Science-based ecological restoration to inform national and European restoration policies

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Ecologia Vegetal 2024/2025

Outline

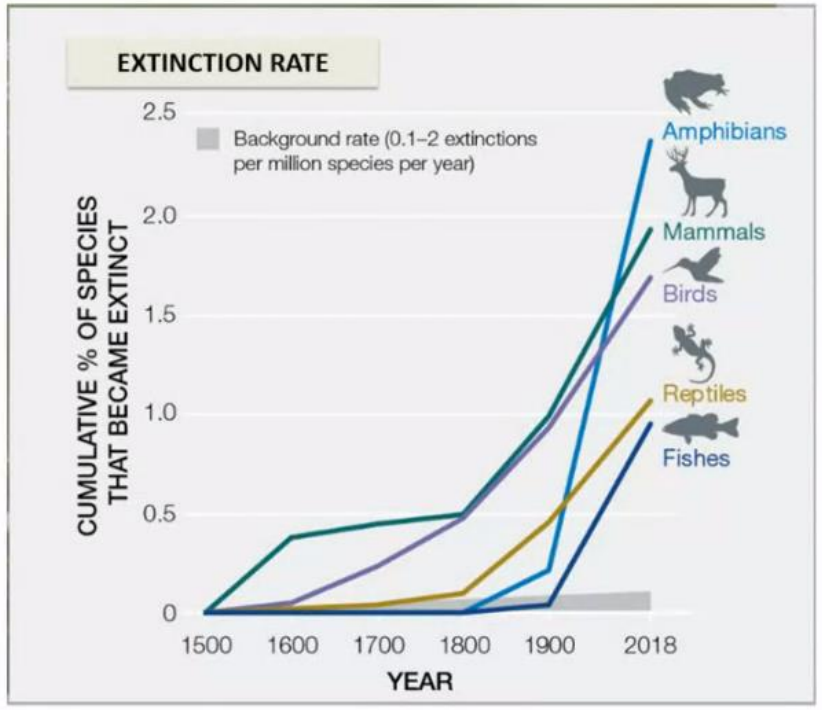
1. Biodiversity crisis and ecosystem degradation
2. Restoration activities (broad sense) and ecological restoration
3. EU Nature Restoration Law
4. Examples of restoration projects implemented in Portugal
    - Scientific evidence and monitoring
    - Costal dune system
    - Limestone quarry
    - Dryland agroforestry systems

Ecosystem degradation and policy initiatives

Ecosystem degradation currently **affects 75% of the land surface**, with a negative impact on the well-being of **at least 3.2 billion people**, costing **more than 10% of the annual gross global product** in biodiversity loss and ecosystem services**, negatively affecting all Sustainable Development Goals**.

Wetlands have globally **decreased by 87%** over the last 300 years.

The Global and EU biodiversity crisis



Biodiversity loss and the degradation of ecosystems, continue at an alarming rate, across the broad range of ecosystem types in EU:

- >80% of habitats in poor condition, peatlands, grasslands and dune habitats worst
- In Western, Central and Eastern Europe wetlands have shrunk by 50% since 1970

