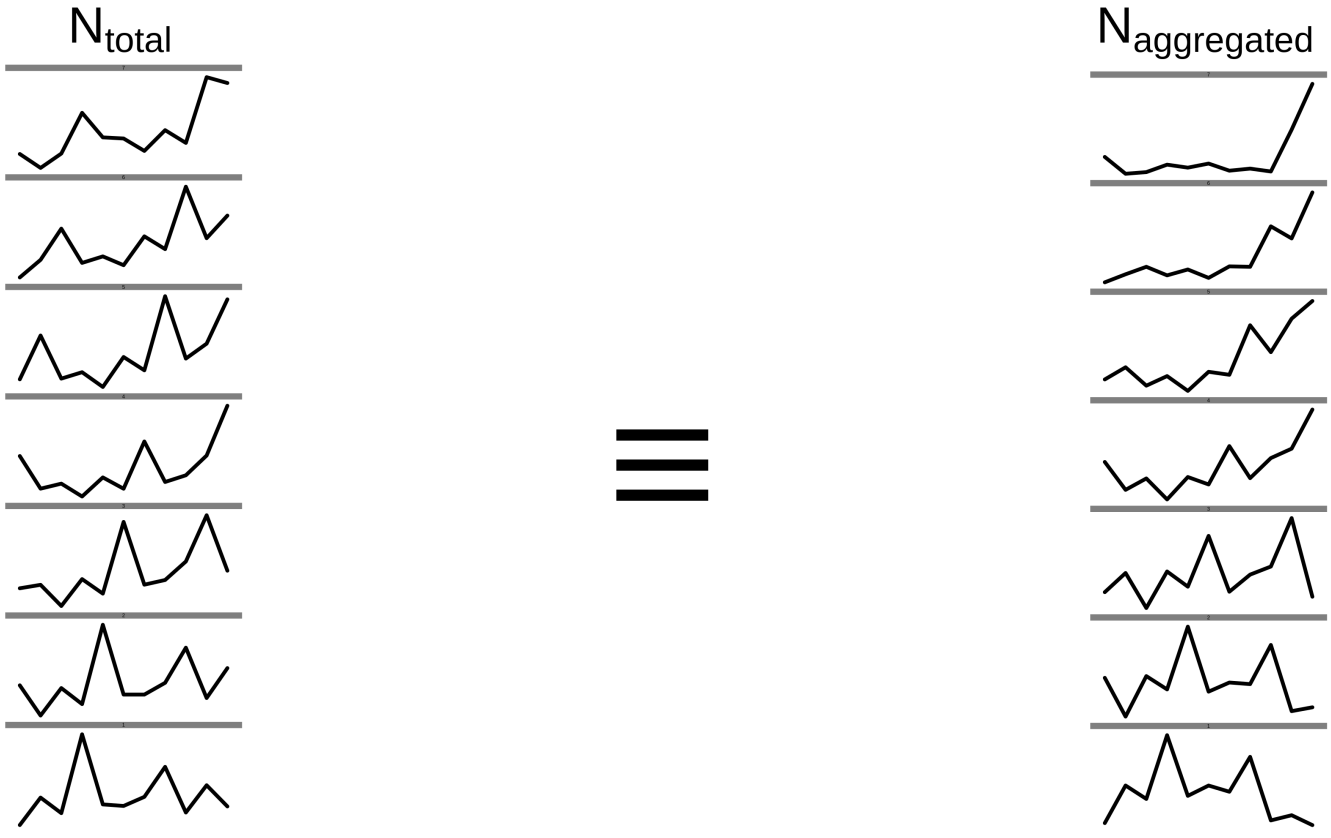
