

UCL

Université
catholique
de Louvain



Part of PhD project

Comparing population and individual-based viability analysis models for the Bog Fritillary butterfly



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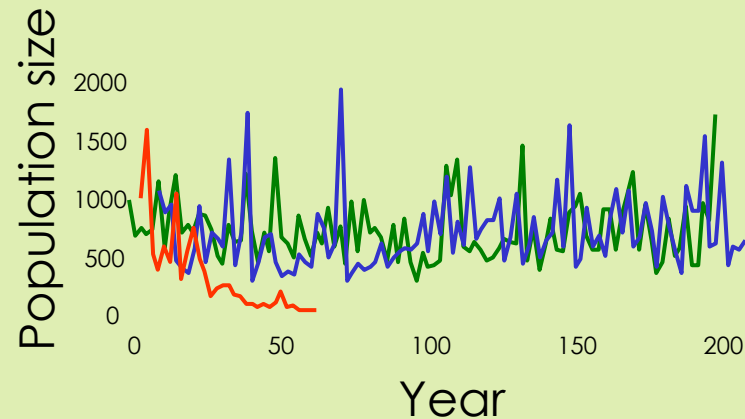
Population Viability Analysis (PVA)

Input

Biological data
Landscape data



PVA = Stochastic simulation
model of population
dynamics

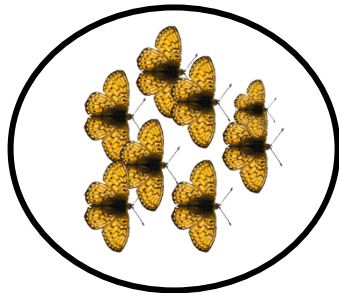


Output

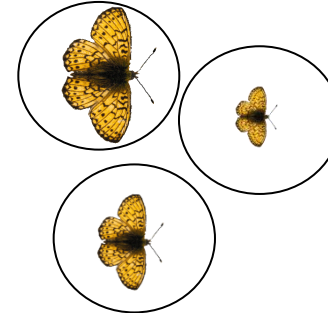
Extinction risk curves
(Meta)population
size
....

Model types used in PVA

Structured
population
model (SPM)



Individual-
based model
(IBM)



Individuals
are similar

Individuals
are different



Preceding stage

	Egg	Larva	Pupa	Adult
Egg	0	0	0	77
Larva	0.75	0	0	0
Pupa	0	0.025	0	0
Adult	0	0	0.67	0

Succeeding
stage



Comparison of IBM and SPM under the pressure of species extinction

Conservation biology is a
“**crisis discipline**”



Trade-off between
model precision and
investment

We compared IBM and SPM in terms of:

