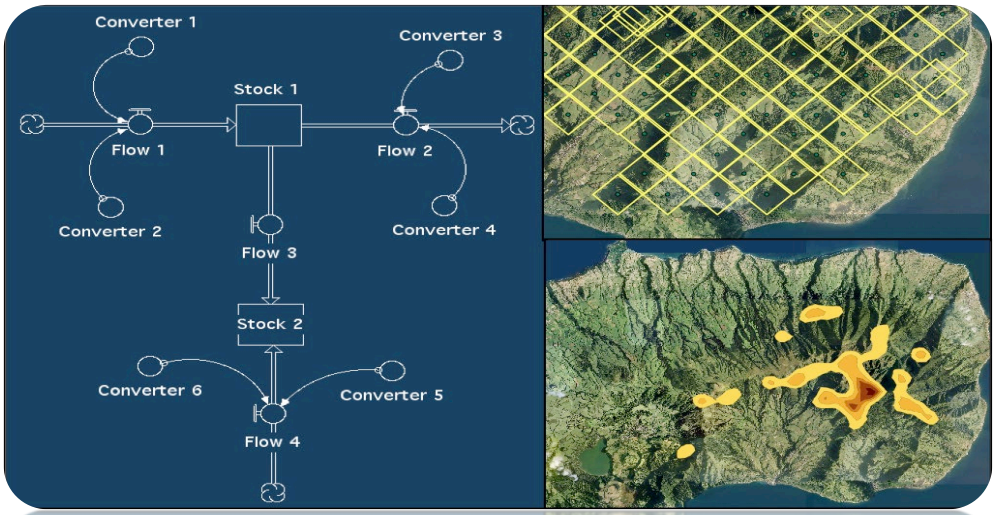
Workshop

The Stochastic Dynamic Methodology (StDM)

Fundamentals and description in practice

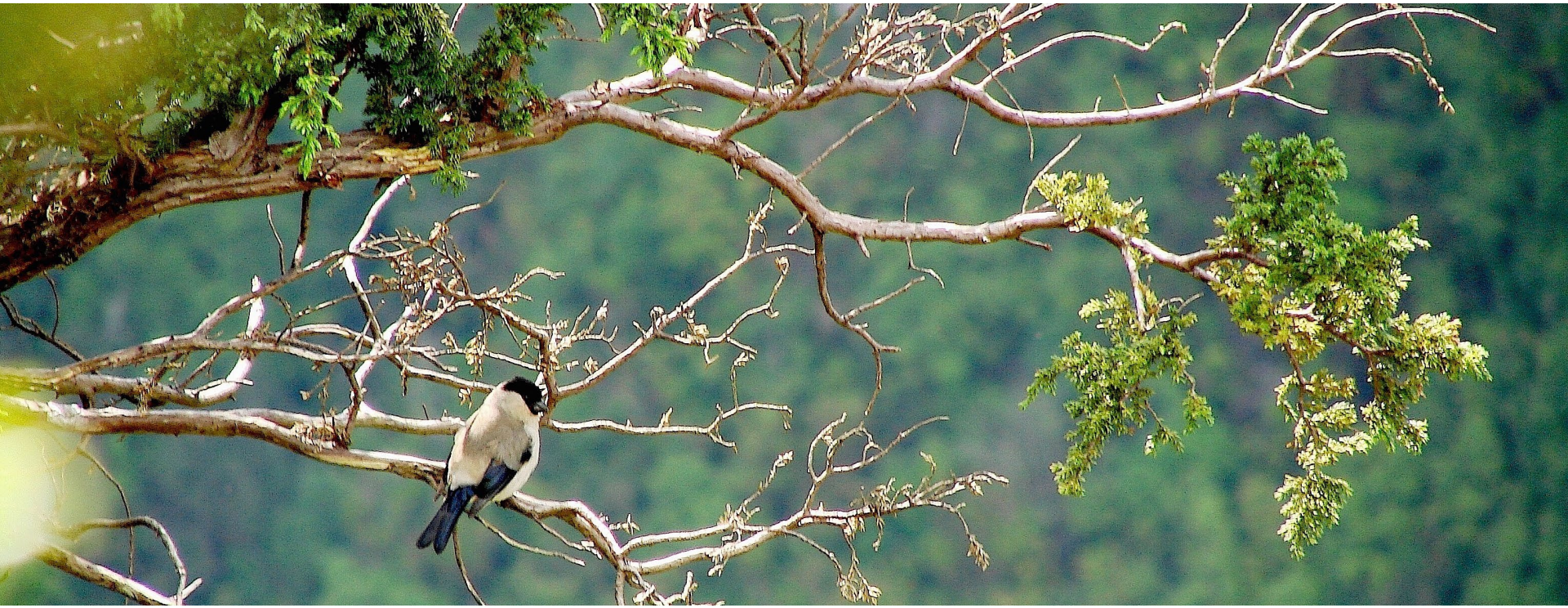
Part II



Rita Bastos, Mário Santos & João Alexandre Cabral

Laboratory of Applied Ecology, Centre for the Research and Technology of Agro-Environment and Biological Science, University of Trás-os-Montes e Alto Douro
Portugal

Testing a novel spatially-explicit dynamic modelling approach in the scope of the laurel forest management for the endangered Azores bullfinch (*Pyrrhula murina*) conservation



Bastos, R., Santos, M., Ramos, J.A., Vicente, J., Guerra, C., Alonso, J., Honrado, J., Ceia, R., Timóteo, S., Cabral, J.A., 2012. Testing a novel spatially-explicit dynamic modelling approach in the scope of the laurel forest management for the endangered Azores bullfinch (*Pyrrhula murina*) conservation. Biological Conservation, 147: 243-254.

