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Bioclimatic modelling and environmental tolerance to global change in strawberry tree

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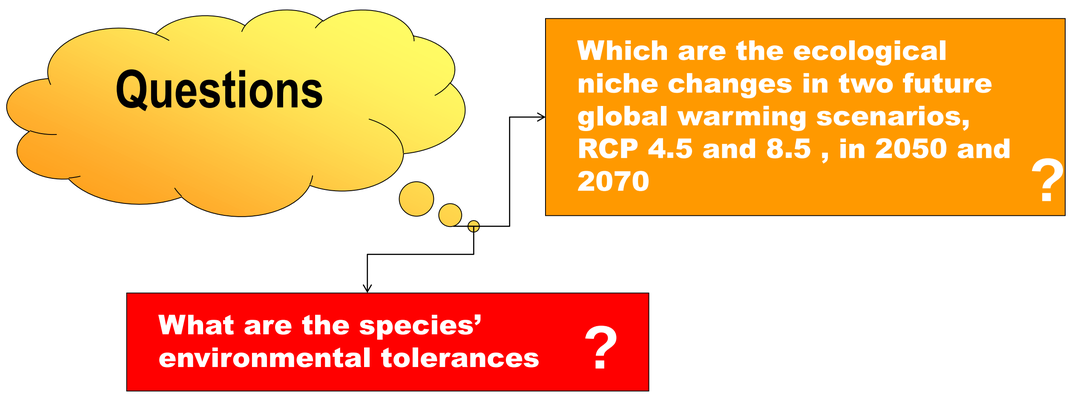
PURPOSE OF THE STUDY



MATERIAL AND METHODS

- 90,425 plots (1-Km grid level)
- 318 plots with the species (presence) dataset, including 25 % of testing points (Fig. 1)
- Seven bioclimate attributes were used as the best predictor variables, in the subsequent modelling, selected using a Bayesian network methodology with the software BayesiaLab v6.0.7
- Current climate conditions, future 2050 (RCP 4.5 and RCP 8.5), and future 2070 (RCP 4.5. and RCP 8.5.)
- Modelling in the MaxEnt software

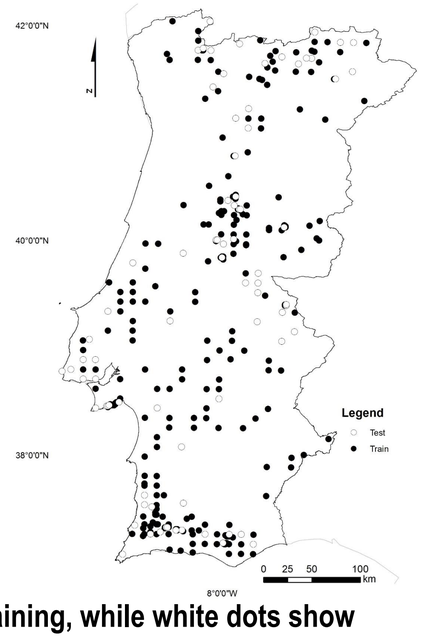


Fig. 1. Black dots show the presence locations used for training, while white dots show test locations.

Table 1. Variables used in modelling, extracted from WorldClim, after a network using a Bayesian methodology to detect the best predictor variables of the strawberry tree presence, and relative contributions to the Maxent model predictions (in %).

Code	Climate variable	Unities	%
t_{max}	Monthly average maximum temperature	°C * 10	4.9
t_{min}	Monthly average minimum temperature	°C * 10	4.1
BIO1	Annual mean temperature	°C * 10	3.8
BIO2	Mean diurnal range (mean of monthly (max temp - min temp))	°C * 10	9.6
BIO5	Max. temperature of warmest month	°C * 10	11.1
BIO9	Mean temperature of driest quarter	°C * 10	9.5
BIO15	Precipitation seasonality (coefficient of variation)	%	57.0

Table 2. Territorial evolution in percentage (area) of the present climate conditions, future 2050 (RCP 4.5 and RCP 8.5), and future 2070 (RCP 4.5. and RCP 8.5.) for the different classes of probability of presence of the species predicted conditions.

Area (%)		RCP 4.5.		RCP 8.5.	
Class (%)	Present	2050	2070	2050	2070
≤ 20	10	45	50	53	65
]20-40]	35	26	25	21	17
]40-60]	35	13	9	10	7
]60-80]	14	7	8	5	3
]80-100]	6	8	8	10	8

