

# FRAGILE

Marie Skłodowska–Curie Actions Staff Exchange  
2026



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# FRAGILE

Frankincense Resilience through Actions for Global Involvement and Local Empowerment

- **Coordinator:** Mendel University in Brno
- **Consortium:** 7 legal entities across EU and 5 partners from Associated Countries & Third Countries
- **Duration:** 2026–2030 (4 years)
- **Beginning of the project:** September 2026
- **Funded by the European Union under Horizon Europe**



# BENEFICIARIES

| Partner organisations                        | Country     | Abbreviation |
|----------------------------------------------|-------------|--------------|
| MENDEL UNIVERSITY IN BRNO                    | coordinator | MENDELU      |
| UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA   | Italy       | UNIROMA1     |
| UNIVERSITE LIBRE DE BRUXELLES                | Belgium     | ULB          |
| WAGENINGEN UNIVERSITY                        | Netherlands | WU           |
| UNIVERZITA PALACKEHO V OLOMOUCI              | Czechia     | UP           |
| UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU | Poland      | AMU          |
| Nord University                              | Norway      | NORD         |



**SAPIENZA**  
UNIVERSITÀ DI ROMA



**WAGENINGEN** **UR**  
*For quality of life*



Palacký  
University  
Olomouc

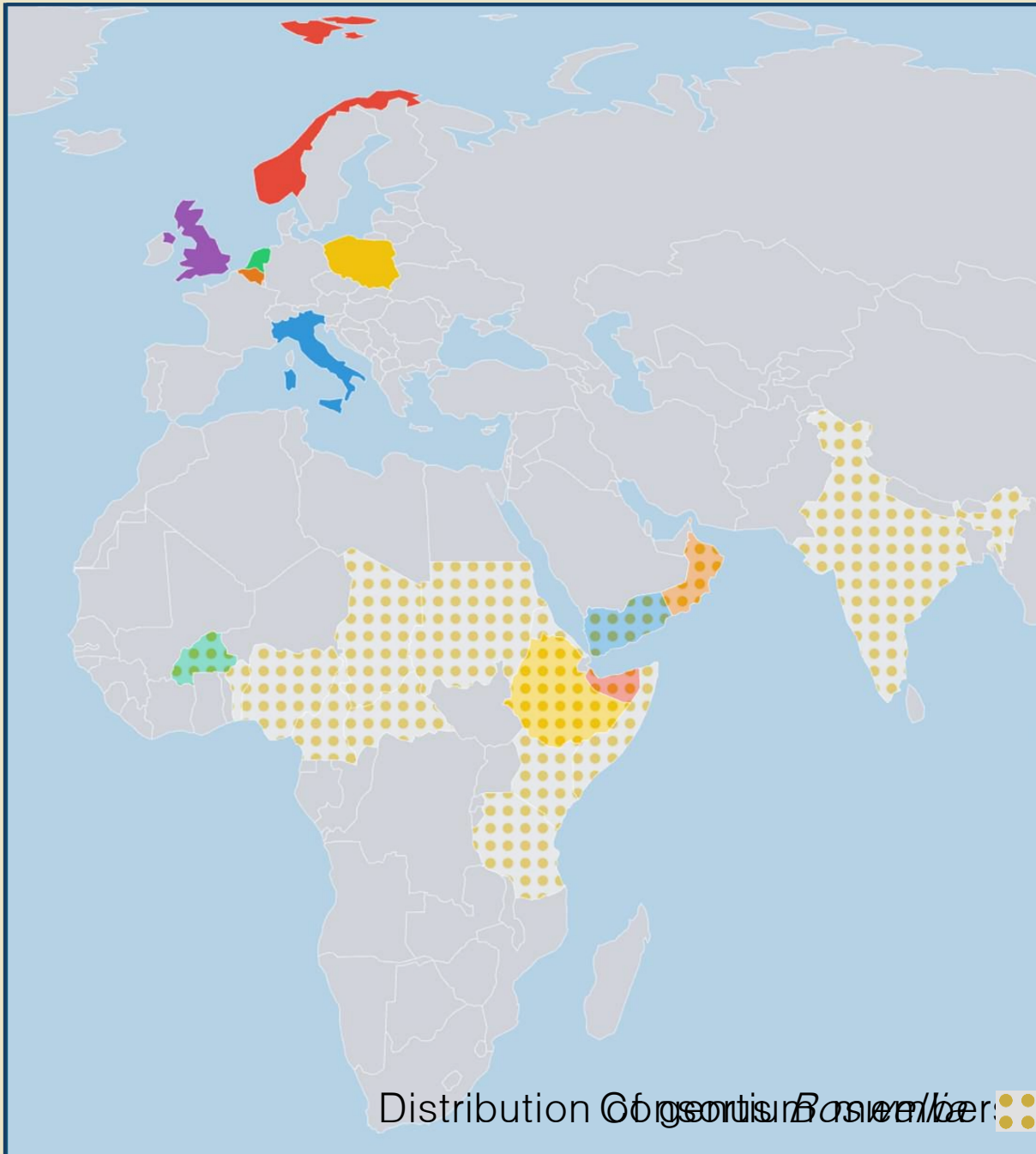


# ASSOCIATED PARTNERS & THIRD COUNTRIES

| Organisation                      | Country        | Abbreviation |
|-----------------------------------|----------------|--------------|
| MEKELLE UNIVERSITY                | Ethiopia       | MU           |
| UNIVERSITE NAZI BONI              | Burkina Faso   | NBU          |
| Enviromental protection Authority | Yemen          | EPA          |
| Environment Society of Oman       | Oman           | ESO          |
| Dayaxa Frankincense Company       | Somalia        | DAYAXA       |
| ROYAL BOTANIC GARDEN EDINBURGH    | United Kingdom | RBGE         |