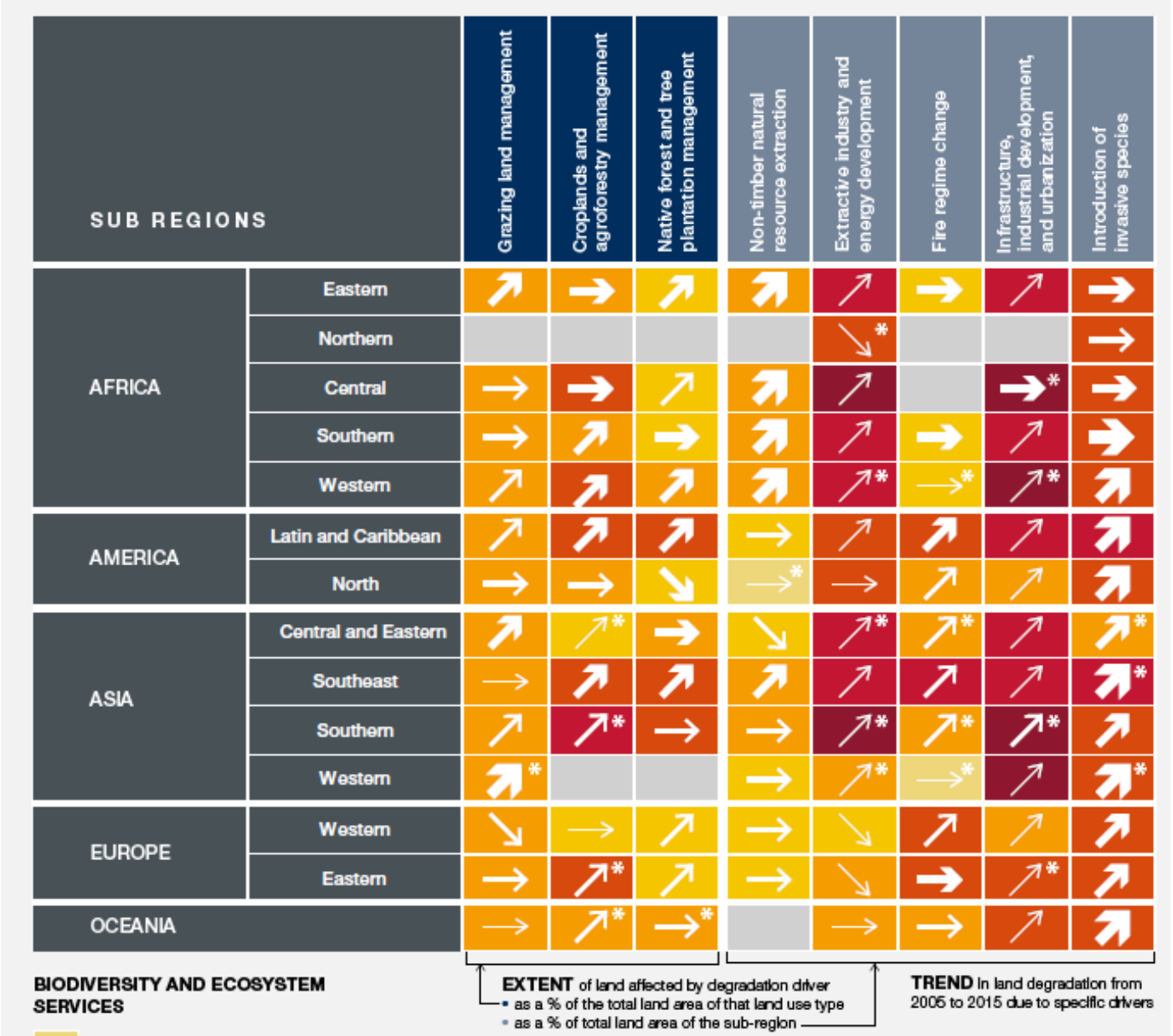
IPBES - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2018)

Degradation causes

Management of:

- Grazing
- Agriculture and agroforestry systems
- Native forests and plantations