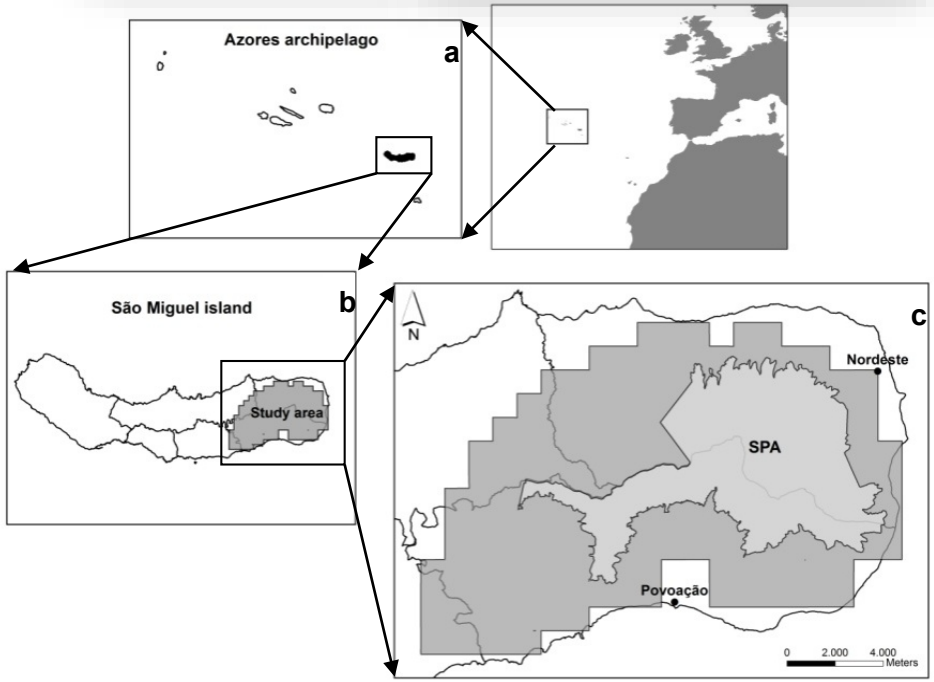
INEXT
cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY
LABORATÓRIO DE ECOLOGIA APLICADA
CITAB Centro de Investigação e de Tecnologias Agro-Ambientais e Biológicas
utad

Introduction

The Azores bullfinch
- *Pyrrhula murina*
- Azores islands (Portugal)

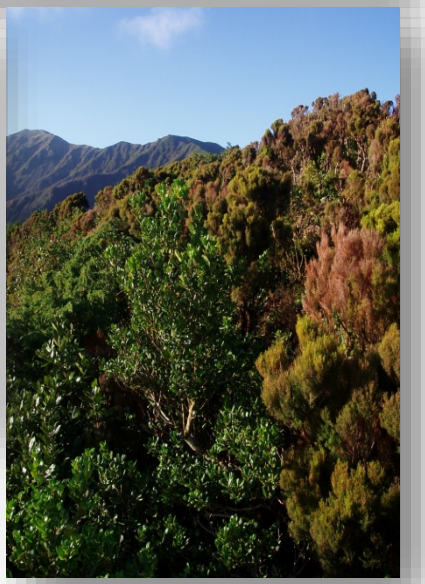
Distribution
-Serra da Tronqueira

Habitat constraints
-Land use changes
-Invasive plant species



EU Funding Programmes

Conservation status - “Critically endangered” to “Endangered” (BirdLife International)



Stochastic Dynamic Methodology

Stochastic-dynamic methodology (StDM)

captures the complexity of some ecological consequences

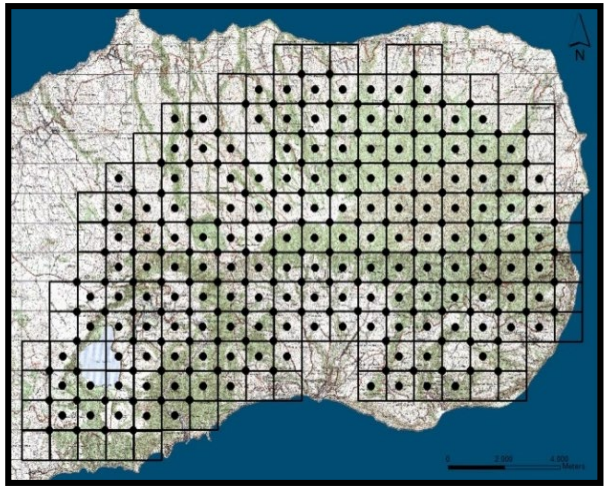
representative gradients of change

Exotic plants invasion and land use changes
(*Cryptomeria japonica*, *Clethra arborea* and *Pittorsporum undulatum*)

Sampling Strategy

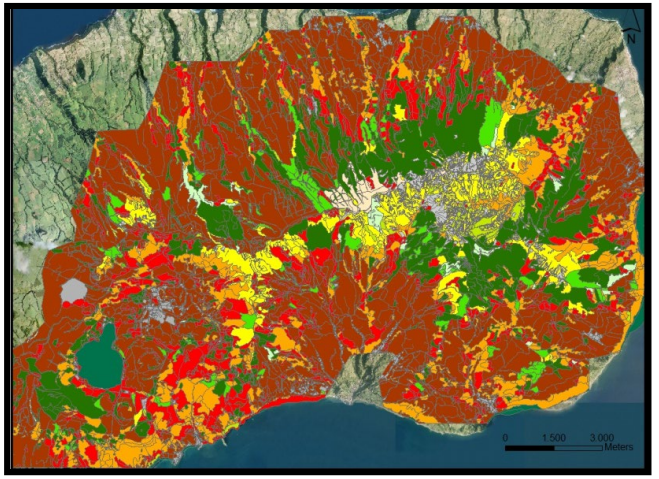
- "Atlas do Priolo" 2008
  - 50 researchers
  - 306 point-counts

  90 Azores bullfinch



- Vegetation mapping
  - Foto-interpretation and validation in the field

  Forestry areas
  Humanized areas
  Natural vegetation



Habitat characterization

Habitat classes selection:

- **Pure laurel forest**

  Laurel forest (>75%)

- **Laurel forest – initial invasion process**

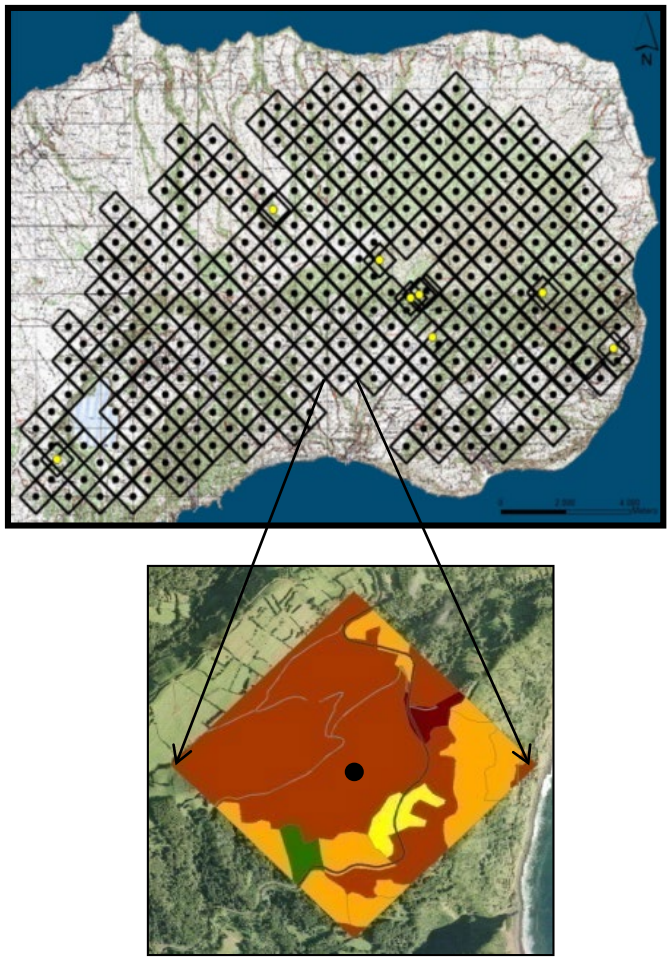
  Laurel forest (50%–75%)
  e.g. C. arborea (25%–50%)