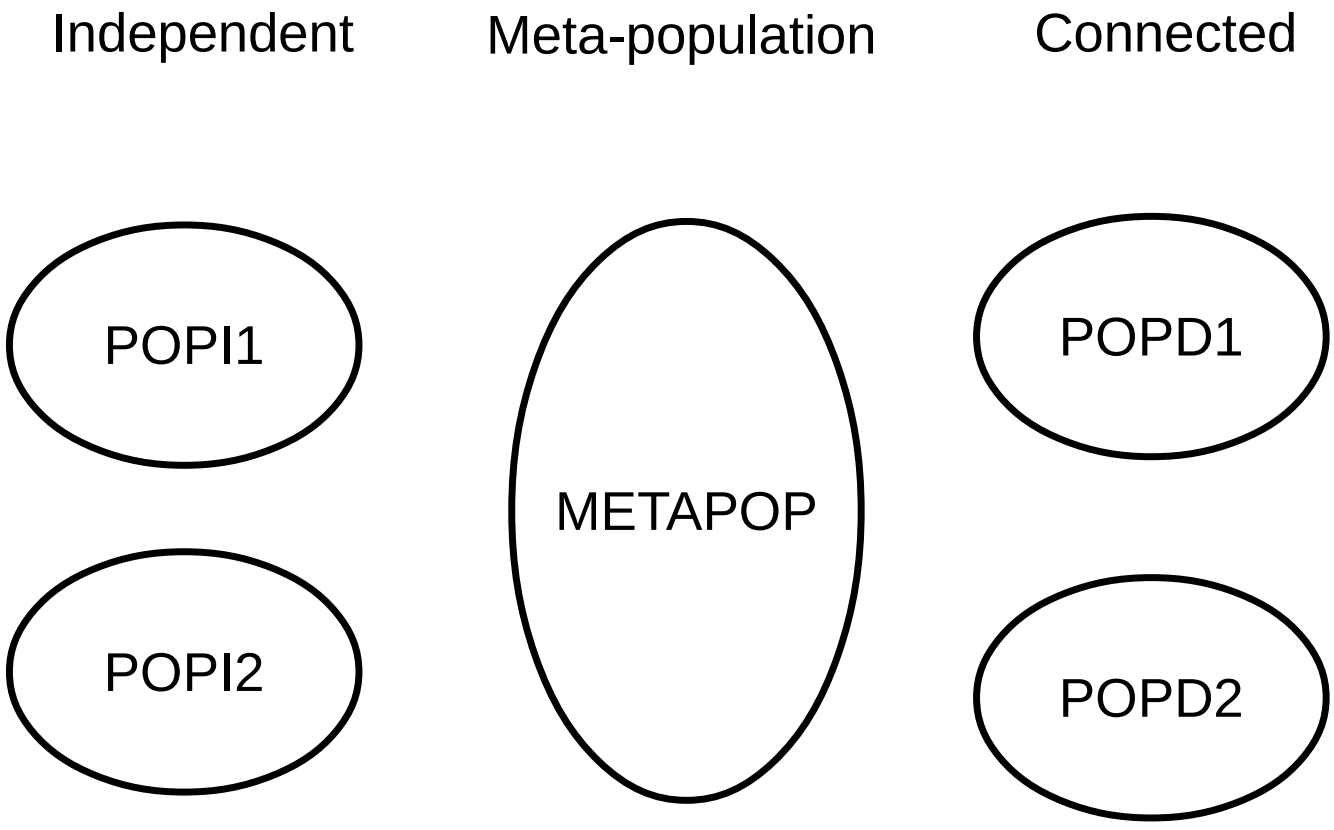