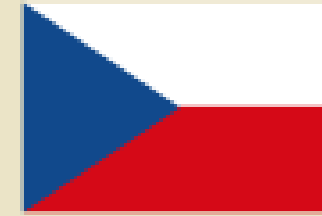


# Distribution of Consortium members And Distribution of genus *Boswellia*

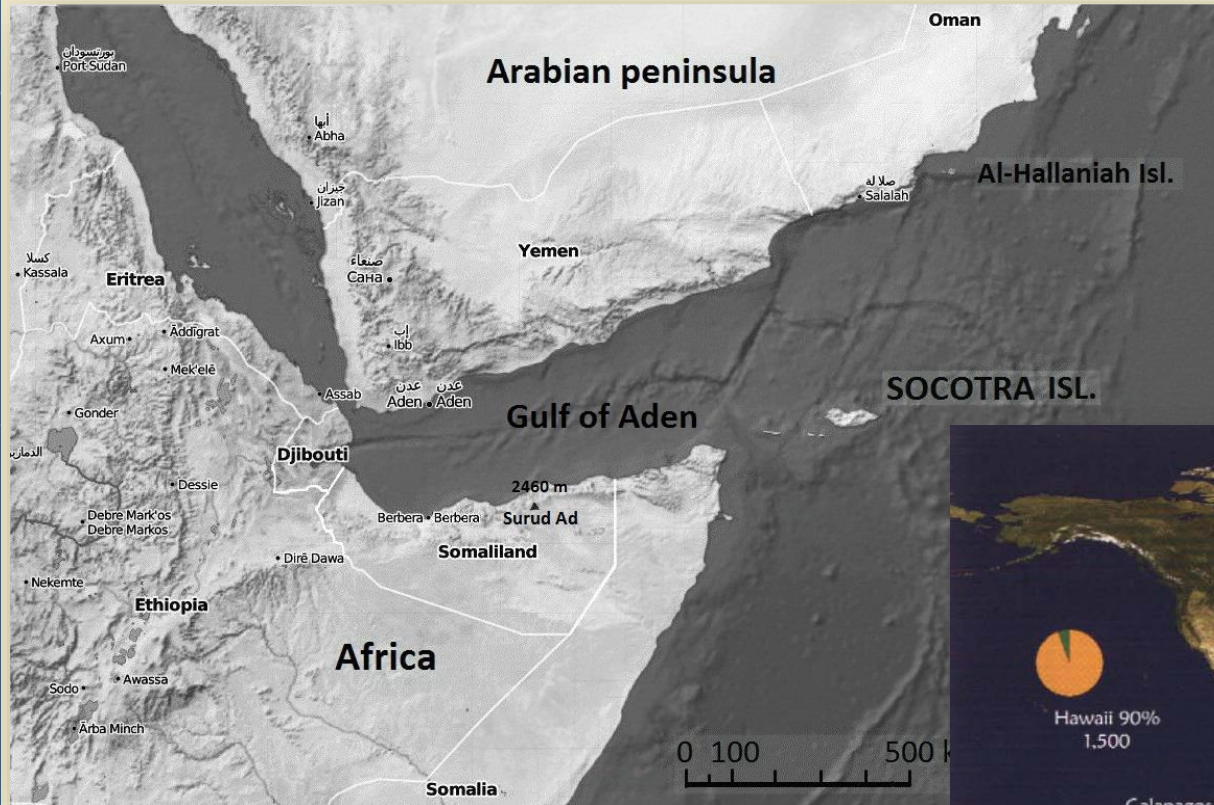


How was the FRAGILE consortium born?

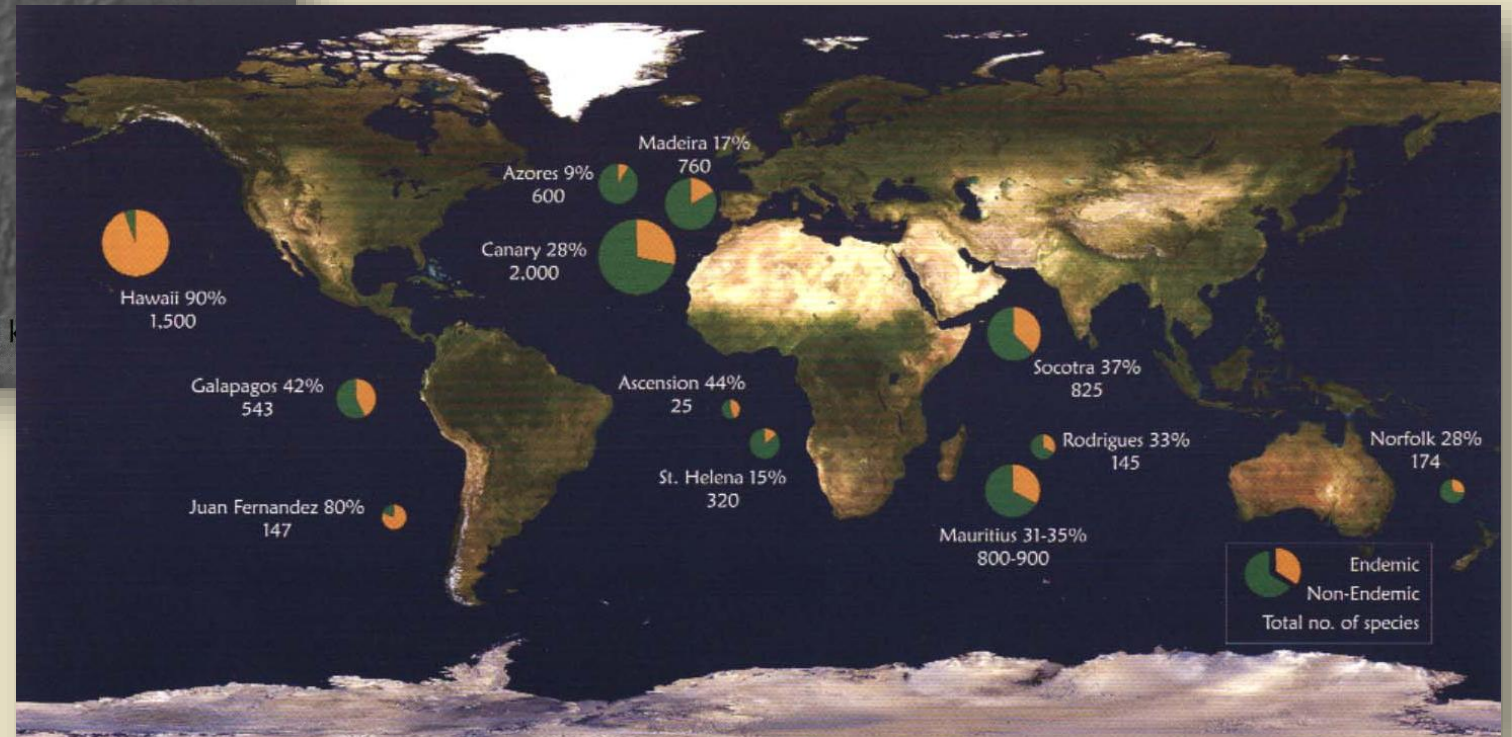
# Everything started in 1999...