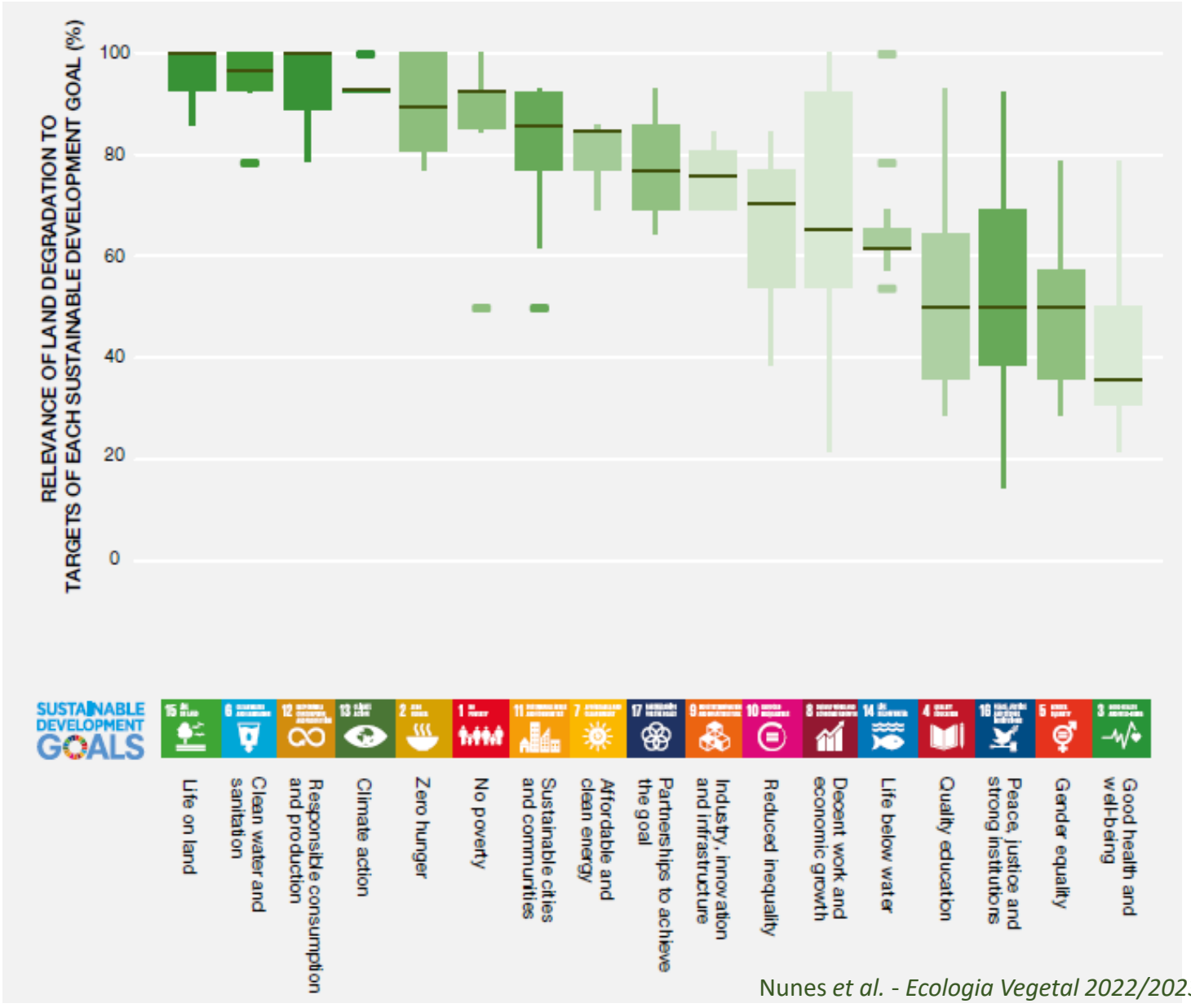
- Exploitation of natural resources
- Development of the extractive and energy industry
- Change in fire regimes
- Infrastructure, industries and urbanization
- Introduction of invasive species



IPBES (2018)

Degradation consequences

In all Sustainable Development Goals



IPBES (2018)