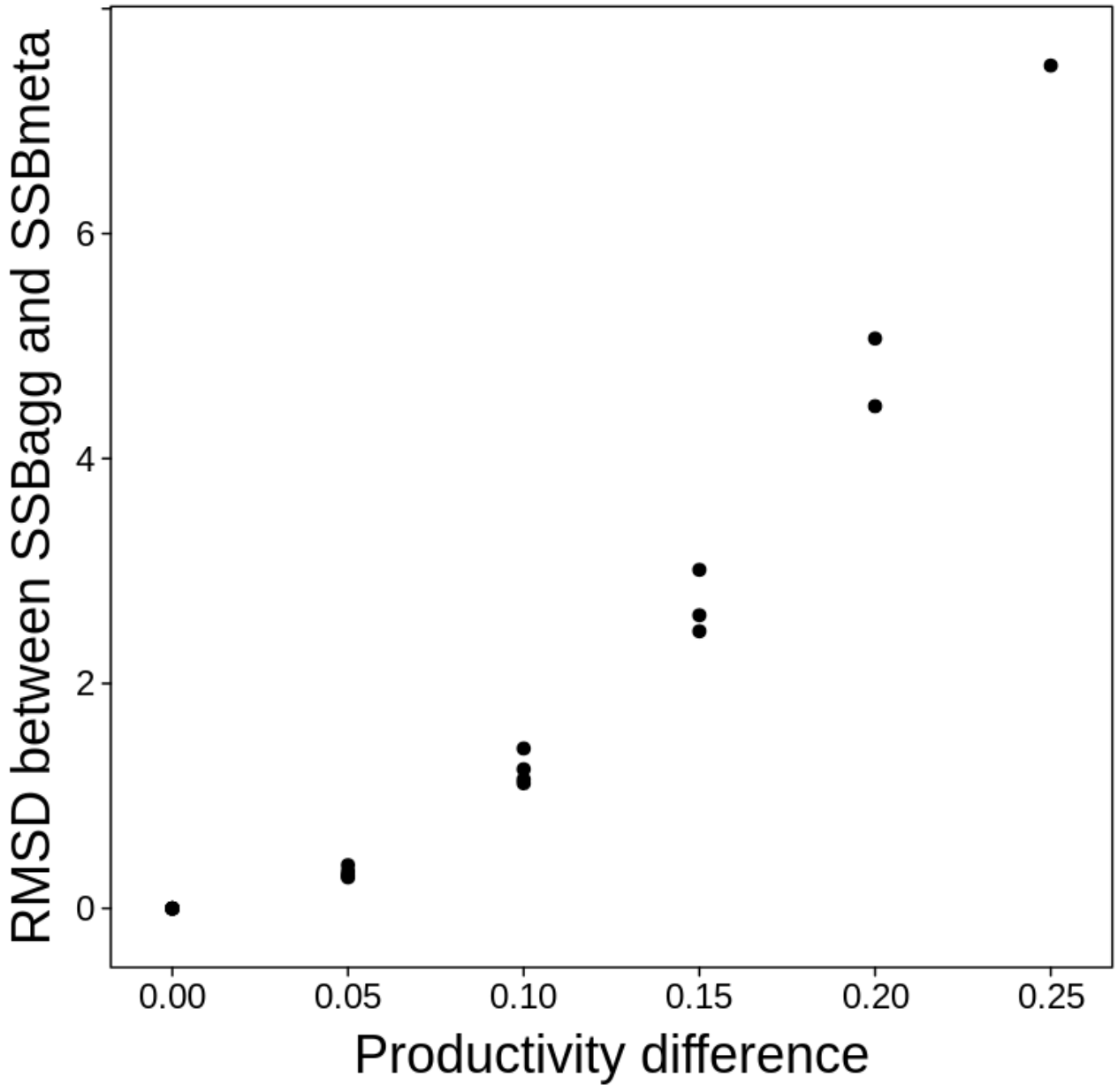
Compare !