**CZECH  
AID**

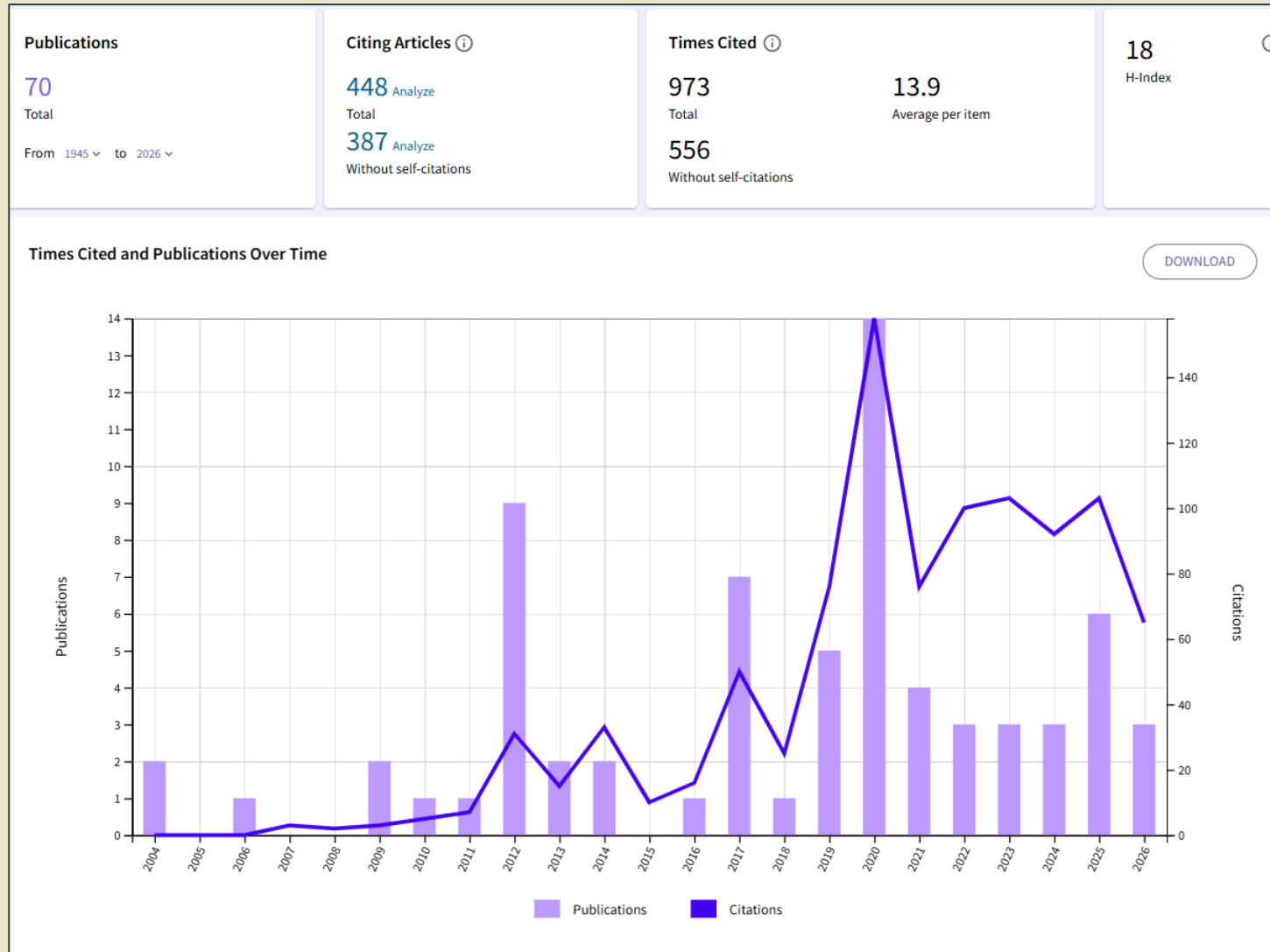


A broad international scientific teams were built over the long term period.



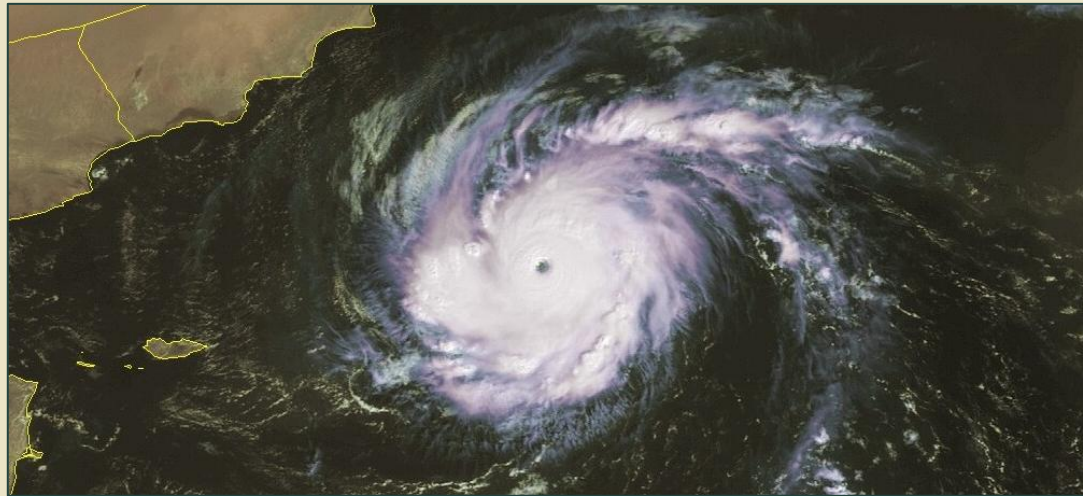
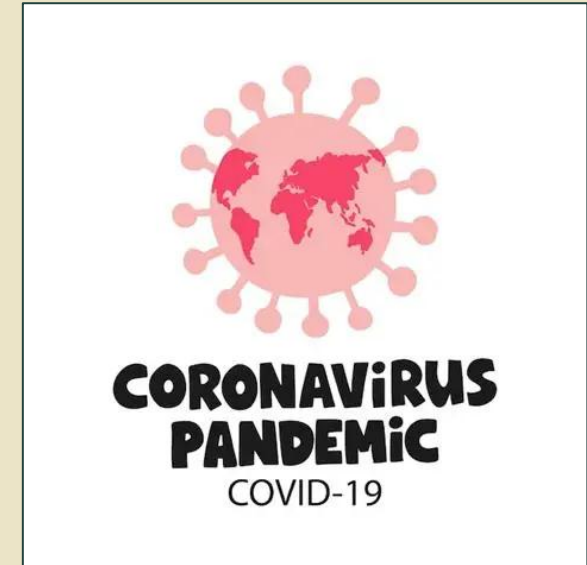
# Hard, honest and purposeful work

Key words: Socotra and Mendel University



# Resilience and overcoming obstacles

- Arabic spring
- Cyclones in 2015
- Coronavirus pandemic



We were  
always  
working on  
the ground  
without  
interruption.