- **Laurel forest – advanced invasion process**

  Laurel forest (25–50%)
  e.g. C. arborea (50–75%)

- **Total invaded areas**

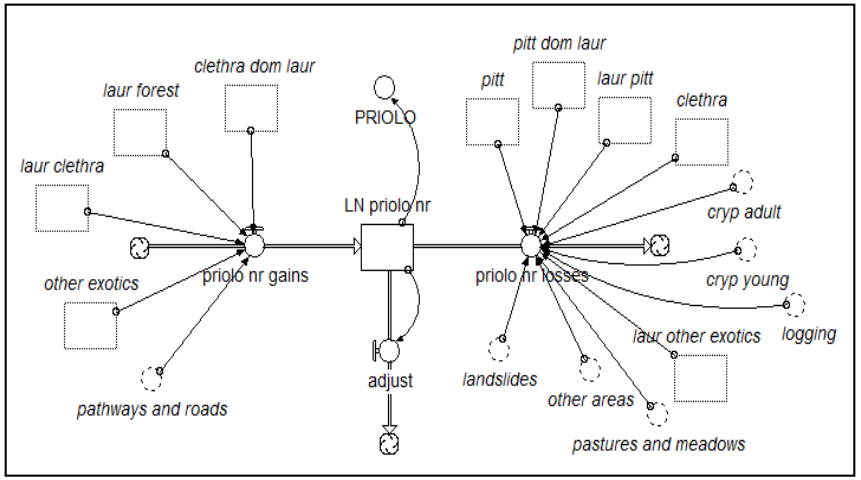
  e.g. C. arborea (>75%)



Methodology

- Data analysis
  - Generalized Linear Models – Multi-model Inference

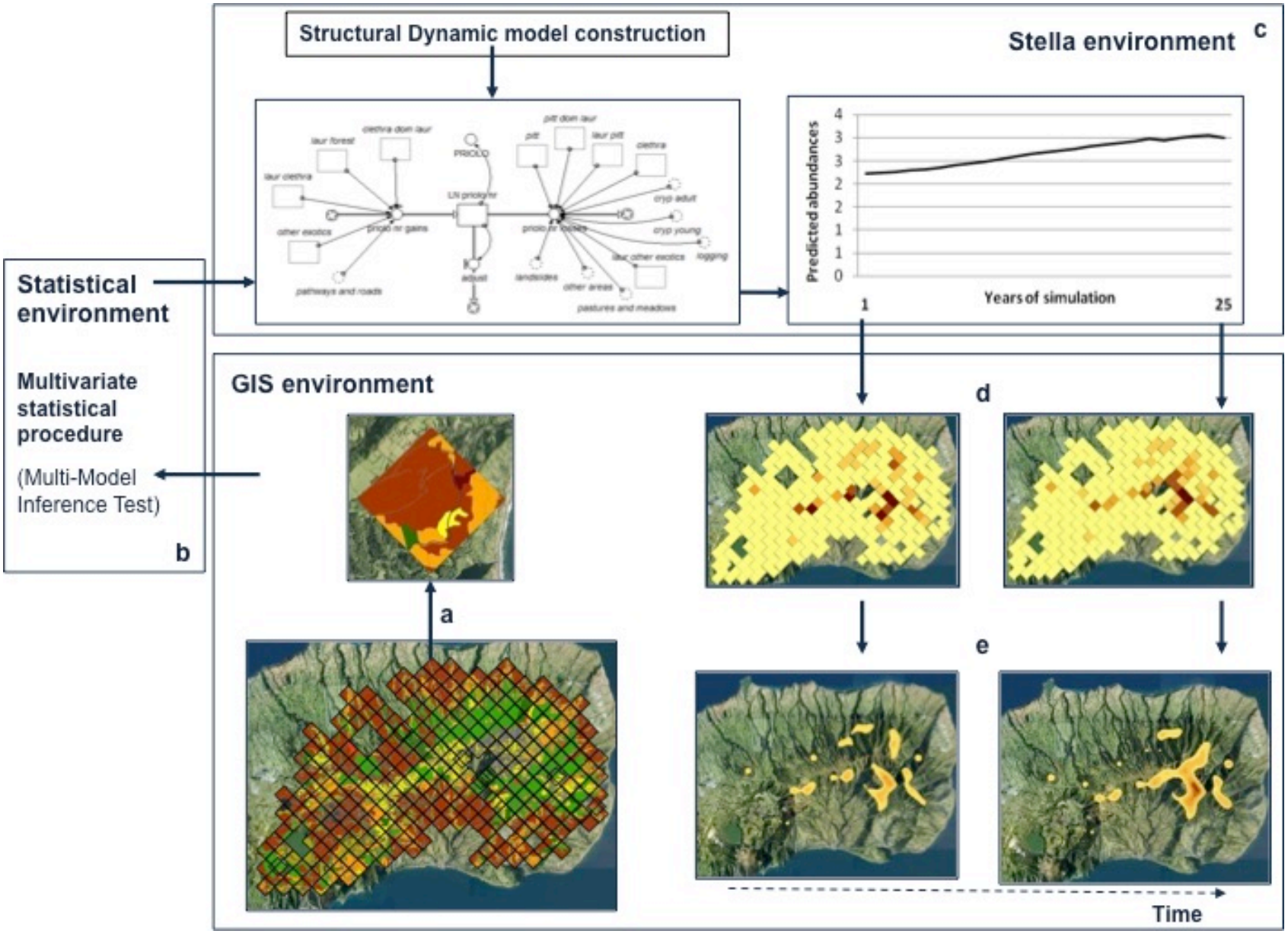
- Dynamic model construction and StDM unit