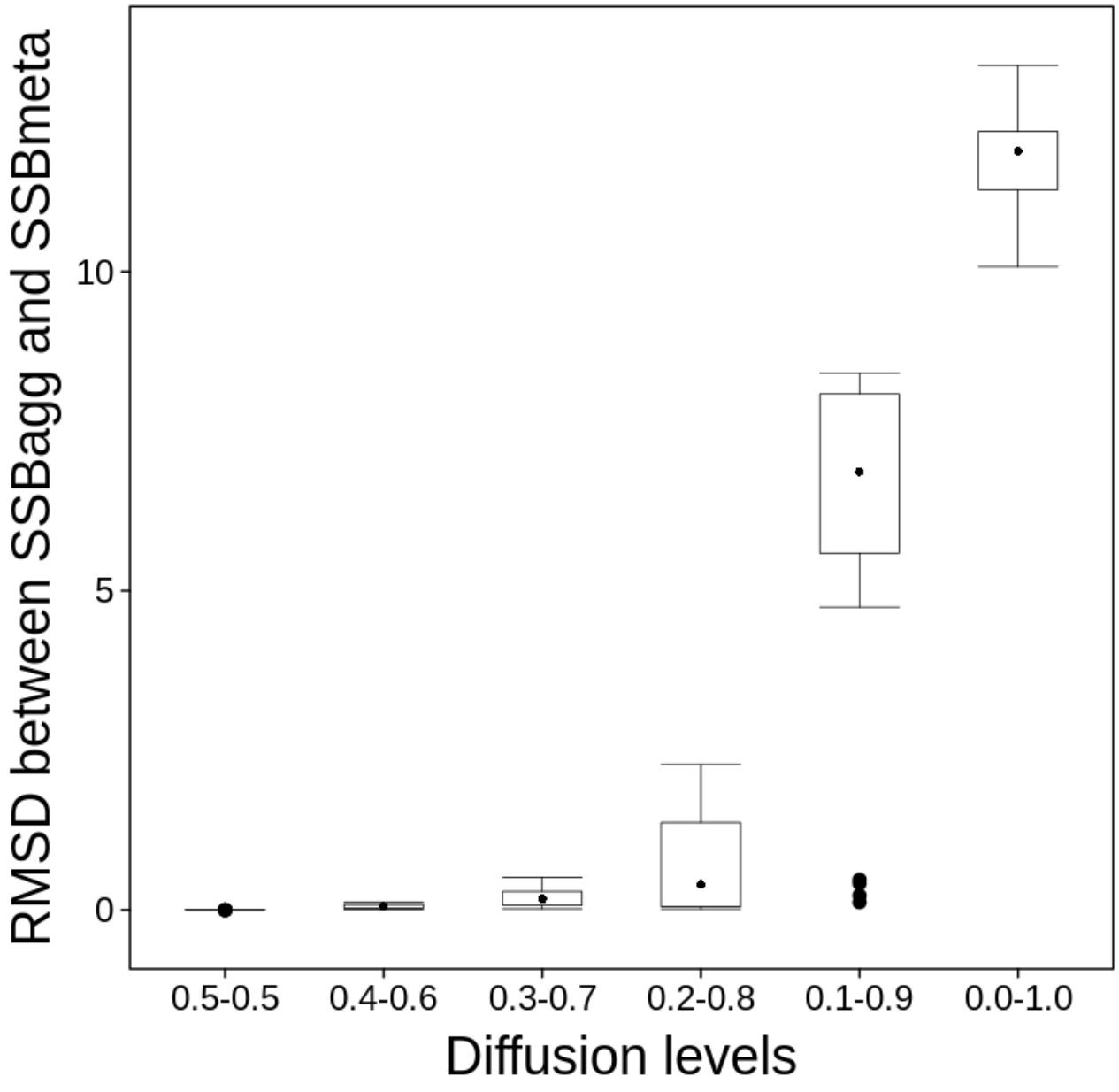
Simulation study



