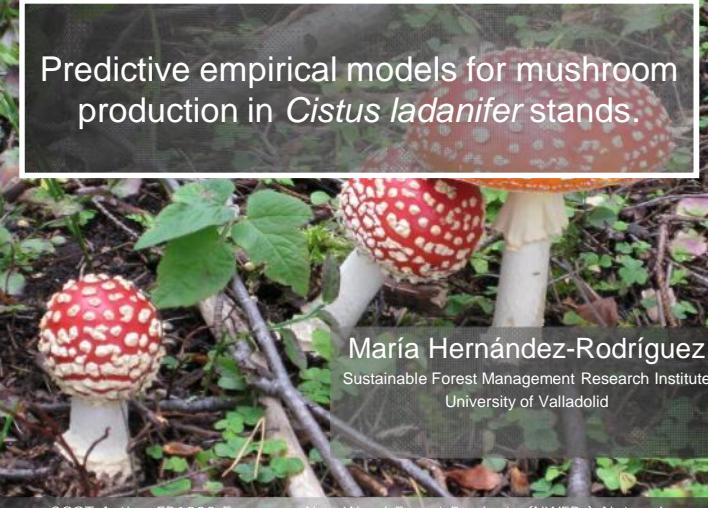


Predictive empirical models for mushroom production in *Cistus ladanifer* stands.



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Sustainable Forest Management Research Institute
University of Valladolid

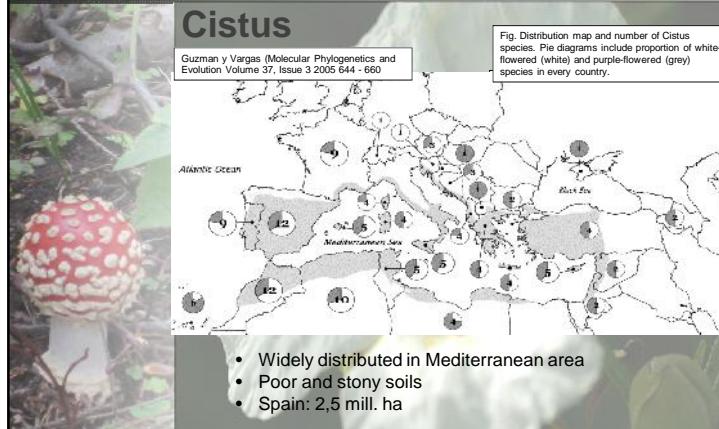
COST Action FP1203 European Non-Wood Forest Products (NWFPs) Network

Introduction

Cistus

Guzman y Vargas (Molecular Phylogenetics and Evolution Volume 37, Issue 3 2005 644 - 660)

Fig. Distribution map and number of Cistus species. Pie diagrams include proportion of white-flowered (white) and purple-flowered (grey) species in every country.

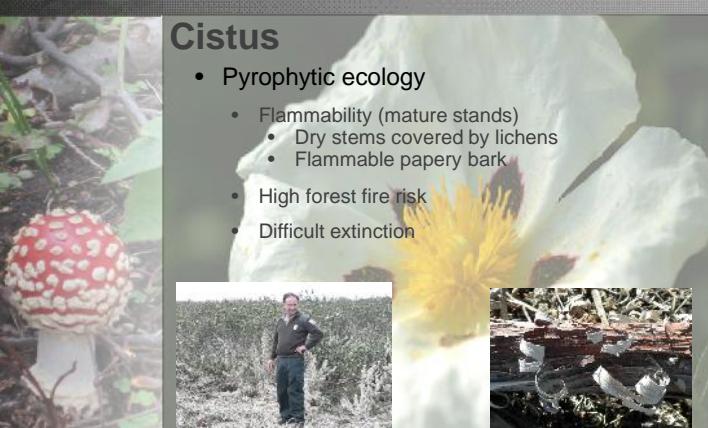


- Widely distributed in Mediterranean area
- Poor and stony soils
- Spain: 2,5 mill. ha

Introduction

Cistus

- Pyrophytic ecology
 - Flammability (mature stands)
 - Dry stems covered by lichens
 - Flammable papery bark
 - High forest fire risk
 - Difficult extinction



Introduction

Cistus

- Worthless unproductive ecosystems?
 - Protective value
 - Wildlife shelter
 - Beekeeping flora
 - Medicinal value
 - Use in perfume industry