Nunes *et al.* - *Ecologia Vegetal 2022/2023*

Ecosystem degradation and policy initiatives

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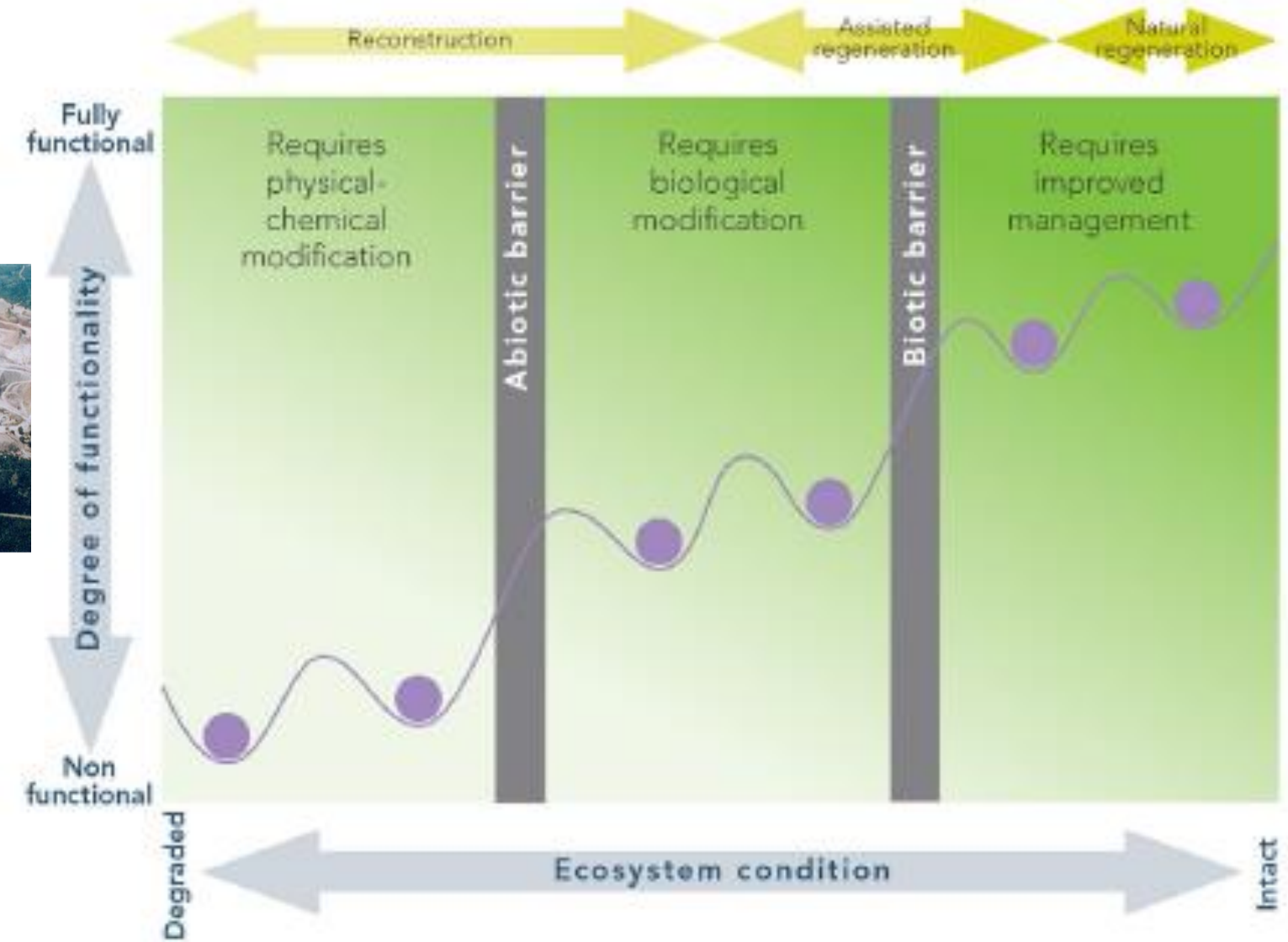
UN Decade on Ecosystem Restoration (2021 – 2030) to combat climate change impacts and loss of biodiversity, increase food safety and water supply

EU Green Deal (2019) key objective to preserve and restore ecosystems and biodiversity, including the **2030 Biodiversity Strategy**

EU Nature Restoration Law (22nd June 2022) The legislative proposal for binding nature restoration targets presented by the European Commission

IPBES - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2018)

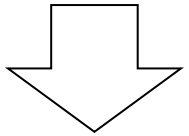
The level of restoration intervention needed depends on the degree of degradation



McDonald et al. 2016. International standards for the practice of ecological restoration. SER, Washington, D.C.