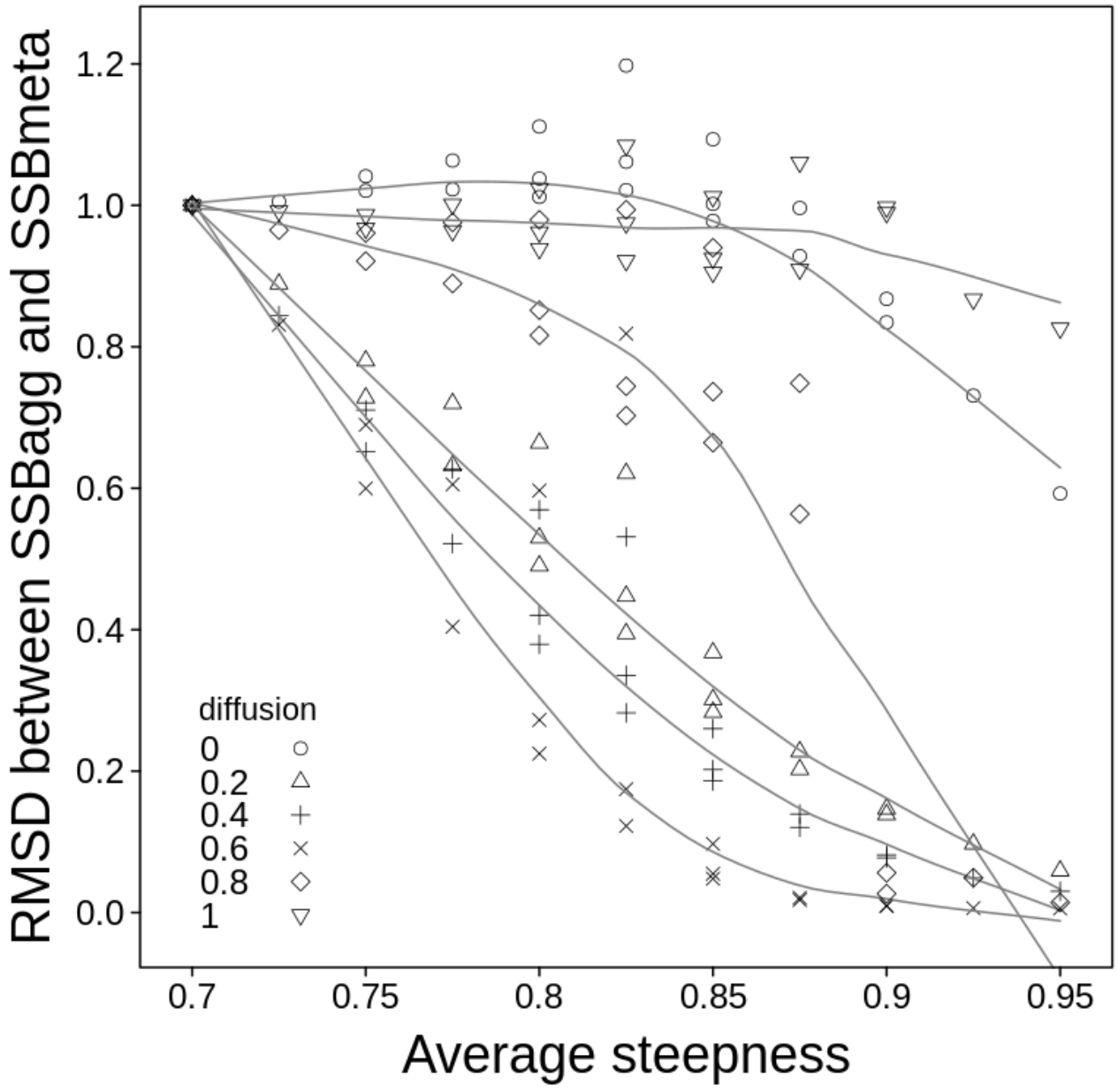
Steepness effect for independent populations