# 2000–2017– Acceptance by the international scientific community

2017–2020: Support to the Integrated Programme for the Conservation and Development of Socotra Archipelago” (UNEP–GEF #5347)

Friends of Soqotra

أصدقاء سقطرى



**SENCKENBERG**  
world of biodiversity



**SAPIENZA**  
UNIVERSITÀ DI ROMA



# Conservation of endangered endemic frankincense trees on Socotra Island



Phase 1  
2020–2022

Phase 2  
2023–2025

Phase 3  
2026–2029



MSCA



SAPIENZA  
UNIVERSITÀ DI ROMA



Centre for  
Middle Eastern  
Plants

PART OF THE ROYAL BOTANIC GARDEN EDINBURGH



GHENT  
UNIVERSITY



WAGENINGEN  
UNIVERSITY & RESEARCH

ULB

UNIVERSITÉ  
LIBRE  
DE BRUXELLES



ADAM MICKIEWICZ  
UNIVERSITY  
POZNAŃ



# FRAGILE team

- Franklinia project team = nucleus
- **Main idea** = from Socotra to global investigation and conservation of *Boswellia* genus
- New important **partners** from **countries with *Boswellia* occurrence**

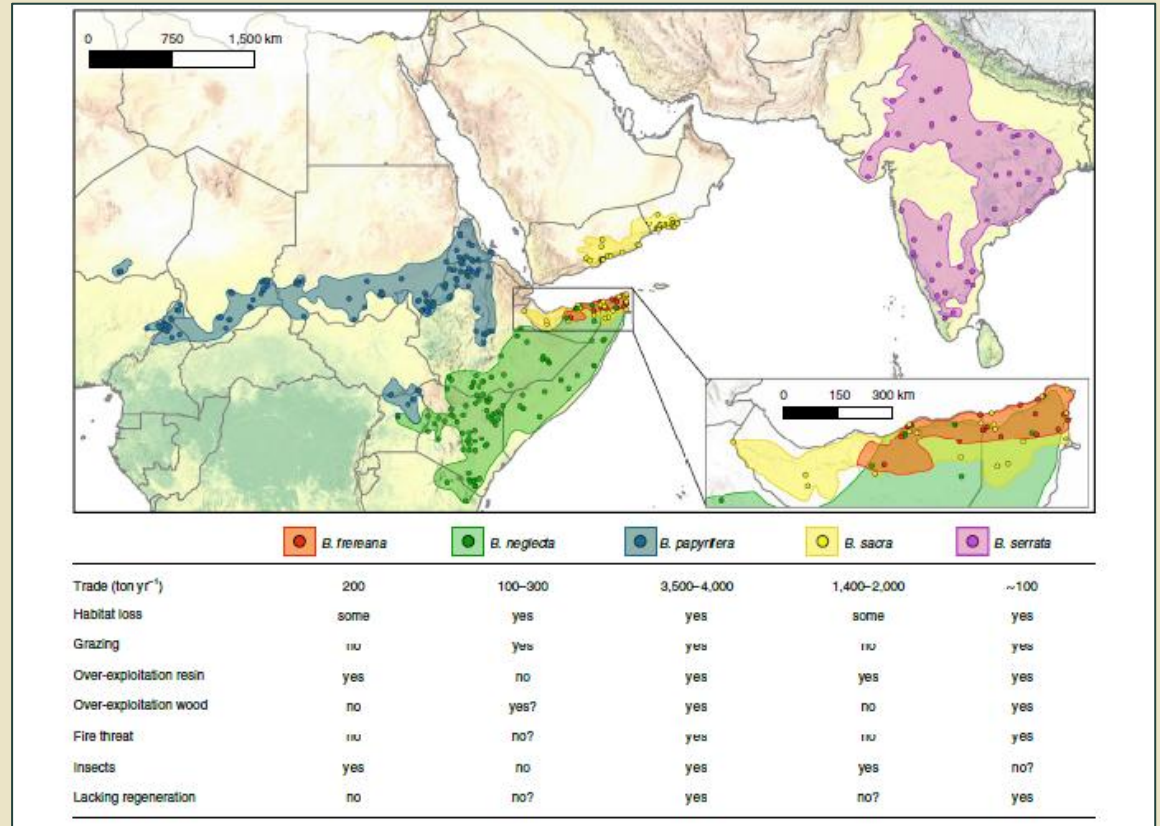


## Why were we successful?

- Attractive, important and challenging research topic
- Experienced team creating together interdisciplinary solutions
- Careful preparation with feasible outputs
- Excellent support of faculty administration

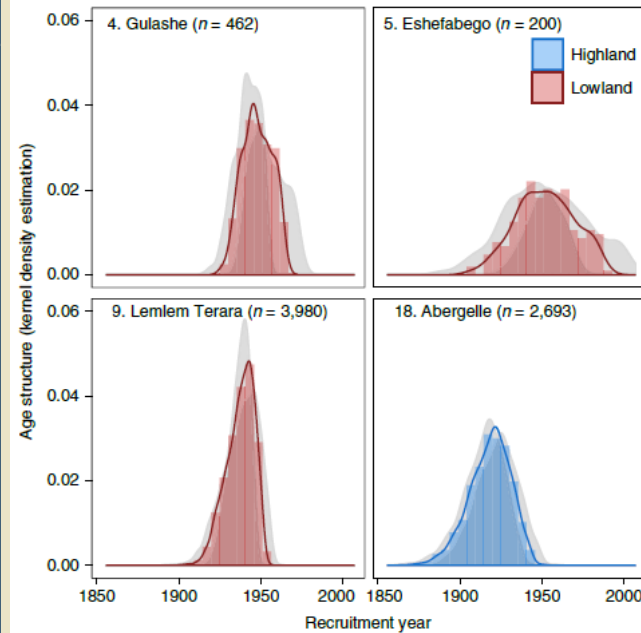
# Why Frankincense?