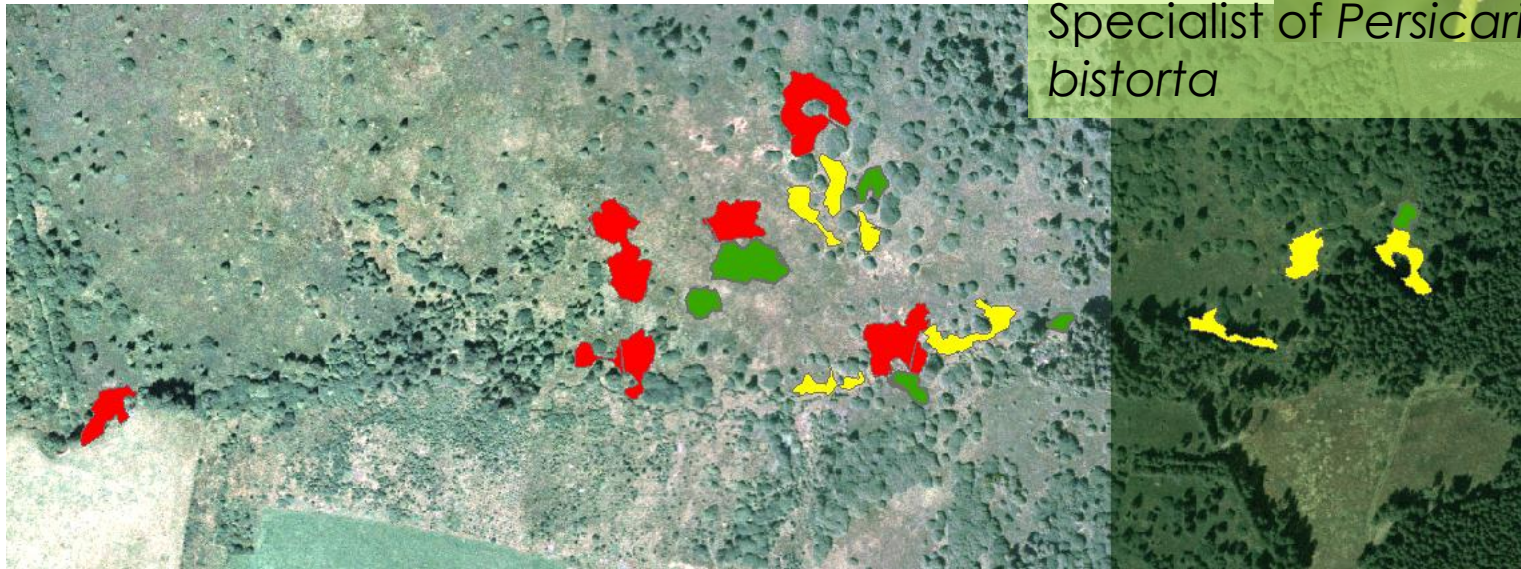
- Baseline scenarios
- Fit to the field data
- Ranking of a set of climate change scenarios
- Time and data resources required for model development and exploitation