Diffusion effect for connected populations



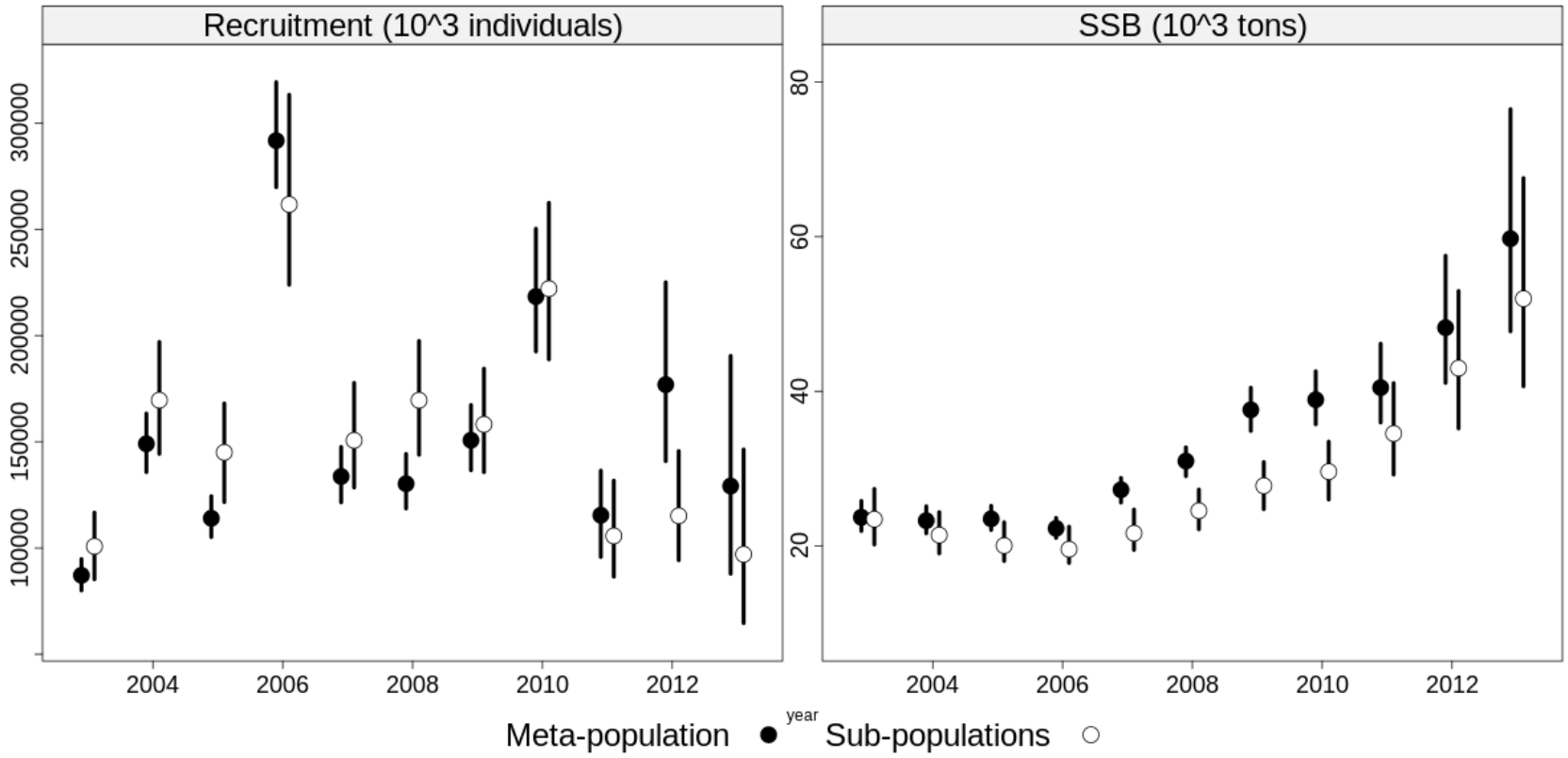
Productivity effect for connected populations



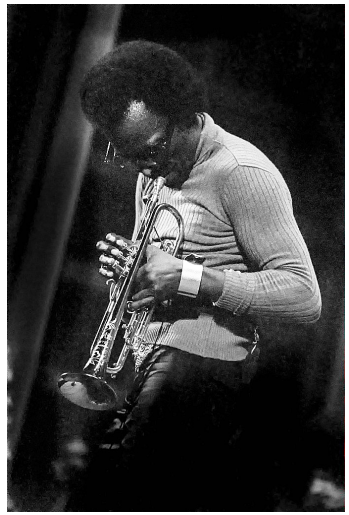
Units

How to deal with population structure in stock assessment. The north sea cod case study.