- Spatio-temporal projections

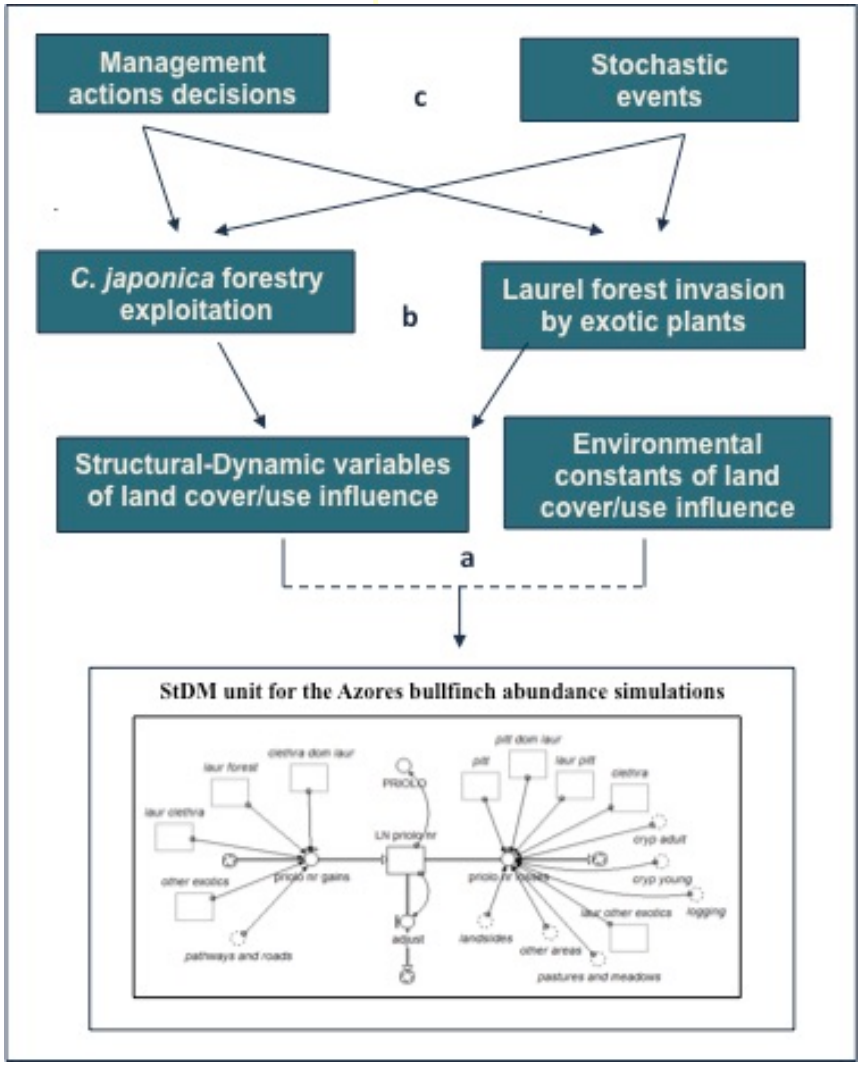
  - Since StDM estimations perform individual abundances for each study unit, an interpolation method was applied in order to account for spatial autocorrelation within the overall study area.

The Framework



Stochastic-Dynamic Model

Conceptual diagram of the StDM model used to estimate the Azores bullfinch abundances in São Miguel Island.



Influences in the StDM simulations of the Azores bullfinch abundances:

(a) the overall structural-dynamic variables and environmental constants

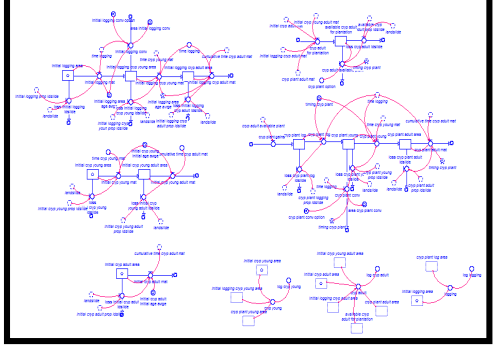
(b) influences of the land cover/use dynamics;

(c) influences of the management options and stochastic events.