Boloria eunomia in Belgian Ardenne

Pisserotte peat bog reserve
Area = 28.92 ha
Cell = 10.45 m²

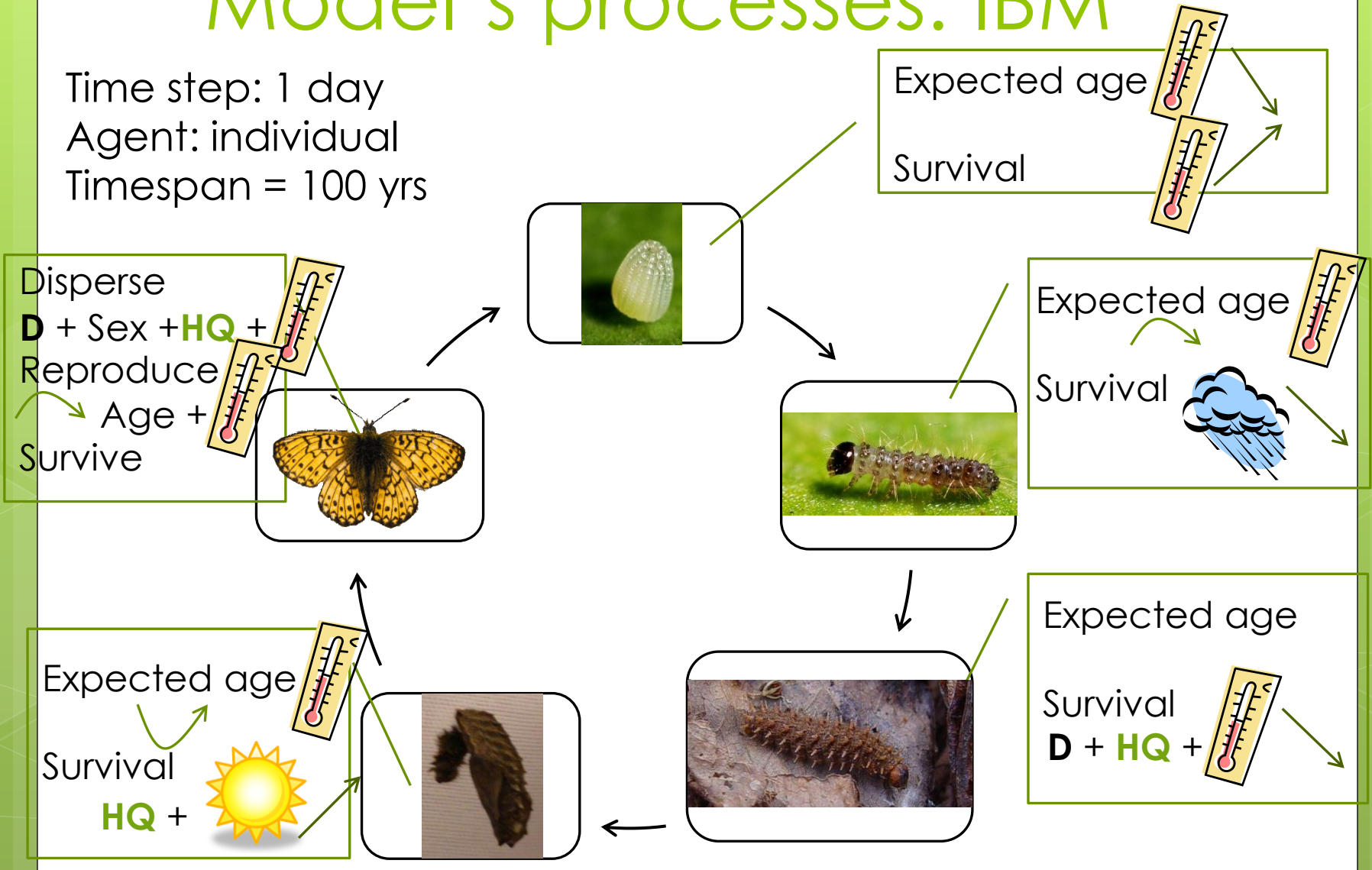