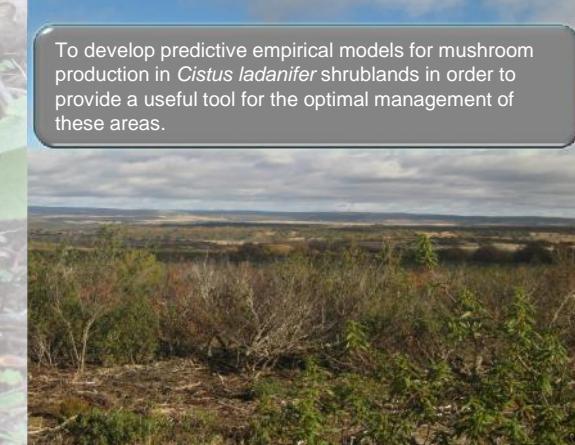
Introduction

Cistus

- Worthless unproductive ecosystems?
- High mushroom production
 - High fungal diversity
 - Early production of edible species
- Management
 - Mycorrhizal reservoir
 - Fire prevention
 - Economic benefit from NWFP

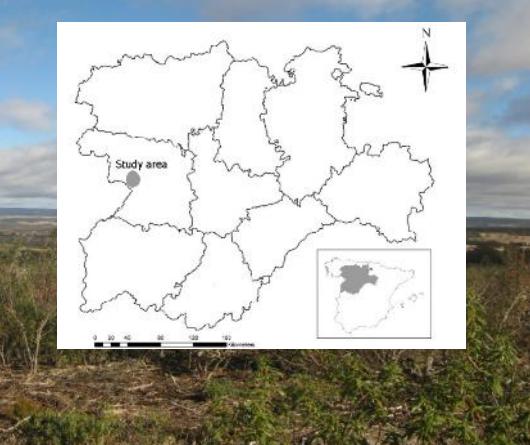



Objective

To develop predictive empirical models for mushroom production in *Cistus ladanifer* shrublands in order to provide a useful tool for the optimal management of these areas.

Material & Methods

Material & Methods

Permanent plots




Material & Methods

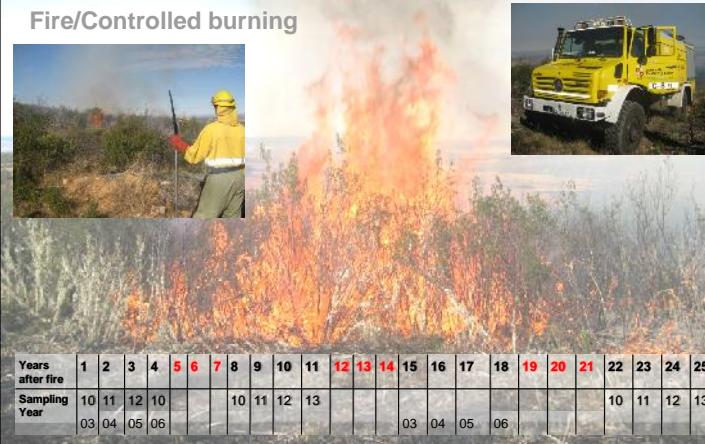
Total clearing



Years after clearing	1	2	3	4	5	6	7	8	9	10	11
Sampling Year	10	11	12	13				10	11	12	13

Material & Methods

Fire/Controlled burning



Years after fire	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Sampling Year	10	11	12	10				10	11	12	13				03	04	05	06				10	11	12	13

Material & Methods

Sampling



Material & Methods

Laboratory work



Material & Methods

Data analysis

- Mushroom production and diversity models
 - Mycorrhizal and saprotrophic taxa:
 - Production (kg ha^{-1})
 - Diversity: Shannon Index
 - $H = -\sum p_i \ln p_i$
 - p_i : relative importance of each sp.
 - *Boletus edulis* production (kg ha^{-1})
 - Predictors:
 - Climatic variables-
 - Treatment
 - Time after treatment
 - Vegetation structure
- Vegetation structure models
 - Prediction of missing values
 - Test of different growth functions



Material & Methods

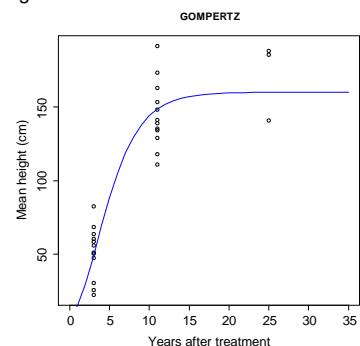
Data analysis

- Mushroom production and diversity models
 - Nonlinear regression analysis and fixed-effects modeling approach
 - The effect of treatment was tested using a dummy variable
 - Evaluation criteria:
 - Accordance with current scientific knowledge
 - Logical behaviour of the models in extrapolations
 - Simplicity
 - Statistical significance ($p\text{-value} < 0.05$).