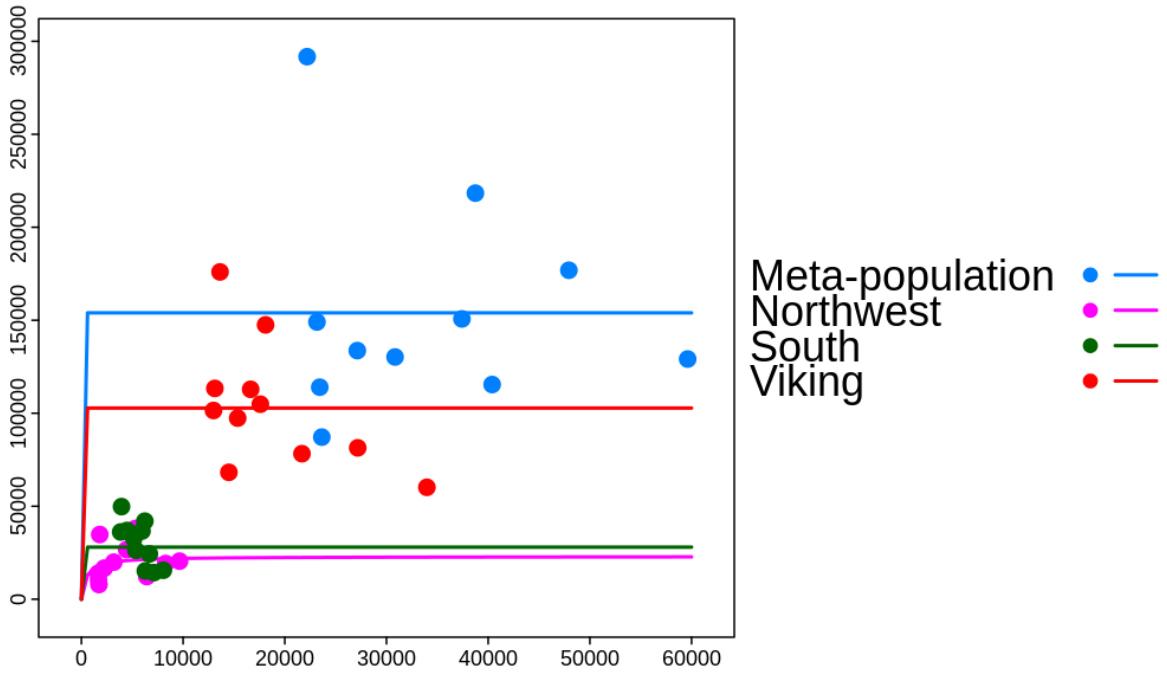
Results for North Sea cod



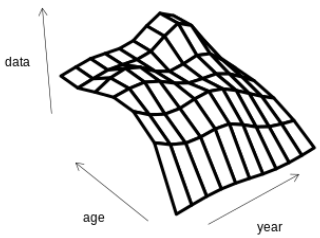
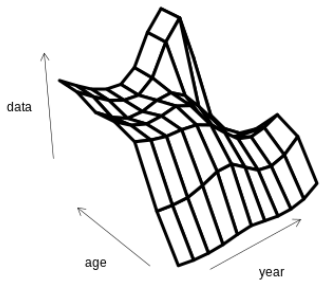
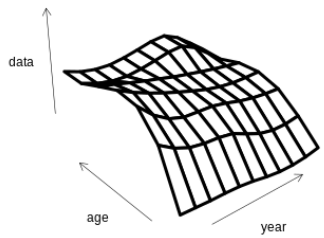
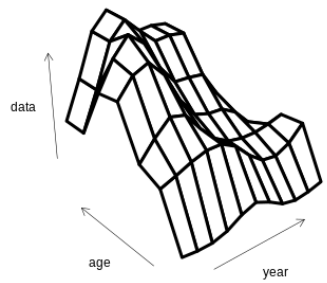
So what !?



Results: stock-recruitment



Results: fishing mortality

Meta-population	Viking	Northwest	South
			

No panacea ! there are constraints !

➔ The initial hypothesis of sub-population spatial dynamics must be based on information sources designed for such studies, like morphometrics, genetics, tagging, etc.

... and lots of work ...

➔ Input data for stock assessment must be reprocessed !

Main message

Meta-population theory and stock assessment models can be combined to study spatial heterogeneity, allowing the development of regional management actions.