Univoltine species
Specialist of *Persicaria bistorta*



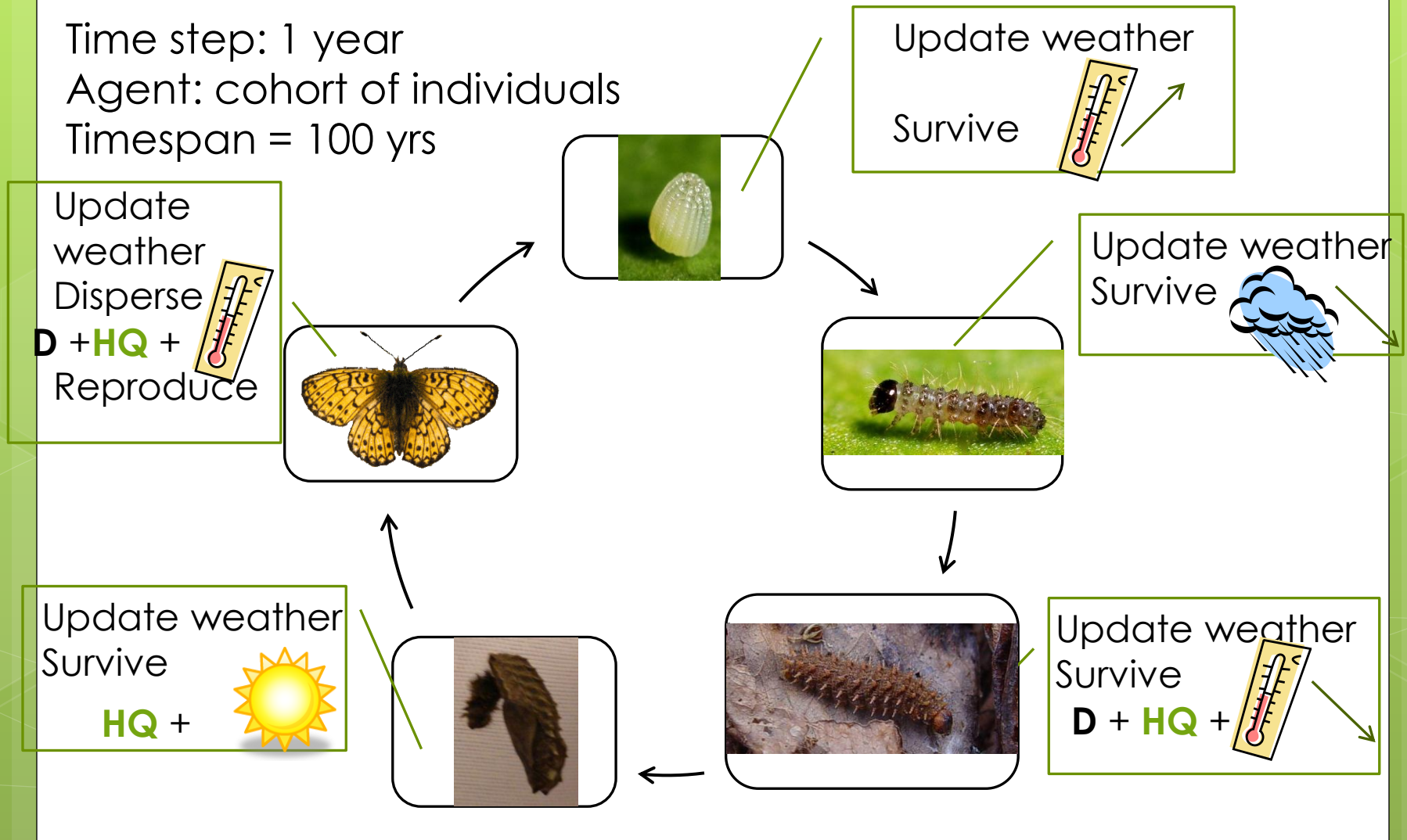
Model's processes: IBM

Time step: 1 day