Broad restoration concept

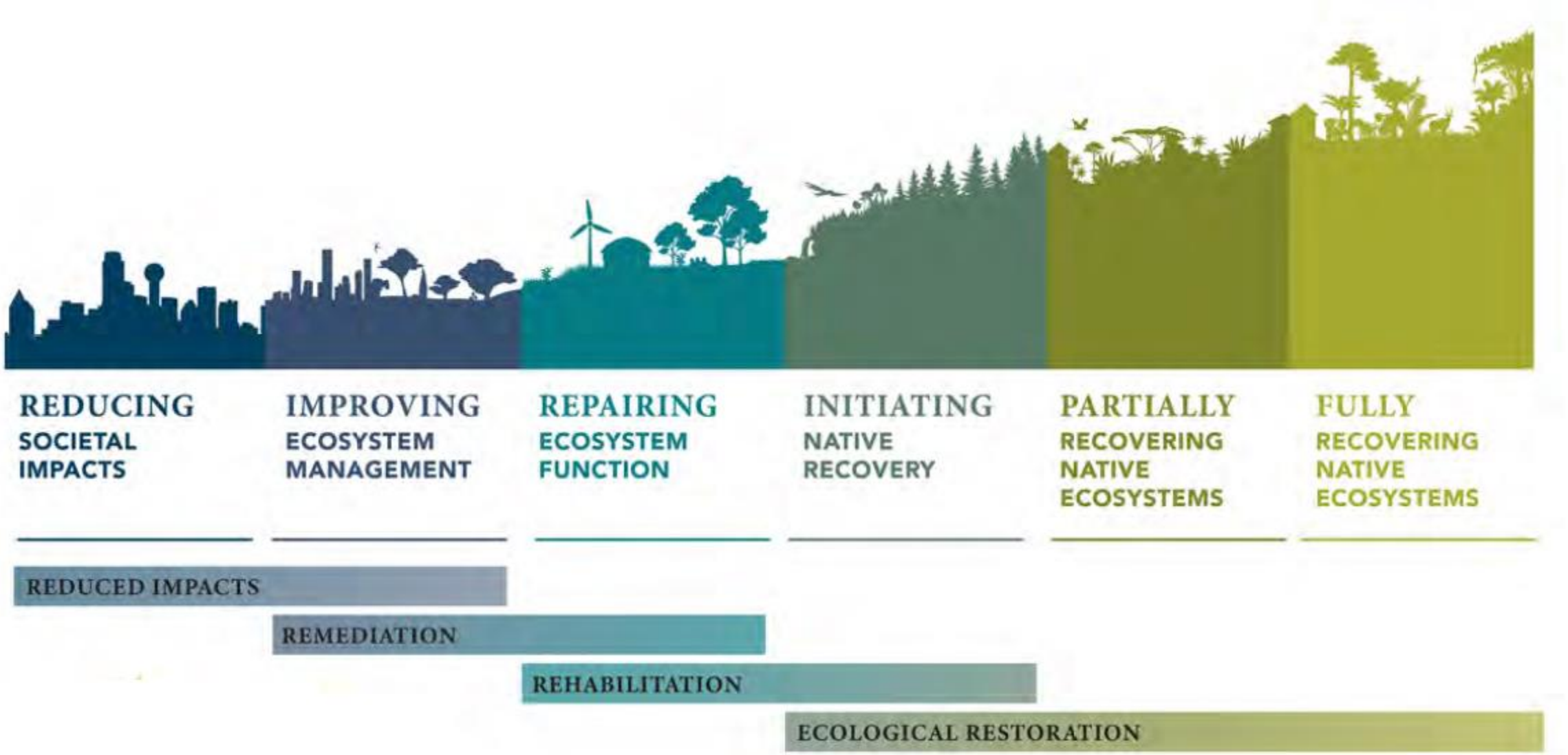
The concept of restoration in many of these initiatives and agreements is **very broad** and includes many approaches to restoration including **ecosystem management** and **nature-based solutions**



Seen as: “a contribution to reversing the loss of biodiversity, recovering connectivity, improving ecosystem resilience, enhancing the provision of ecosystem services, mitigating and adapting to the effects of climate change, combating desertification and land degradation, and improving human well-being while reducing environmental risks and scarcities.”

Gann et al. (2019)

Restoration activities *Continuum*



Gann et al. 2019. International principles and standards for the practice of ecological restoration

UE Nature Restoration Law

Baroni et al. (2022)

Misconception: restoration = no management = “rewilding”

Rewilding = “passive restoration” passive management of ecological succession in abandoned landscapes (e.g. creation of no-hunting areas, low-intervention forestry management, setting aside agricultural land, the removal of dispersal barriers, and the restoration of natural flood regimes)

“Common” interpretation: passive regeneration/spontaneous; no-intervention management; natural processes