- 25 species, 12 endemic for Socotra
- 5 species are economically most important

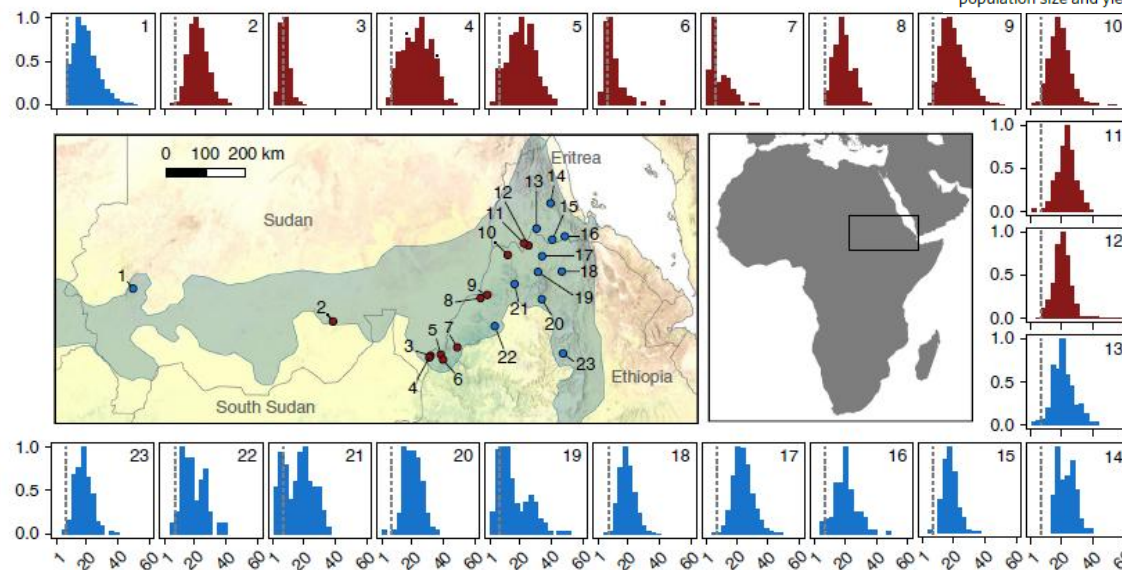


# Frankincense in peril

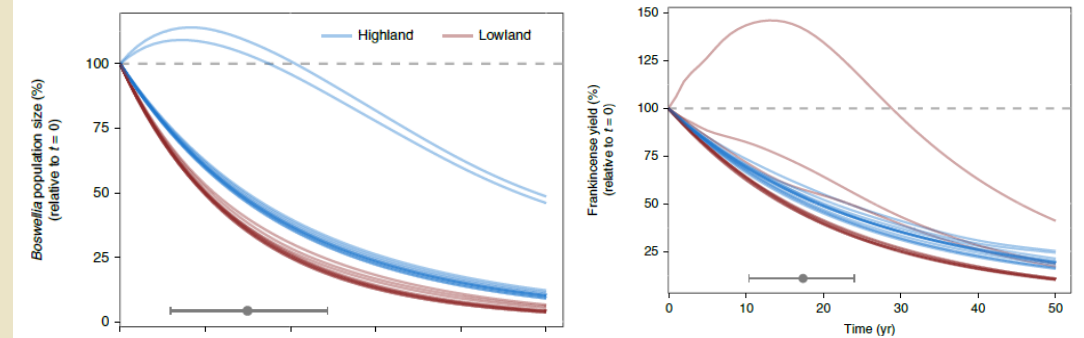
Frans Bongers<sup>1\*</sup>, Peter Groenendijk<sup>1,2,3</sup>, Tesfaye Bekele<sup>4</sup>, Emiru Birhane<sup>5,6</sup>, Abebe Damtew<sup>5</sup>, Mathieu Decuyper<sup>1,7</sup>, Abeje Eshete<sup>4</sup>, Alemu Gezahgne<sup>4</sup>, Atkilt Girma<sup>5,8</sup>, Mohamed A. Khamis<sup>9</sup>, Mulugeta Lemenih<sup>10</sup>, Tefera Mengistu<sup>11</sup>, Woldeselassie Ogbazghi<sup>12</sup>, Ute Sass-Klaassen<sup>1</sup>, Wubalem Tadesse<sup>4</sup>, Mindaye Teshome<sup>10,4</sup>, Motuma Tolera<sup>13</sup>, Frank J. Sterck<sup>1,14</sup> and Pieter A. Zuidema<sup>1,14</sup>



**Fig. 3 | Regeneration failure in *Boswellia* populations obtained from tree-ring analysis.** Distributions of the estimated calendar year of recruitment (bars and coloured lines) for four populations and their 95% CI (shaded area) on the basis of uncertainty in the age-diameter relations (Supplementary Fig. 1). Population numbers as in Fig. 2.