RESULTS

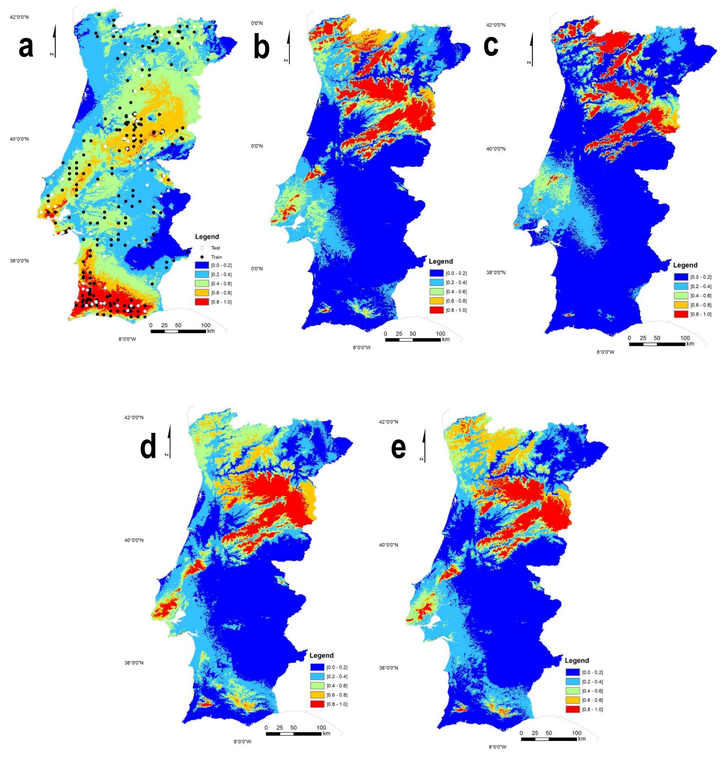


Fig 2. Representation of the Maxent models for the *A. unedo* habitat suitability predictions. Warmer colors show areas with better predicted conditions. (a) Present (current climate conditions). (b) Future 2050, RCP 4.5. (c) Future 2070, RCP 4.5. (d) Future 2050, RCP 8.5. (e) Future 2070, RCP 8.5.

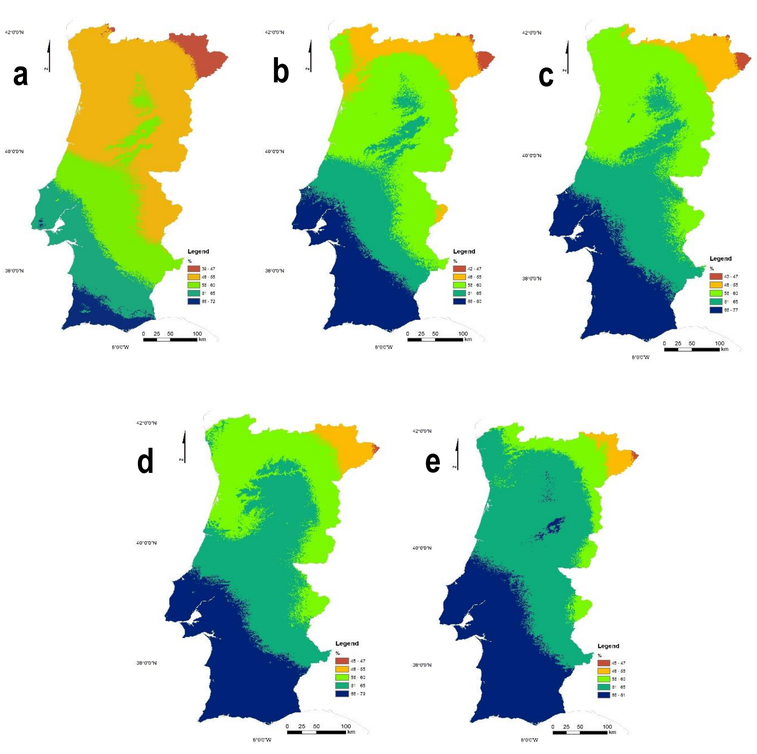


Fig 3. Representation of the variable BIO15, the precipitation seasonality in %, with the highest contribution for the *A. unedo* habitat suitability predictions in Maxent. (a) Present (current climate conditions). (b) Future 2050, RCP 4.5. (c) Future 2070, RCP 4.5. (d) Future 2050, RCP 8.5. (e) Future 2070, RCP 8.5.

TAKE HOME

The evaluation of the impact of climate change on the forest in Portugal suggest a trend on strawberry tree migration from south to north and from the interior to the coastal areas (Fig 2 a-e) in the futures scenarios. Moreover, under this scenarios, the species may disappear from the presently drier area in the south of the country.

Considering a probability of occurrence of the species > 60%, until 2050, for the RCP 4.5 and the RCP 8.5 scenarios, the species' potential area reduction compared to the present scenario was about 21%, in both cases (Fig 1a, b and d, Tab. 2). Until 2070, the total expected reduction is of 19% and 44%, for the same RCP scenarios respectively (Fig 1a, c and e, Tab. 2). The reduction in area is considerably higher for the worst warming scenario (RCP 8.5) considering a period of 20 years, from 2050 to 2070, for a probability of the species occurrence superior to 60%, ca. 30% (Fig 1d and e; Tab. 2).

Changes in precipitation seasonality were predicted to progressively increase in the 2050 and 2070 warming scenarios (RCP 4.5 and 8.5) (Fig. 3 a-e). Strawberry tree seems to develop better in medium precipitation variability (Fig. a), which suggests that this species may have high sensitiveness to high variation in precipitation and, thus, disadvantaged within the seasonality precipitation predictions

The reduction of habitat suitable for this species is very significant and mountain regions are predicted to be a refuge. Reduction in suitable area and potential competition with agriculture occupation seem to constitute a main concern to the future maintenance of the strawberry tree formations in nature. The Mediterranean forests are fragile ecosystems vulnerable to recent global warming and reduction of precipitation, and a long-term negative effect is expected on vegetation with increasing drought and in areas burnt by fires. The strawberry tree is a case study that can contribute to foresee the evolution of the Mediterranean species due to the future global warming in this region.

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