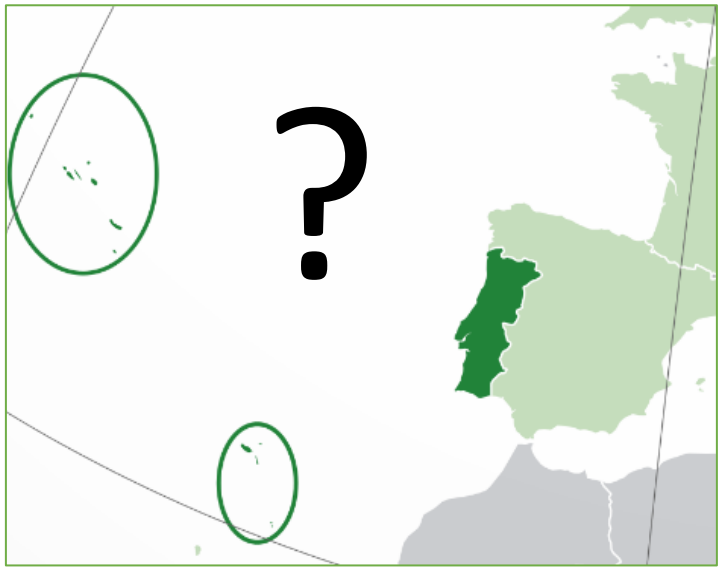
Rewilding *trófico*: planned reintroduction of key species such as top predators (e.g. wolf or lynx) or herbivores into a habitat from which they disappeared, in an effort to increase biodiversity and restore ecosystem health. It may include the introduction of non-native species as ecological replacements for species that became extinct centuries or millennia ago;

An approach that could make sense in specific contexts and is not a panacea for ecosystem restoration; still lacks scientific evidence, requiring careful monitoring and the precautionary principle

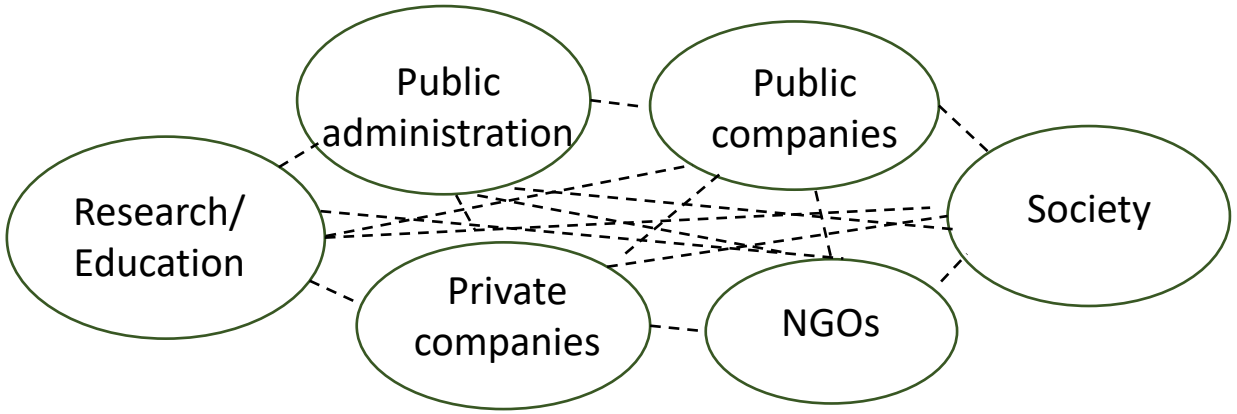
Perino et al. 2019

Can we get an overview of restoration projects in Portugal?

- Who are the main actors?
- How many projects are there and where?
- What means and approaches are used?
- How successful is it? How are they evaluated?
- How are they financed?
- What are the main limitations? What are the priorities?



How can we share knowledge, experience, resources, tools, projects, opportunities?



Scientific evidence and monitoring of ecosystem restoration in Portugal

Agroforestry systems restoration (Alentejo)

Dune restoration (Costa da Caparica)

Quarry restoration (Arrábida Natural Park)

Post-fire restoration (Bragança)

Mine fitorremediation (Alentejo)

Scientific evidence and monitoring of ecosystem restoration in Portugal

Restoration in rivers - riparian habitats





Photos Helena Alves. Pedro Teiga


Maria João Cardoso


Patricia M. Rodríguez González - CEF, ISA-UL

https://www.ser.org/news/602944/SER-E-Webinar-State-of-Ecological-Restoration-in-Portugal.htm

