

# Mapping tree species vulnerability to multiple threats as a guide to restoration and conservation of tropical dry forests

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## Context

Most vulnerability assessments:

- Are not spatially explicit
- And/or focus only on climate change and/or land use change
- Assume that different species are equally sensitive to threats

## Research questions

1. How to design a transparent but robust **spatially explicit vulnerability mapping** method to estimate the impact of **different current and future threats** to **different tree species**?
2. How to translate these patterns of vulnerability into concrete recommendations for **restoration and conservation actions**?

## Methodology

**Study species:** 50 most frequent species of the tropical dry forests of northwestern Peru and southern Ecuador

Ensemble **habitat suitability modelling** to estimate distribution ranges and **climate change exposure**

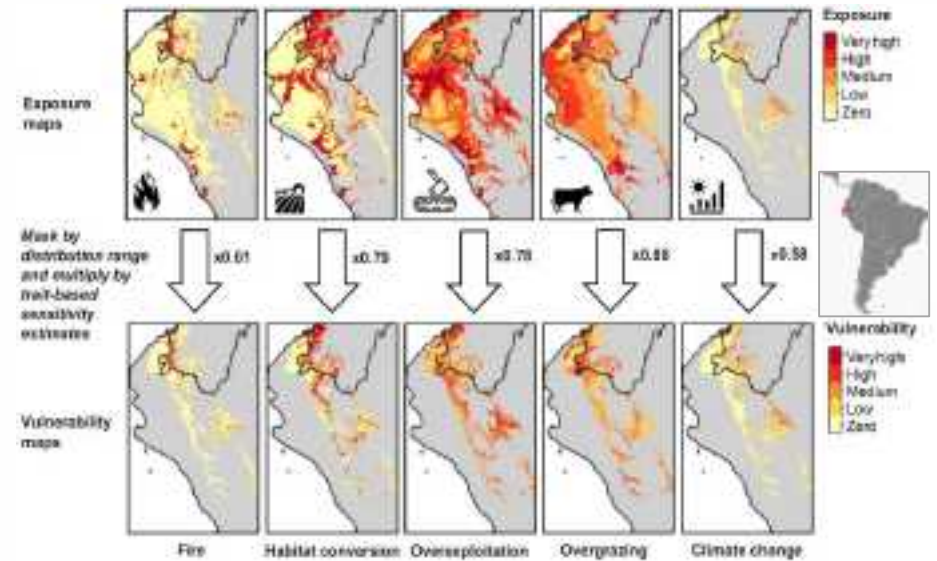
Freely available spatial datasets to estimate **exposure to fire, habitat conversion, overexploitation, and overgrazing**

**Sensitivity scoring** of tree species using functional traits:

Trait	Fire	Habitat conversion	Over-exploitation	Overgrazing	Climate change
Bark thickness	High	Low	Low	Low	Low
Cultivated species	Low	High	Low	Low	Low
Dispersal type	Low	Low	Low	Low	Low
Flaxseed species	Low	Low	High	Low	Low
Germination strategy	High	Low	Low	Low	Low
Growth rate	Low	Low	Low	High	High
Leaf palatability	Low	Low	Low	High	Low
Leaf phenology	Low	Low	Low	Low	Low
Maximum height	High	Low	Low	Low	Low
Nitrogen fixation	Low	Low	Low	Low	Low
Pollination type	Low	Low	Low	Low	Low
Presence of spines	Low	Low	Low	Low	Low
Resprouting capacity	Low	Low	Low	Low	Low
Seed weight	Low	Low	Low	Low	High
Sexual system	Low	Low	Low	Low	Low
Stem or root succulence	Low	Low	Low	Low	Low
Timber species	Low	Low	Low	Low	Low
Wood density	High	Low	Low	Low	Low

Trait importance (weight): Very low (1) Low (2) Medium (3) High (4) Very high (5)

**Vulnerability maps = exposure maps x sensitivity:**



**Sensitivity analysis** to assess robustness of the results against

- Thresholds used to construct exposure maps (nominal, best-case, worst-case)
- Chosen trait weights to estimate sensitivity
- Missing traits

## Results

**Main findings:**

1. Average of 46% of species distribution range under high to very high vulnerability to at least one of the five threats
2. Habitat conversion, overgrazing and overexploitation more important threats than climate change
3. Results relatively robust against chosen trait weights and missing traits, but sensitive to thresholds used to construct exposure maps

**Species-specific priority maps for restoration and conservation actions:**



**In-situ conservation** and seed collection in areas with low vulnerability to climate change and current threats

**Ex-situ conservation** or translocation of populations in areas with high climate change vulnerability

**Active planting or assisted regeneration** in areas under high current threat vulnerability but low climate change vulnerability

**General priority maps for restoration and conservation actions:**