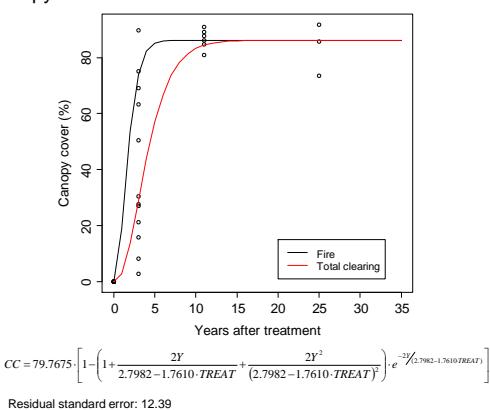
Results: Vegetation models

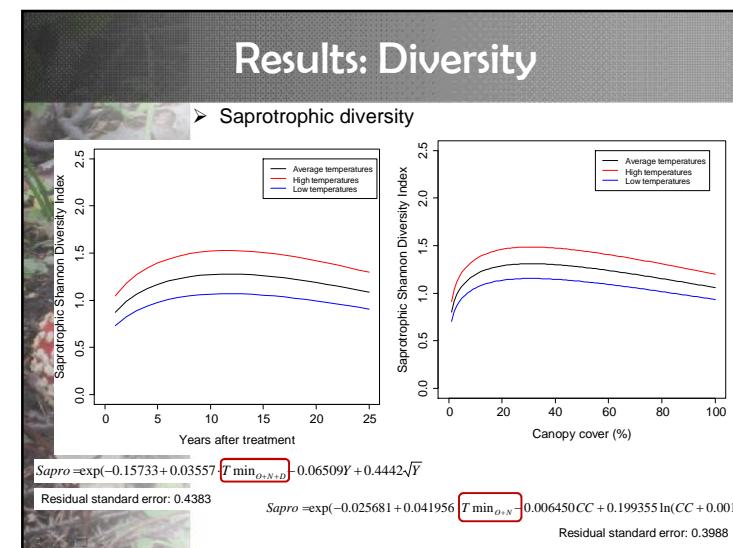
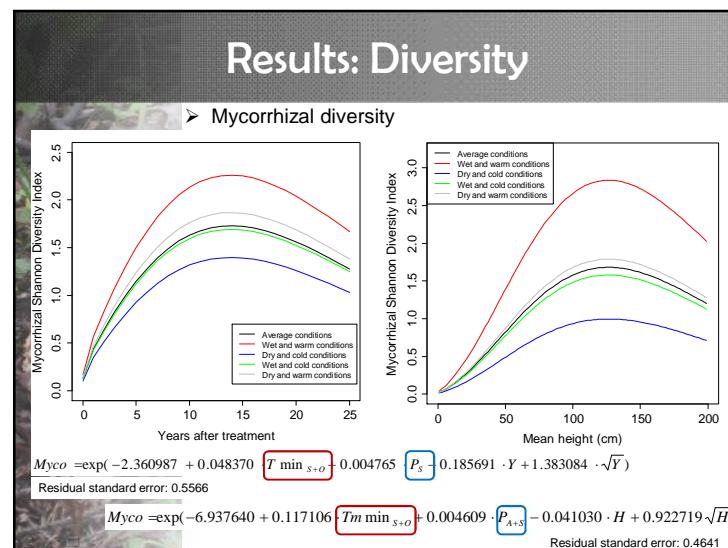
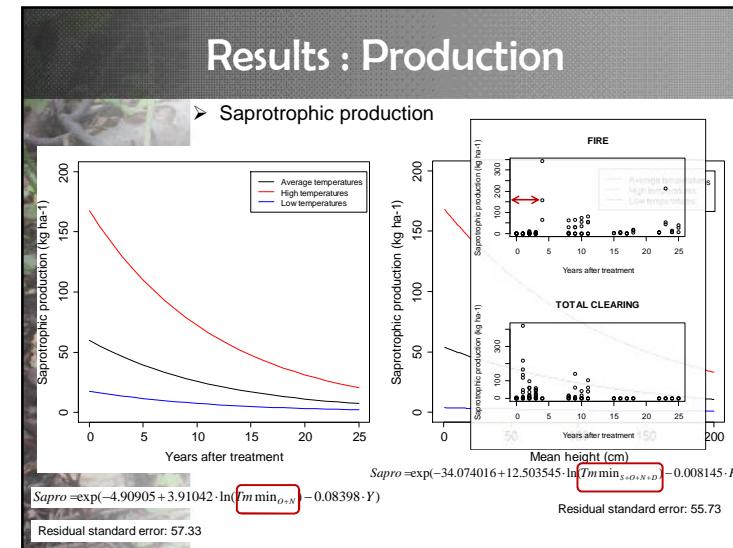
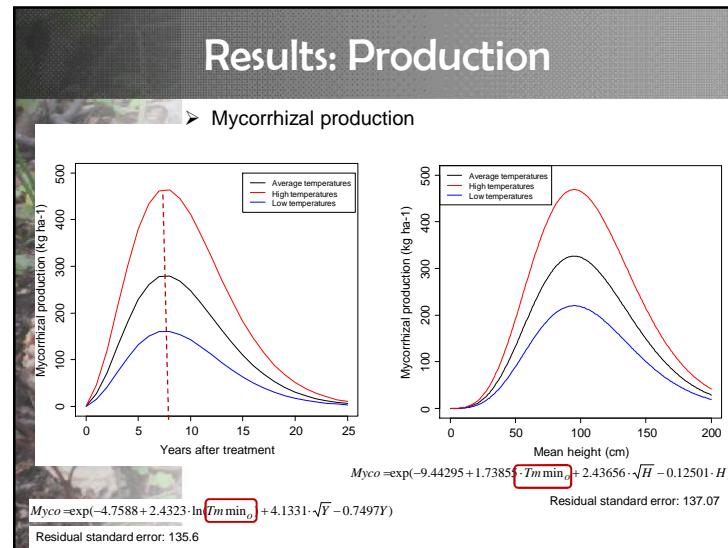
➤ Mean height