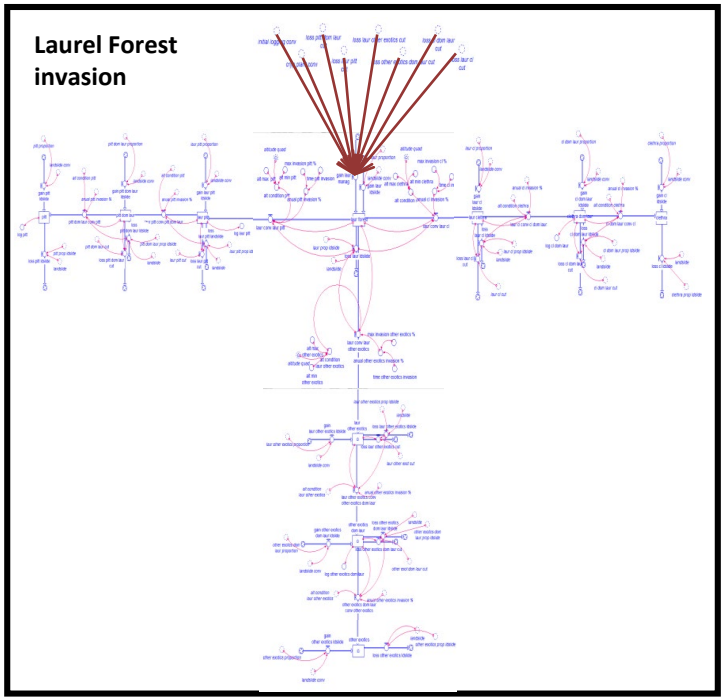
iNEXT

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

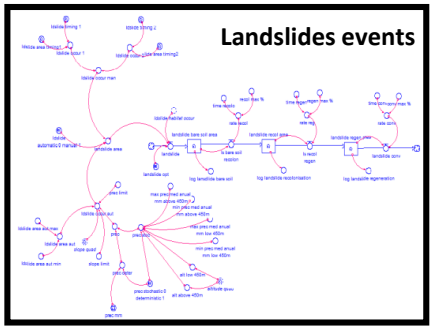
C. japonica Forestry Cycles



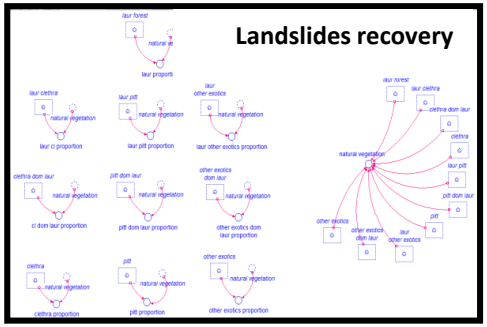
Laurel Forest invasion



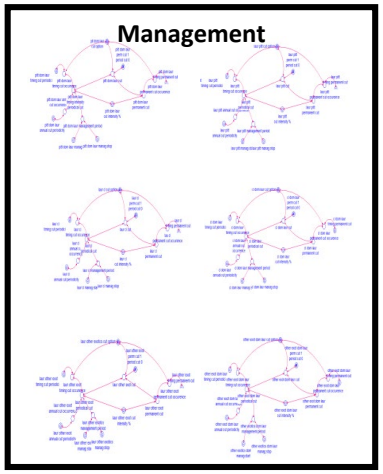
Landslides events



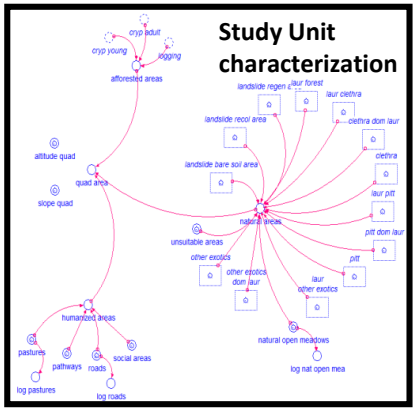
Landslides recovery



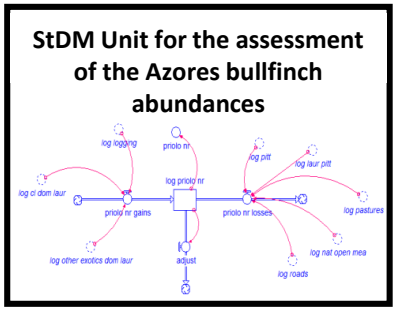
Management



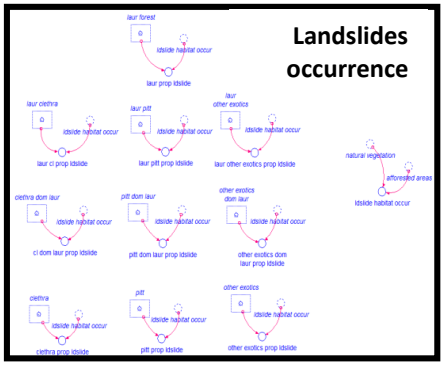
Study Unit characterization



StDM Unit for the assessment of the Azores bullfinch abundances

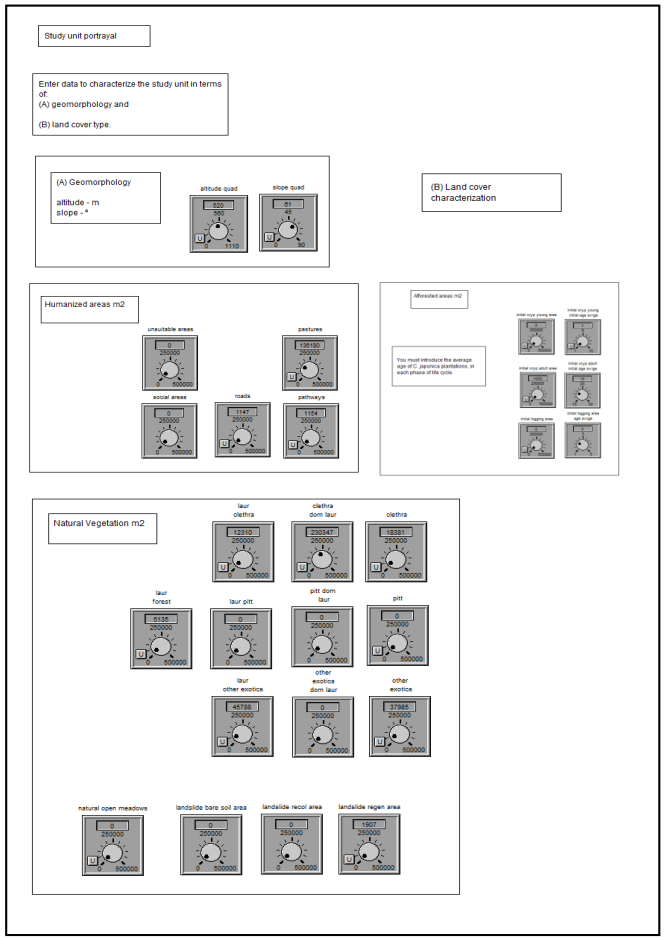


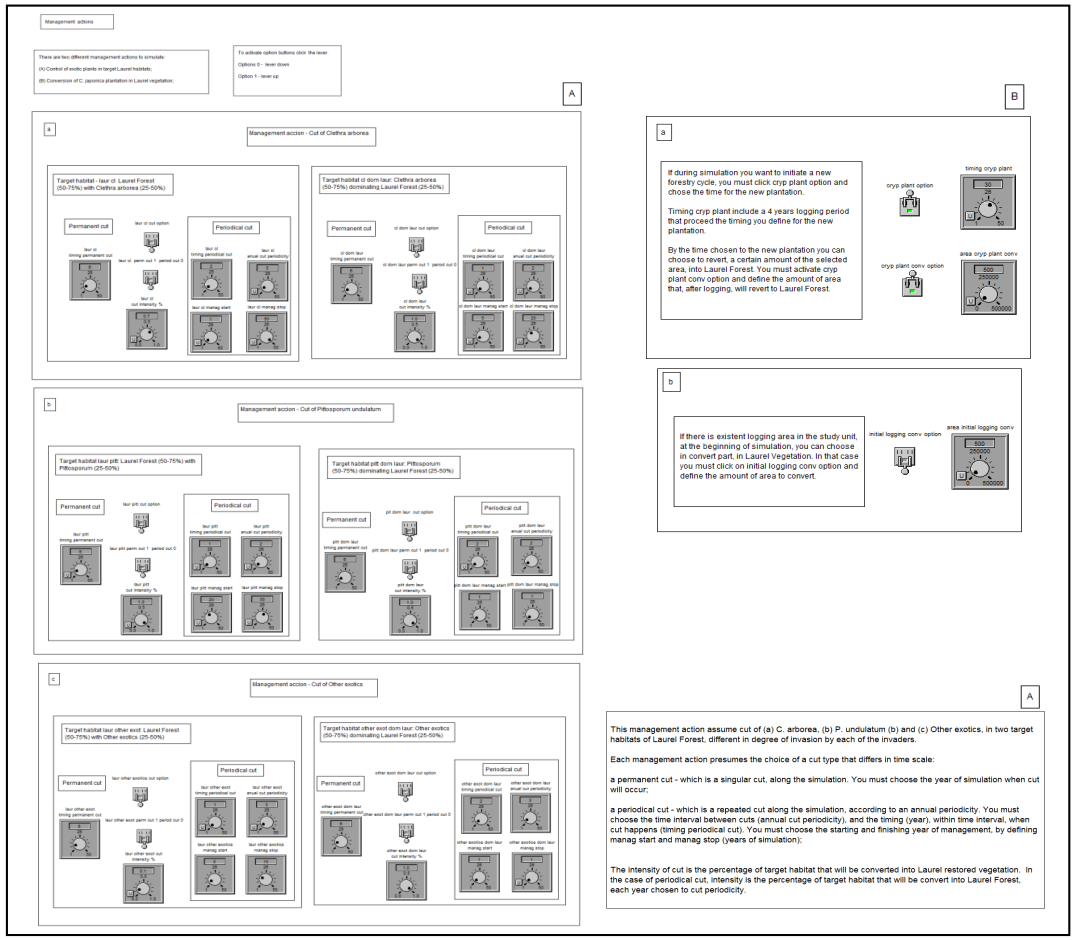
Landslides occurrence



Stella environment

Model Interface





Scenarios description

- Effectiveness of previous habitat management actions:

  - Scenario 1: the lack of the “LIFE Priolo” management actions.