Agent: individual
Timespan = 100 yrs



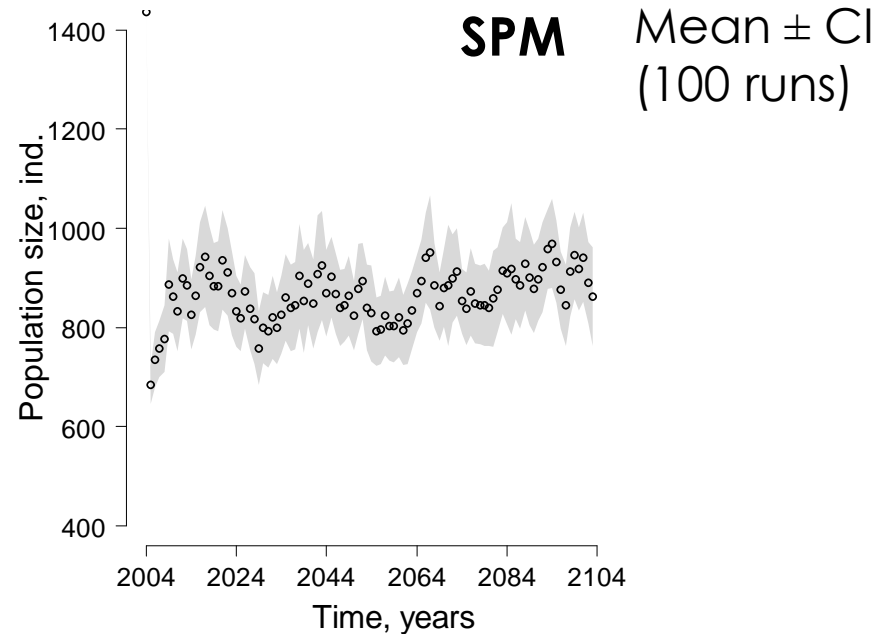
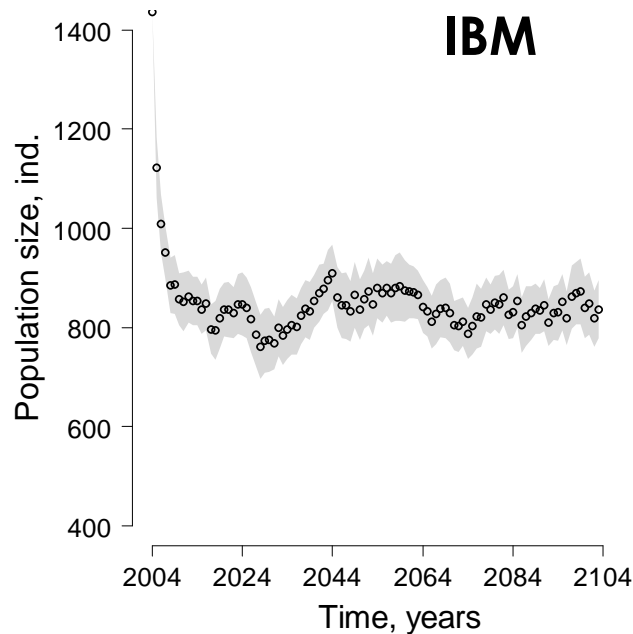
Model's processes: SPM