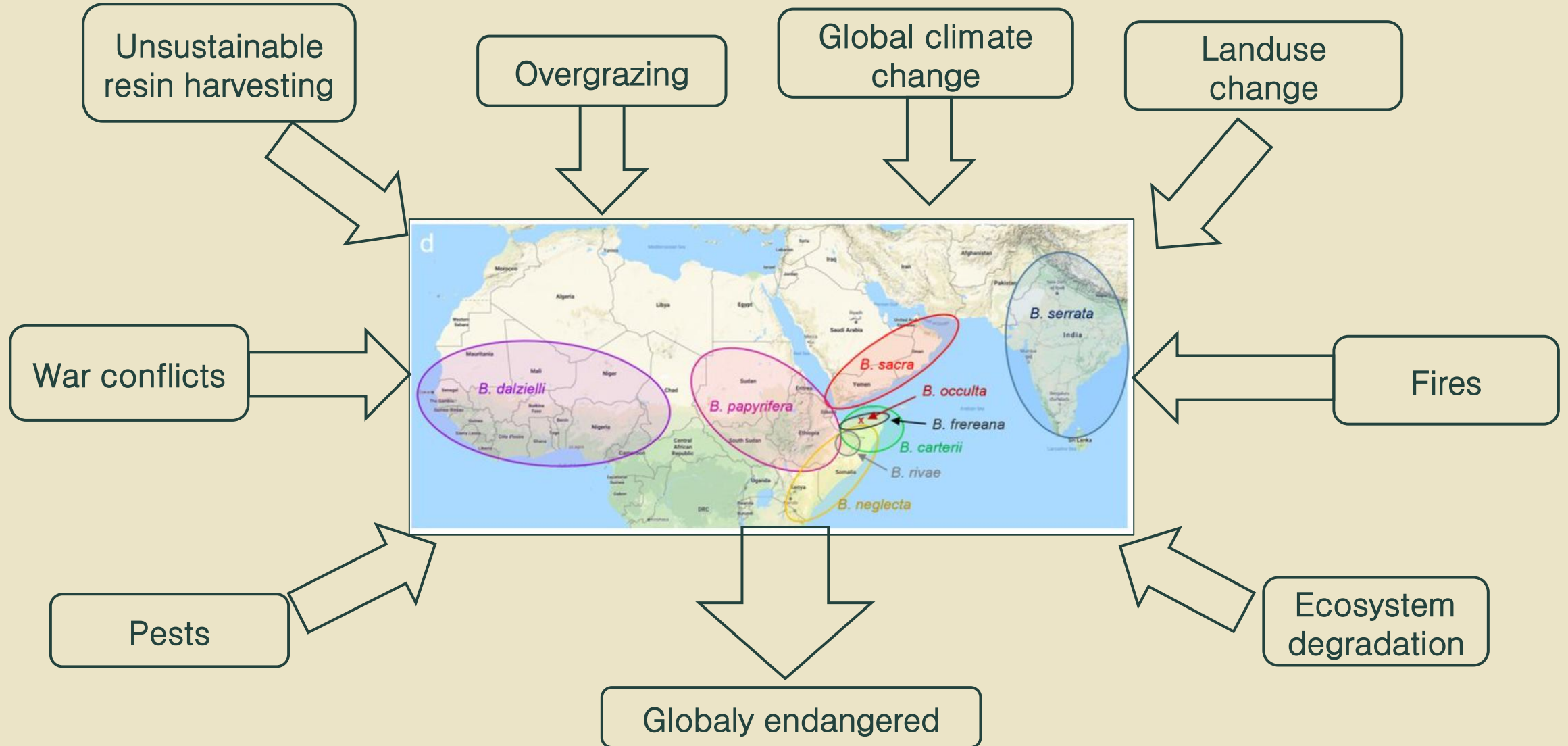


**Fig. 2 | Distribution and size structures of *Boswellia papyrifera* populations.** Map shows distribution of *B. papyrifera*, the main global source of frankincense, and locations of 23 *B. papyrifera* populations included in this study from highland (blue) and lowland (red) sites. Size structures are on the basis of relative abundance (highest class, 1) in 3-cm-wide tree diameter classes (minimum diameter, 1 cm). Size structures show that small, juvenile trees (<7 cm stem diameter, grey dashed vertical lines) are often missing, potentially due to cattle ranging and frequent fires. Site information is given in Supplementary Table 2. Hillshade layer credit: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodastyselsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community.



**Fig. 4 | Projected development of *Boswellia* populations and frankincense yield at 23 sites.** Projections show rapid decline of both population size and frankincense yield across the Horn of Africa, in both highland (blue;  $n=12$ ) and lowland (red;  $n=11$ ) classes. Each line represents the average population and yield projection of the 250 bootstrapped Integral Projection Model runs. Lines are semitransparent to allow for visualization of overlapping projections (see Supplementary Fig. 4 for individual graphs per site). Dots represent average time (whiskers, 1 s.d.) to reach 50% of initial population size and yield.

# Threats for Boswellia populations



5 CR  
5 EN  
3 VU  
3 LC  
1 NT

# Natural heritage

17 species listed in IUCN Red List

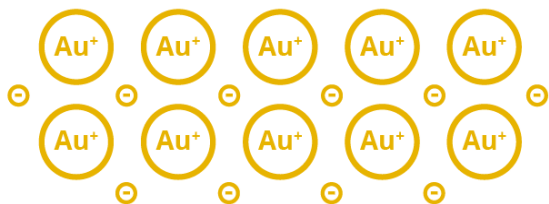
|                                                                                                                                                                                           |                                                                                                                                                                                           |                                                                                                                                                                                          |                                                                                                           |                                                                                                                           |                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
|  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia elongata</i></b><br/>↓ Decreasing &lt;EN&gt;</p>   |  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia socotrana</i></b><br/>↓ Decreasing &lt;VU&gt;</p> |  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia bullata</i></b><br/>↓ Decreasing &lt;EN&gt;</p> | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia scopulorum</i></b><br/>↓ Decreasing &lt;CR&gt;</p>  | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia ovalifoliolata</i></b><br/>↓ Decreasing &lt;VU&gt;</p>              | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia ameero</i></b><br/>↓ Decreasing &lt;EN&gt;</p>               |
|  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia popoviana</i></b><br/>↓ Decreasing &lt;EN&gt;</p> |  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia nana</i></b><br/>Unknown &lt;CR&gt;</p>          |  <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia samhaensis</i></b><br/>Unknown &lt;CR&gt;</p>  | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia dioscoridis</i></b><br/>↓ Decreasing &lt;EN&gt;</p> | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b>Milafu</b><br/><i>Boswellia ogadensis</i><br/>Unknown &lt;CR&gt;</p>             | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b>Qura</b><br/><i>Boswellia rivae</i><br/>— Stable &lt;LC&gt;</p>           |
|                                                                                                                                                                                           |                                                                                                                                                                                           |                                                                                                                                                                                          | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia hesperia</i></b><br/>Unknown &lt;CR&gt;</p>         | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b>Indian Frankincense</b><br/><i>Boswellia serrata</i><br/>— Stable &lt;LC&gt;</p> | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b>Tantani</b><br/><i>Boswellia pirottae</i><br/>↓ Decreasing &lt;VU&gt;</p> |
|                                                                                                                                                                                           |                                                                                                                                                                                           |                                                                                                                                                                                          | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia dalzielii</i></b><br/>↓ Decreasing &lt;LC&gt;</p>   | <p>PLANTAE - MAGNOLIOPSIDA GLOBAL<br/><b><i>Boswellia sacra</i></b><br/>Unknown &lt;NT&gt;</p>                            |                                                                                                                    |

# GOLD, FRANKINCENSE & MYRRH

These three substances are brought as gifts by the Three Wise Men in the Christmas story - in this graphic, we examine the uses and chemistry behind them.



## Gold

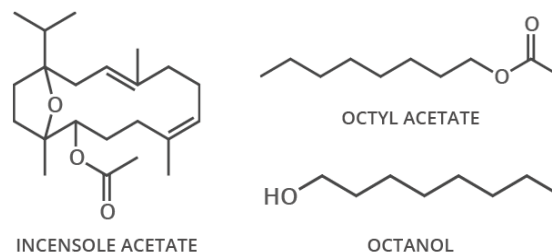


**Electron Configuration:**  $[\text{Xe}]4f^{14}5d^{10}6s^1$

Gold's structure consists of a lattice of cations with a 'sea' of delocalised electrons. Its golden colour is due to it having the correct energy difference between its 5d and 6s electron subshells to absorb photons of blue light.



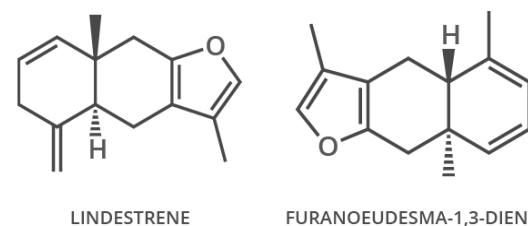
## Frankincense



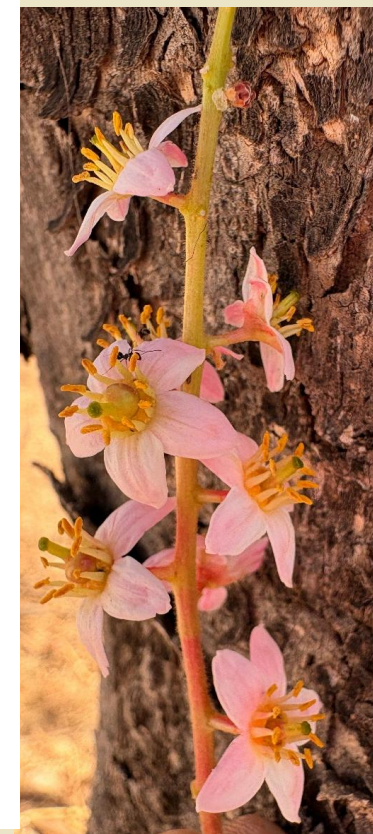
Frankincense resin is used as incense, with its smell the result of various compounds produced when it is burned. These include those shown above, as well as several terpenoid compounds. Research suggests that the compound incensole acetate could help alleviate anxiety & depression.