Results: Vegetation models

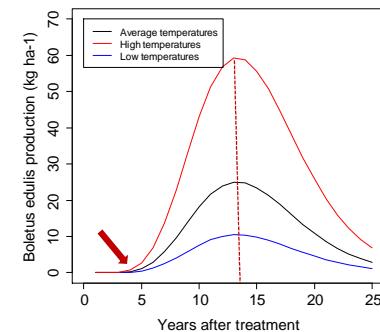
➤ Canopy Cover





Results: *Boletus edulis* production

➤ *Boletus edulis* production

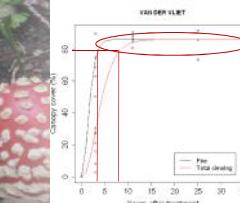
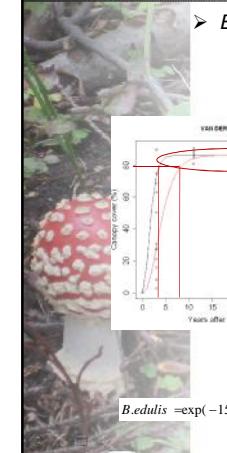


$$B.edulis = \exp(-17.09504 + 0.21615 T_{\text{avg}} + 8.70958 \cdot \log(Y + 0.001) - 0.65478 Y)$$

Residual standard error: 14.22

Results: *Boletus edulis* production

➤ *Boletus edulis* production



$$B.edulis = \exp(-1537 + 0.3667 T_{\text{min}} \text{ min}_{\text{g+e}} + 20.85 \sqrt{H} - 0.8591 H - 130.4 \sqrt{CC} + 587.5 \ln(CC + 0.001))$$

Residual standard error: 12.48

Conclusions



- ✓ These models can be a useful tool for the optimal management of these areas in order to enhance fungal production while preventing forest fires.
- ✓ Models for mushroom production and diversity can be applied from both inventory data or management history data of the scrublands.
- ✓ Although precipitation was not present in most of the models, this does not mean that it has no influence in mushroom fructification because it is correlated with temperatures.
- ✓ No significant differences were found for the two studied treatments.
- ✓ Mycorrhizal taxa are influenced by earlier temperature (September and October) whereas saprotrophic taxa depend on later temperatures (October, November and December).
- ✓ *Boletus edulis* is the most economically valuable species in this ecosystems and can be found from 5-6 years after treatment to the end of *Cistus ladanifer* life cycle (multistage species).

Acknowledges



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UNIVERSITY OF
EASTERN FINLAND

Acknowledges