Time step: 1 year
 Agent: cohort of individuals
 Timespan = 100 yrs

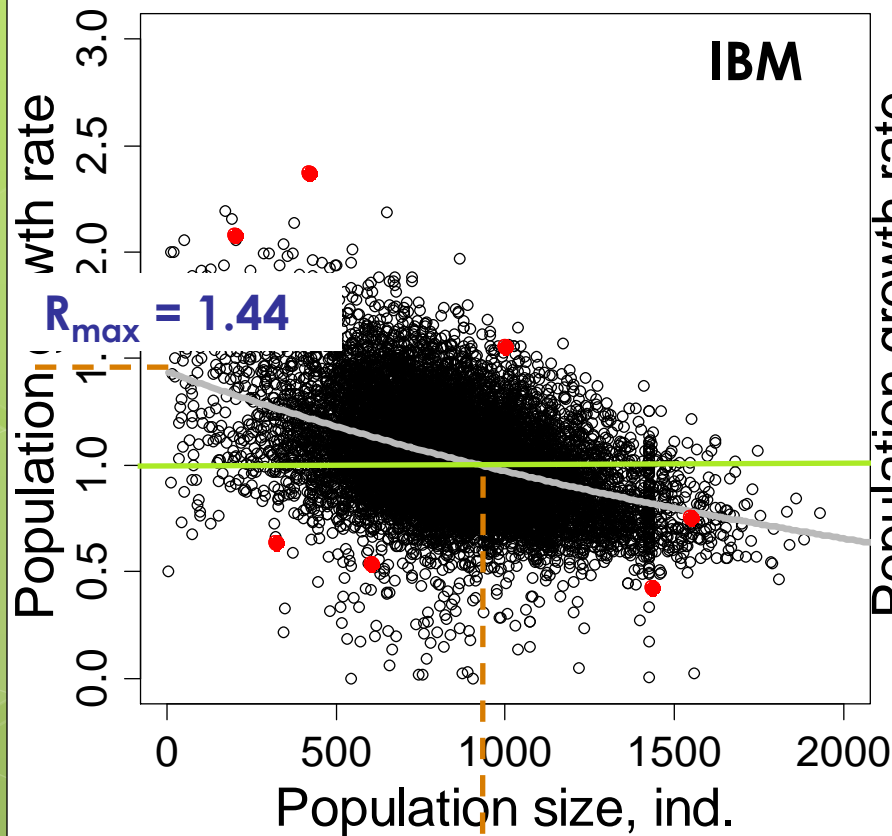


Comparison of baseline scenarios

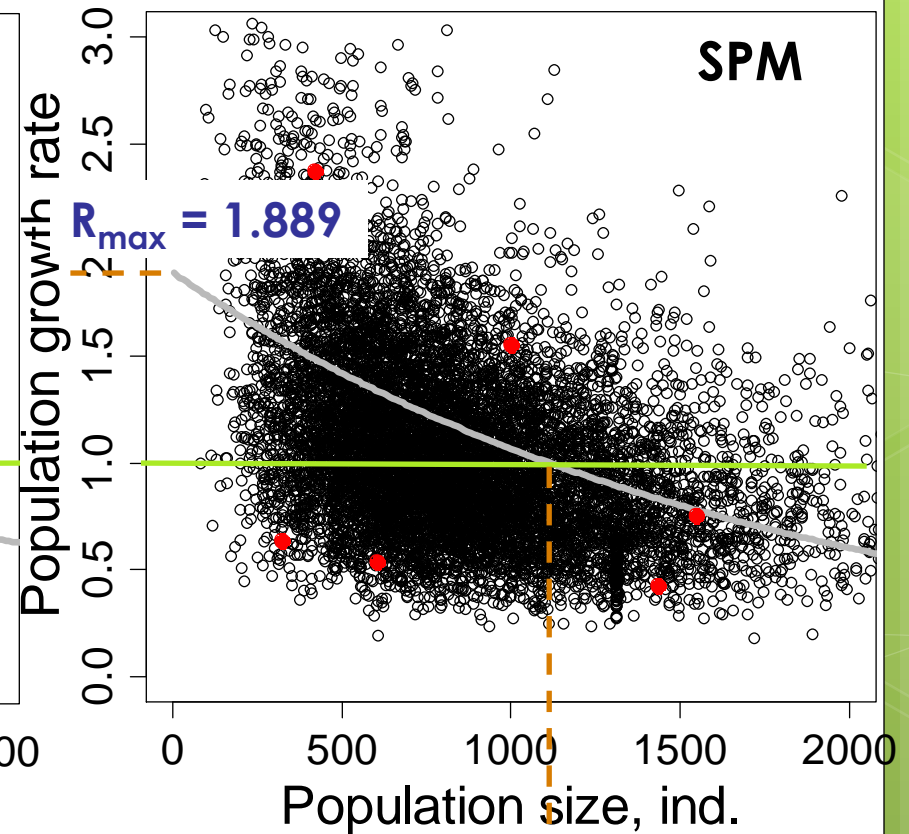
Viability measure	SPM	IBM
Average population size	869	844
STDEV population size	401	264
Geometric mean of growth rate	0.994	0.992
Geometric STD of growth rate	1.509	1.332