## Myrrh

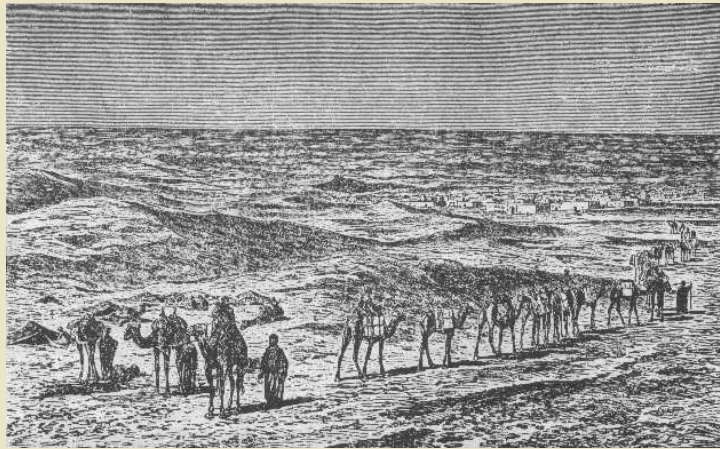


Myrrh resin, like frankincense, can be used in incense & perfumes, though it also has medicinal applications. Its aroma comes from a family of compounds called furanosesquiterpenes. Animal studies have suggested some compounds in myrrh can have an analgesic effect.



# Trees which wrote the human history

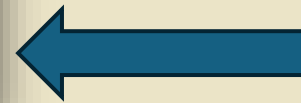
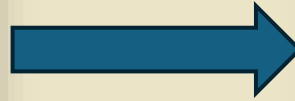
Cultural heritage



# Value chains: poor collectors – reach industry



use



conservation

Sustainable use of natural resources (NTFP) in difficult geo-political, socio-economical and cultural reality

# Amouage (Oman)



- Redemption price of 100 kg non-sorted resin from local collectors in Ethiopia is 5 USD
- After sorting, 15% of resin of the 1st grade is exported for 5 USD per 1 kg



US

AMOUAGE

Search

PERFUMESCOLLECTIONS

ESSENCES

BODY

DISCOVERY

HOUSE OF AMOUAGE



REFLECTION MAN

\$395



GUIDANCE

\$395



EXISTENCE

\$395



PURPOSE 50

\$550

# What is FRAGILE?

## The problem:

*Boswellia* species are globally threatened by over-exploitation and ecosystem degradation

## Why it matters:

Frankincense supports livelihoods, culture, and global markets (>1 billion USD annually)

## Our aim:

Long-term conservation, sustainable management, and resilient value chains

# WORK PACKAGES

**1. Biosystematics of *Boswellia*:  
Better Understanding the  
Relationship Among Taxa**



**2. Inventory & Conservation  
Status Assessment**



**3. Genetic Diversity and  
Population Differentiation of  
*Boswellia* sp. - A Baseline for  
Gene Pool Conservation**



**4. Growth Dynamics of  
*Boswellia* Species under  
Multiple Stressors**



**5. Trees as Biodiversity Hubs:  
Advancing Research, Training, and  
Knowledge Exchange on Key  
Ecological Interactions**



**6. *Boswellia* Honeys, Resins and  
Floral Scents: Chemistry, Cultural  
Uses and Knowledge Exchange**



**7. Socio-economy and Governance  
of Frankincense Harvesting and  
Value Chain Improvement**



**8. Science-policy-practitioner  
Exchange on *Boswellia* woodlands  
regeneration, Restoration and  
Conservation**



1.WP

2.WP

3.WP

4.WP

5.WP

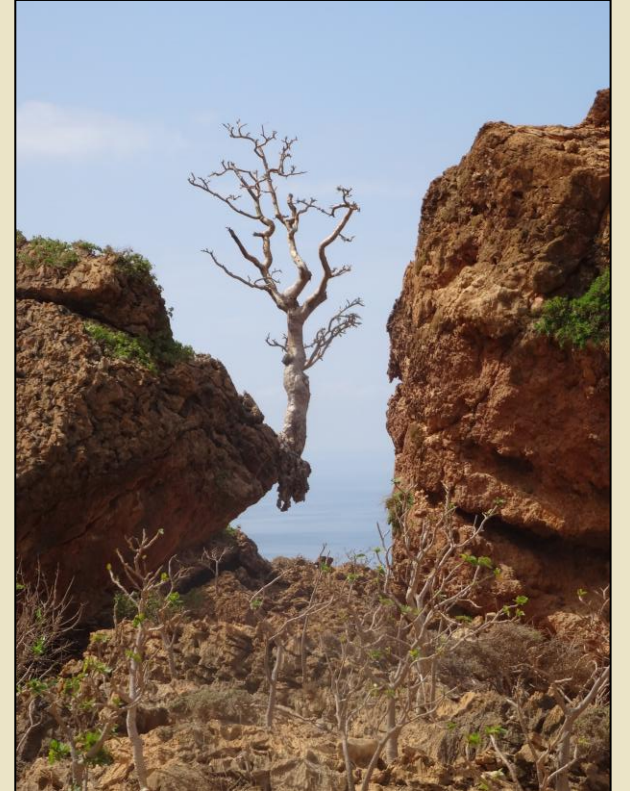
6.WP

7.WP

8.WP

# Biosystematics of *Boswellia*: Better Understanding the Relationship Among Taxa

- **Clarify species boundaries:** resolve taxonomy across ~25 *Boswellia* species
- **Build phylogenetic backbone:** foundational for all downstream WPs
- **Identify conservation priorities:** support evidence-based protection and restoration.
- **Leading partner:** UP



2.WP

3.WP

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6.WP

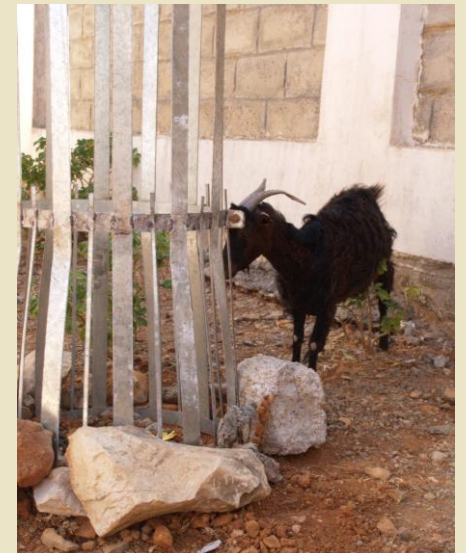
7.WP

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1.WP

## → Inventory & Conservation Status Assessment

- **Assess population status:** evaluate threats: overharvesting, grazing, pests, land-use change, conflict, climate extremes (cited lines).
- **Identify priority sites:** map key populations for targeted conservation.
- **Train local partners:** capacity building in range states (activity type: Research + Training).
- **Provide baseline for other WPs:** informs genetics, ecology, restoration.
- **Leading partner:** UNIROMA1