  - Scenario 2: the “Life Priolo” interventions in the study area.

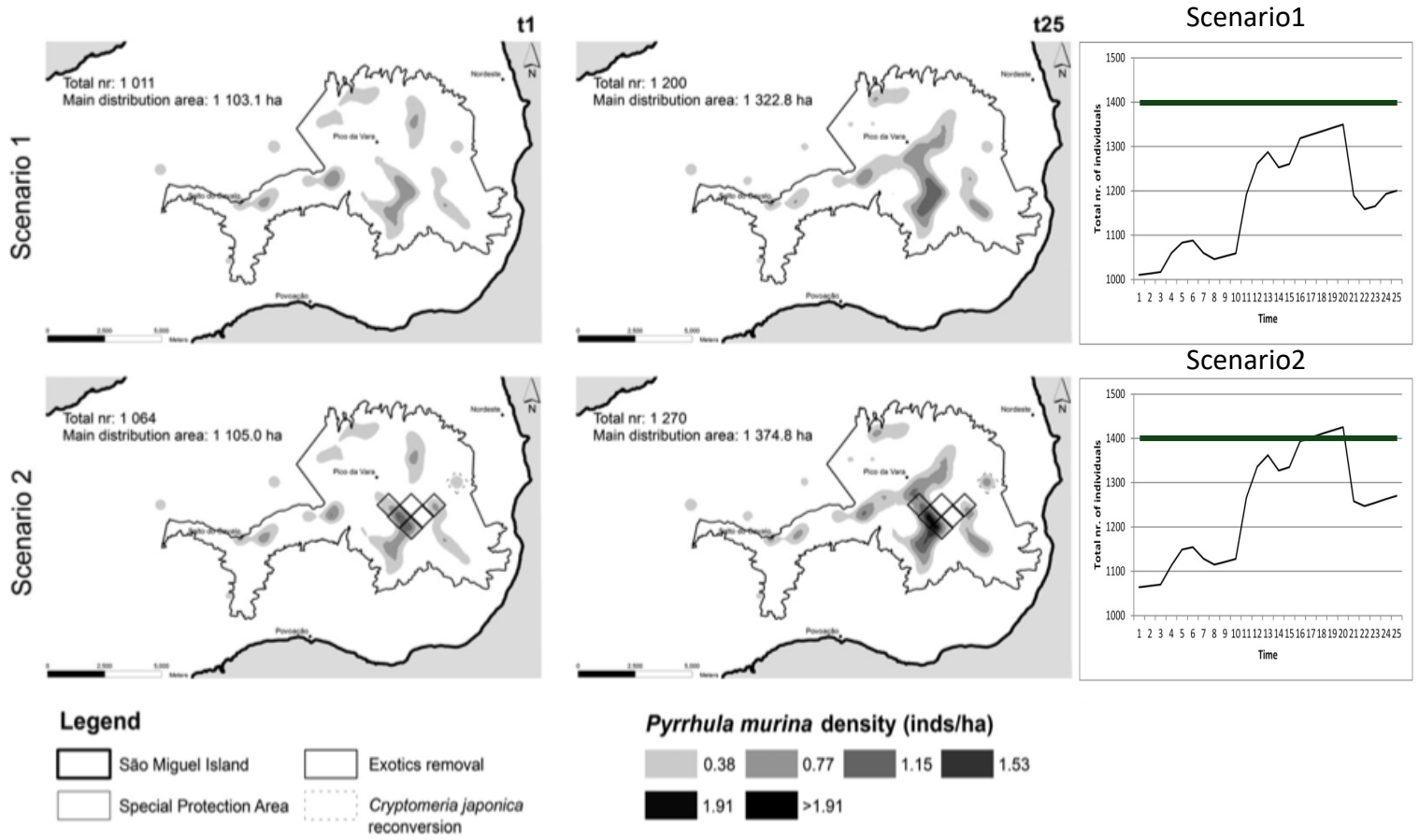
- Effects of future (periodic) management actions:

  - Scenario 3: located in the previously managed areas.

  - Scenario 4: dispersed throughout new potential areas in the western part of the species distribution.