Density dependence arising from both model types

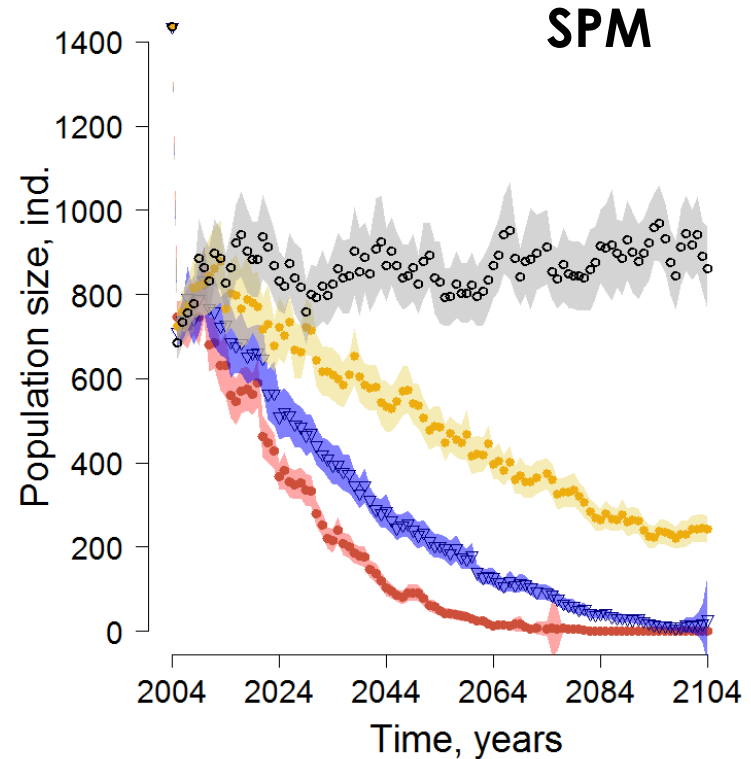
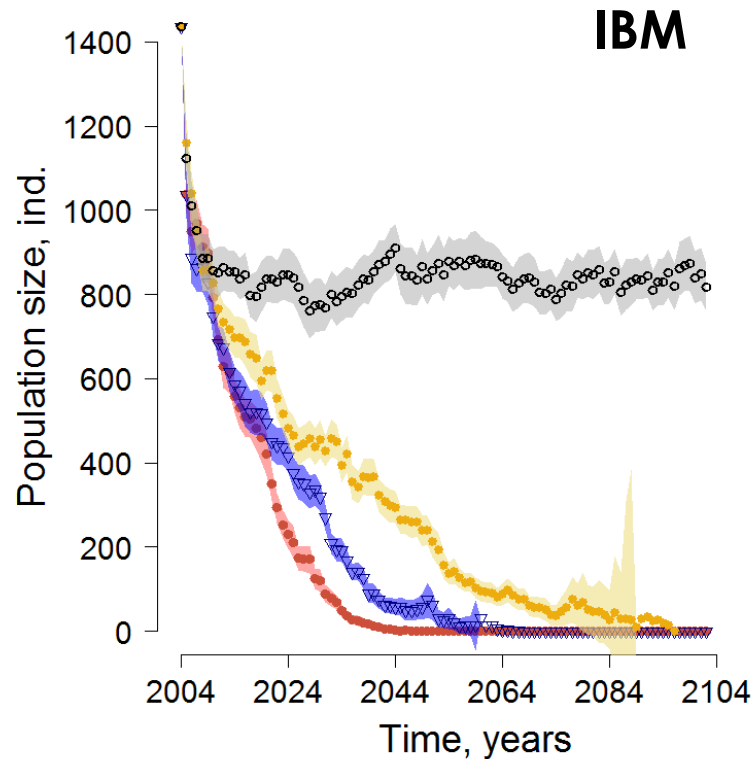


K = 927 ind.



K = 1116 ind.

Comparison of climate change scenario results



○ Baseline ▼ Moderate
● Low ● High

Comparison of the resources needed for both model types

Resources	IBM	SPM
Time		
a) Data collection	7 years CMR (population level): calibration 2 years lab + field experiments (individual level)	7 years CMR (population level): calibration 2 years lab + field experiments (stage survival rates)
b) Model development	360 working-days	160 working-days
c) Running time	12h 24min 19s	10min 27sec
Data		
Number of parameters	43 + 400 of average and 400 of STD dispersal rates	21 + 400 of average dispersal rates
Skills	Knowledge of a programming language	Ready available software (RAMAS, METAPHOR, VORTEX)

SPM is sufficient for the development of conservation suggestions for *B.eunomia*

- Both models successfully reproduced the field observations
- Density dependence parameters are close for two model types
- The ranking of climate change scenarios is the same for both model types
- SPM is less time-consuming (developing and running time)

SPM can successfully be used to develop management suggestions to preserve the viability of *B. eunomia*



Thank you for your attention