3.WP

4.WP

5.WP

6.WP

7.WP

8.WP

1.WP

2.WP

# Genetic Diversity and Population Differentiation of *Boswellia* sp. – A Baseline for Gene Pool Conservation

- **Analyse genetic structure:** detect adaptive lineages and population differentiation.
- **Support gene-pool conservation:** identify vulnerable or unique genetic units.
- **Link genetics to ecology:** integrate with WP2 inventory and WP4 dendroclimatology.
- **Provide baseline for restoration** — guide WP8 regeneration strategies.
- **Leading partner:** AMU



*B. ameero*



*B. bullata*



*B. dioscoridis*



*B. elongata*



*B. nana*

4.WP

## Growth Dynamics of *Boswellia* sp. Under Multiple Stressors

5.WP

6.WP

7.WP

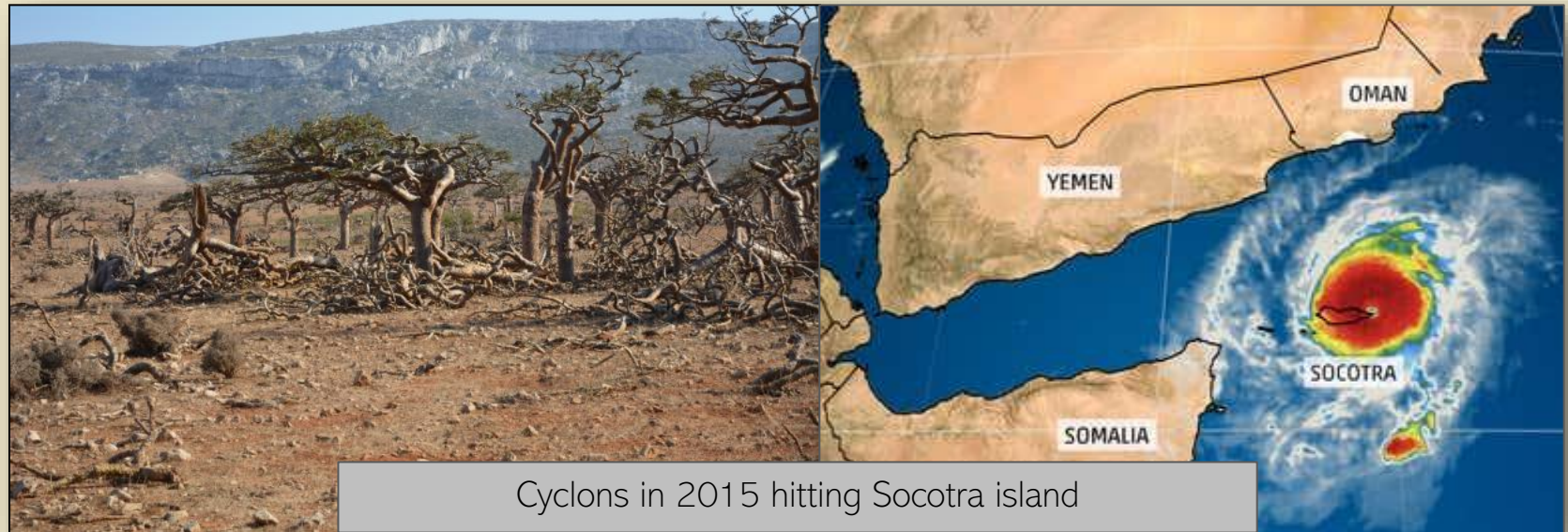
- **Study stress responses** — drought, grazing, tapping wounds, pests, climate extremes.
- **Analyse growth patterns** — dendroclimatology and ecophysiology.
- **Detect climate sensitivities** — prolonged droughts, cyclones.
- **Inform sustainable management** — evidence for tapping guidelines and restoration.
- **Leading partner: NORD**

8.WP

1.WP

2.WP

3.WP



Cyclons in 2015 hitting Socotra island

5.WP

6.WP

7.WP

8.WP

1.WP

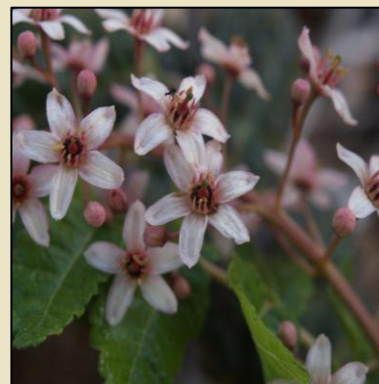
2.WP

3.WP

4.WP

# Trees as Biodiversity Hubs: Advancing Research, Training, and Knowledge Exchange on Key Ecological Interactions

- **Study ecological networks:** pollinators, mycorrhiza, insects, fungi
- **Understand regeneration drivers:** interactions shaping seedling success.
- **Advance training & Exchange:** Research + Training WP.
- **Provide context for restoration** — feeds directly into WP8.
- **Leading partner:** ULB



6.WP

7.WP

8.WP

1.WP

2.WP

3.WP

4.WP

5.WP

# → *Boswellia* Honey and Resins: Chemistry, Cultural Uses and Knowledge Exchange

- **Analyse resin & honey chemistry:** VOCs, bioactive compounds.
- **Document cultural uses:** traditional knowledge, socio-cultural identity.
- **Link chemistry to ecology** — species identity, tapping practices, environmental stress.
- **Support sustainable value chains** — improve product valorisation.
- **Leading organisation:** ULB



7.WP

8.WP

1.WP

2.WP

3.WP

4.WP

5.WP

6.WP

# Socio-economy and Governance of Frankincense Harvesting and value chains Improvement

- **Analyse livelihoods:** frankincense as primary income for hundreds of thousands.
- **Map governance systems:** customary rules, market norms, certification gaps.
- **Evaluate regulatory tools:** CITES risks/benefits, EU trade regulations.
- **Improve value chains:** align economic and ecological incentives.
- **Leading organisation:** WU



8.WP

1.WP

2.WP

3.WP

4.WP

5.WP

6.WP

7.WP

## → Science–policy–practitioner Exchange on *Boswellia* woodlands regeneration

- **Develop restoration strategies:**  
based on ecology, genetics,  
socio–economics.
- **Co–create management guidelines:**  
locally adapted, stakeholder–driven.
- **Implement field regeneration:**  
Light Houses, on–the–ground conservation.
- **Integrate results across WPs:**  
circular flow of data → practical action.
- **Leading organisation: MENDELU**



Thank you