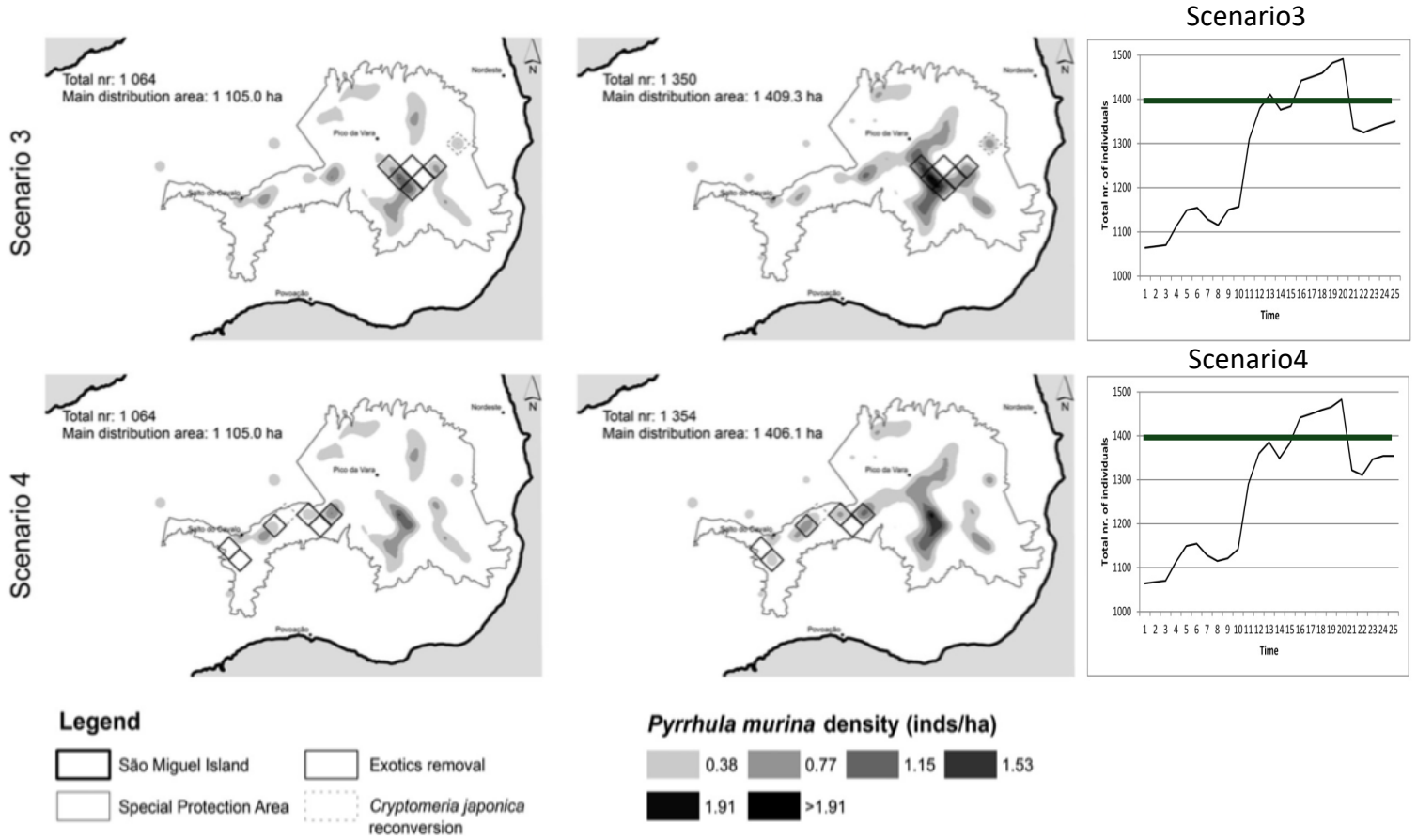
Outcomes from management scenario

- Scenario 1 vs Scenario 2: Effectiveness of previous habitat management actions



Outcomes from management scenarios

- Scenario 3 vs Scenario 4: Effects of future (periodic) habitat management actions



Exploring the Azores bullfinch case study

- Groups of 4 students

Exploring the Azores bullfinch case study

- Groups of 4 students
- Goal: Predict the Azores bullfinch response *to Clethra arborea* invasion and habitat management actions.

Exploring the Azores bullfinch case study

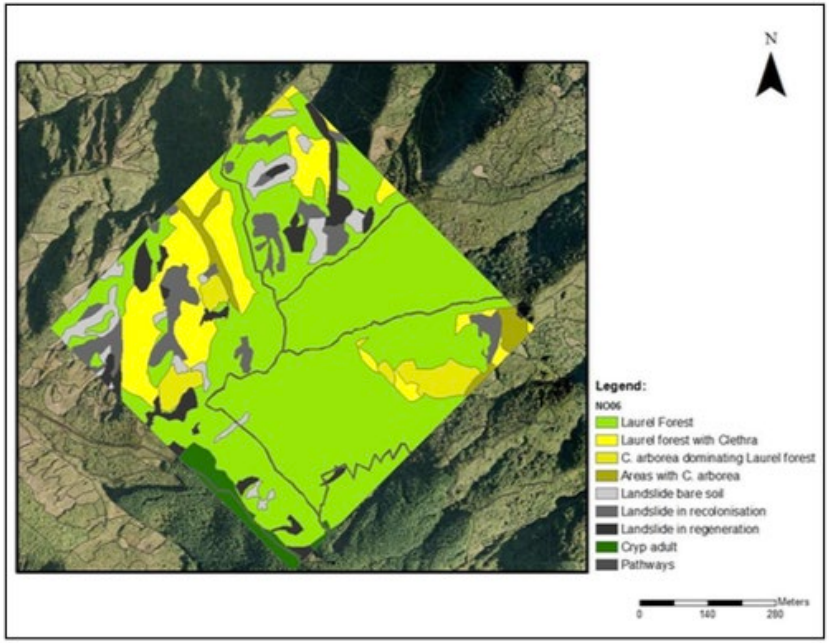
- Groups of 4 students
- Goal: Predict the Azores bullfinch response *to Clethra arborea* invasion and habitat management actions.
- **Modelled Response:** Azores bullfinch abundance (Data-driven)

Exploring the Azores bullfinch case study

- Groups of 4 students
- Goal: Predict the Azores bullfinch response *to Clethra arborea* invasion and habitat management actions.
- **Modelled Response:** Azores bullfinch abundance (Data-driven)
- **Modelled Process 1:** Effect of *Clethra arborea* invasion on laurel vegetation (Vegetation classes succession)
- **Modelled Process 2:** Removal of *Clethra arborea* from laurel habitats.

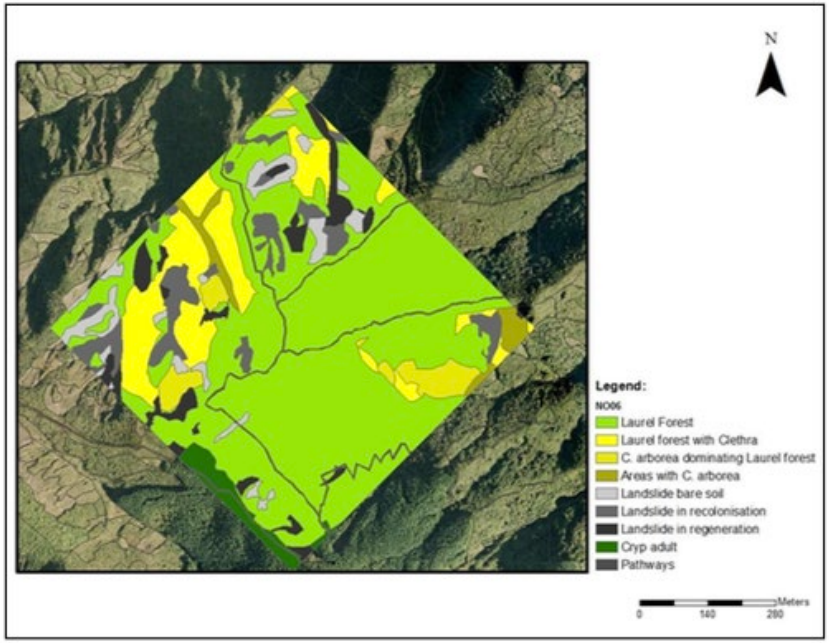
Exploring the Azores bullfinch case study

- Model settings:
  - Study unit of 500000 m2 (50 ha)
  - Time unit – year
  - Length of simulation 50 years



Exploring the Azores bullfinch case study

- Model settings:
  - Study unit of 500000 m2 (50 ha)
  - Time unit – year
  - Length of simulation 50 years



- Habitat features characterization:

Vegetation classes	% of occupation
Pure laurel forest	Laurel forest (>75%)
Initially invaded laurel forest	Laurel forest (50%–75%) *C. arborea* (25%–50%)
Moderately invaded laurel forest	Laurel forest (25–50%) *C. arborea* (50–75%)
Totally invaded laurel forest	*C. arborea* (>75%)

Constructing an StDM model

- Create File: Azores_bullfinch.STMX

Constructing an StDM model

- Create File: Azores_bullfinch.STMX

- **Modelled Response: Azores bullfinch abundance (Data-driven)**

Constructing an StDM model

- Create File: Azores_bullfinch.STMX

- **Modelled Response: Azores bullfinch abundance (Data-driven)**

- Variables:
  - LN PRIOLO = ढ़.37E-01+ (2.00E-06*laurel)+(1.89E-07*laur_cl)+(1.29E-06*cl_laur)+(ढ़.42E-08*cl)

  - PRIOLO = EXP(LN_Priolo) note: IF LN_Priolo=0 then 0 else EXP(LN_Priolo)

Environmental predictor	Description	Coefficient
Constant	-	0.637
Laurel	Pure laurel forest	0.000002
Laurel_clethra	Laurel forest with Clethra	0.000000189
Clethra_laurel	Clethra dominating laurel forest	0.00000129
Clethra	Pure Clethra	-0.0000000642

Constructing an StDM model

- **Modelled Process: Effect of *Clethra arborea* invasion on laurel vegetation (Vegetation classes succession)**

Vegetation classes	Variables	Rate of invasion per year
Pure laurel forest	laur	-
Initially invaded laurel forest	Laur cl	0.001
Moderately invaded laurel forest	Cl laur	0.002
Totally invaded laurel forest	Cl	0.004

Constructing an StDM model

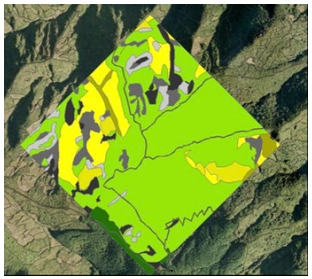
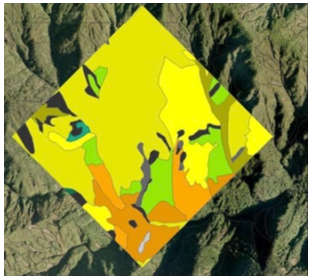
- **Modelled Process: Recreate the removal of *Clethra arborea* from laurel habitats.**

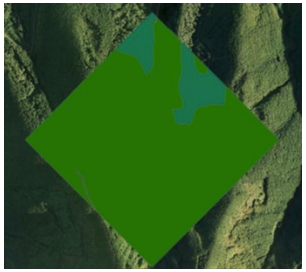
- Variables:
  - Management option (switch on/off)
  - Management timing (timing when management take place along simulation)
  - Management effort (in proportion of target vegetation classes)

Suggestion: Create an Interface in accordance!

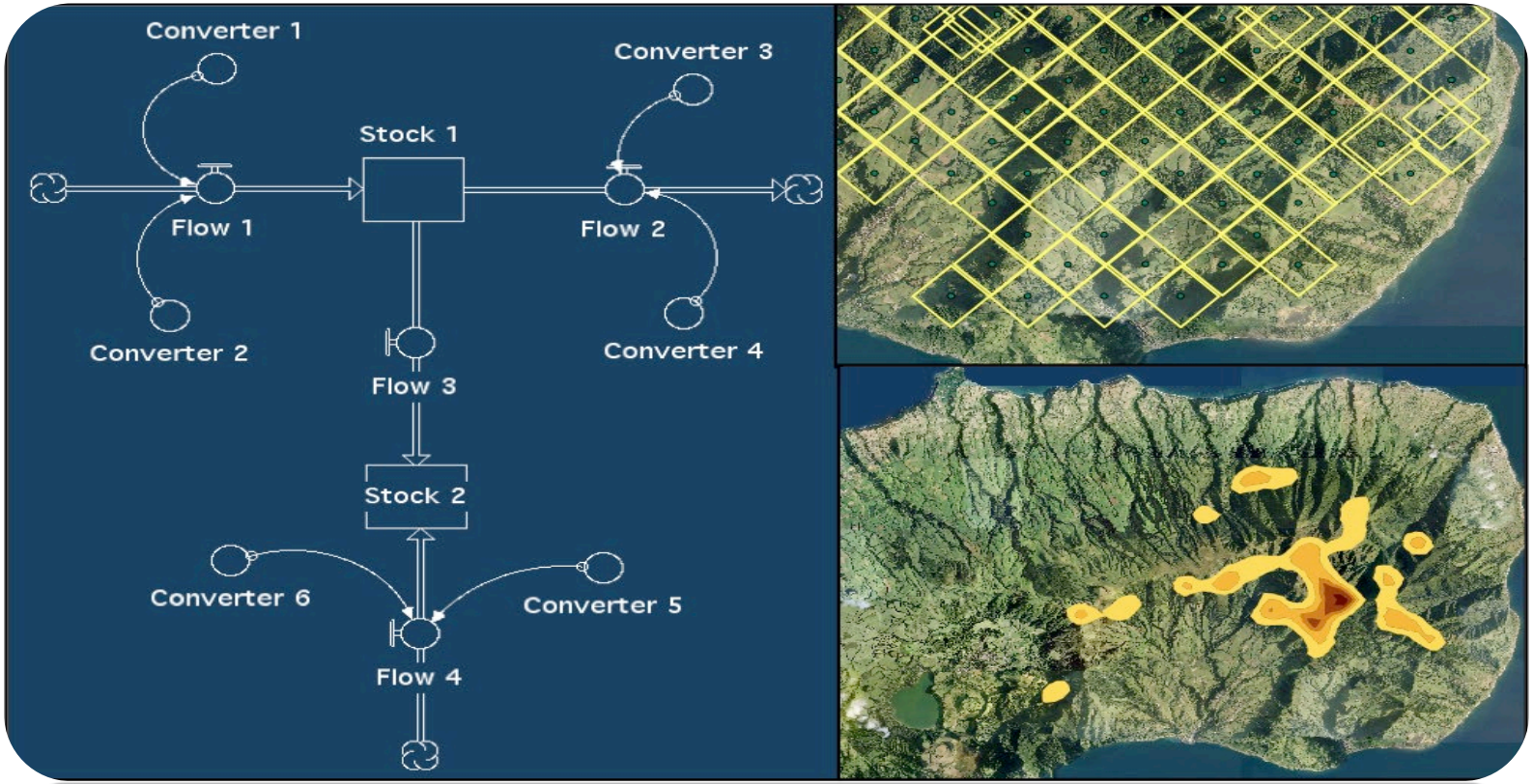
Exploring the Azores bullfinch case study

- Study units characterization:



	1 - Barely invaded	2 - Moderately invaded	3 - Highly invaded	4 - Totally invaded
Laur (m2)	450000	250000	50000	0
Laur cl (m2)	50000	150000	100000	0
Cl laur (m2)	0	50000	150000	100000
Cl (m2)	0	50000	200000	400000



Thanks for your participation!!!

jcabral@utad.pt
mgsantos@utad.pt
ritabastos@utad.pt