Scientific evidence and monitoring of ecosystem restoration in Portugal

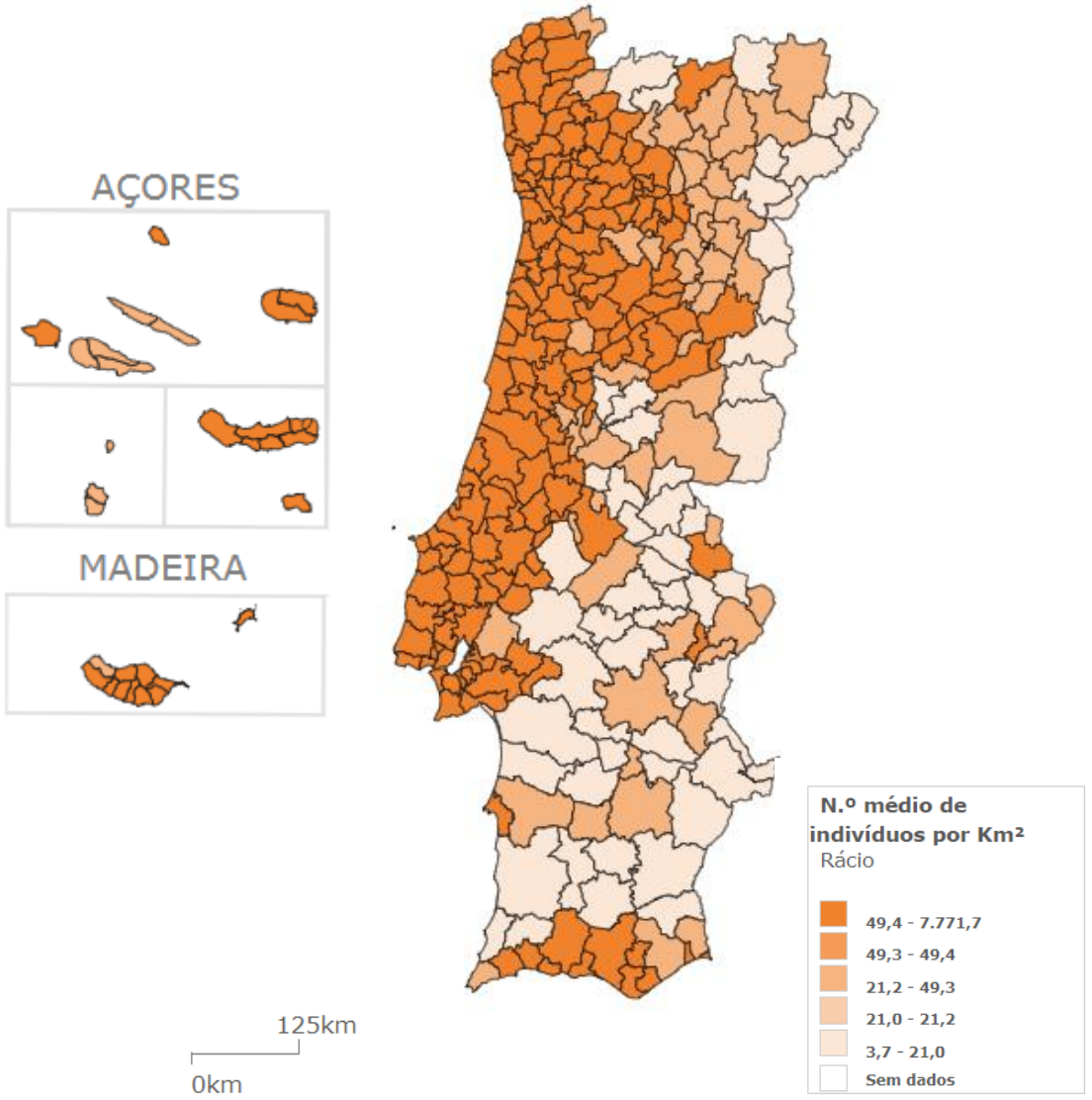
Seagrass restoration

Ana I. Sousa – CESAM, Department of Biology, University of Aveiro

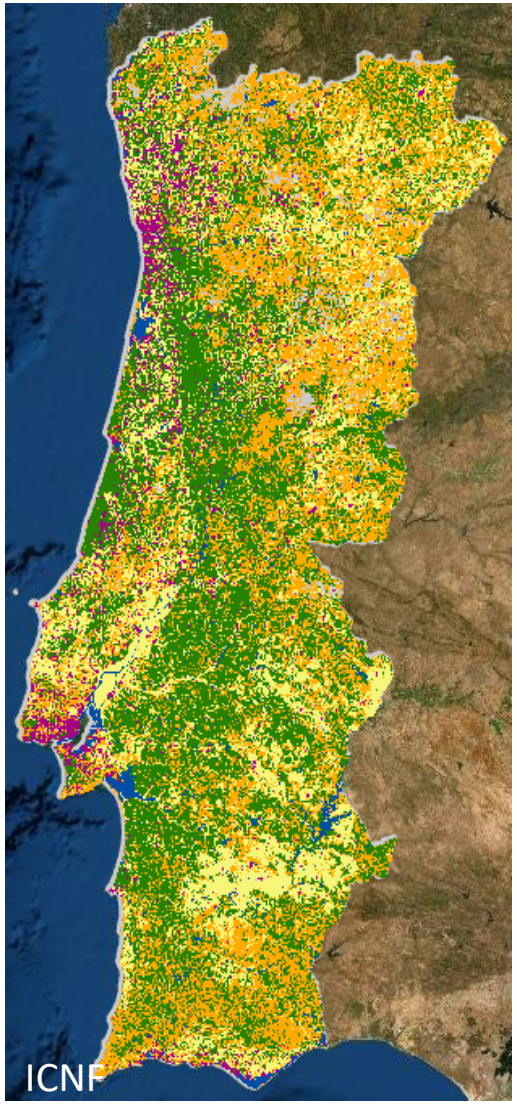
https://www.ser.org/news/602944/SER-E-Webinar-State-of-Ecological-Restoration-in-Portugal.htm

Need for restoration in urban context

Population density 2001



Land Use

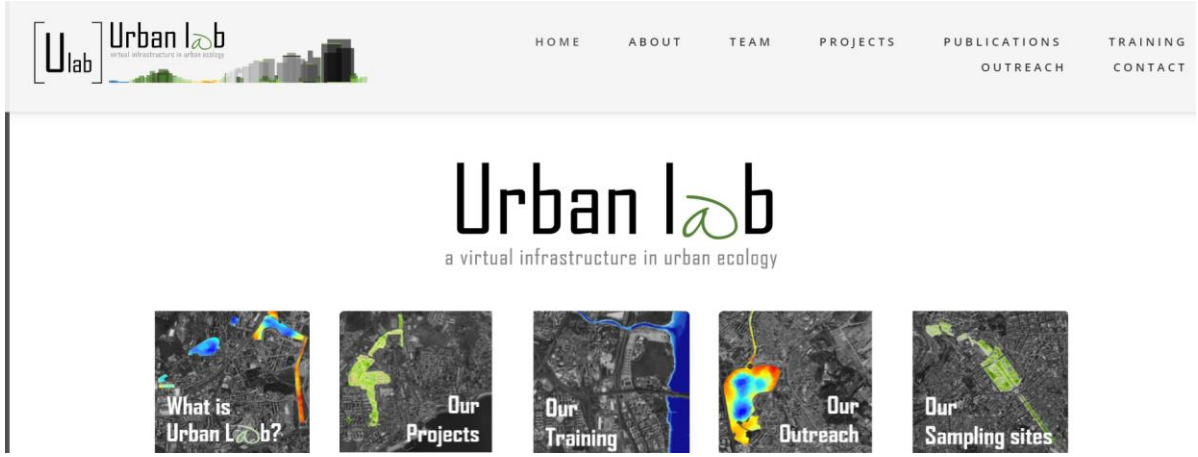


- Agriculture – 24%
- Forests – 35%
- Non-productive – 2%
- Shrublands and grasslands – 31%
- **Urban – 5%**
- Inland waters and wetlands – 2%

pordata.pt

Need for restoration in urban context

Increase urban green spaces with ecological features, such as parks, trees and woodland patches with native species, green roofs, wildflower grasslands, gardens, city horticulture, tree-lined streets, urban meadows and hedges, ponds and watercourses



https://urbanlab.campus.ciencias.ulisboa.pt/

HOW GREEN SPACES CAN HELP TO COOL DOWN CITIES

2ND SUSTAINABLE CAMPUS CONFERENCE

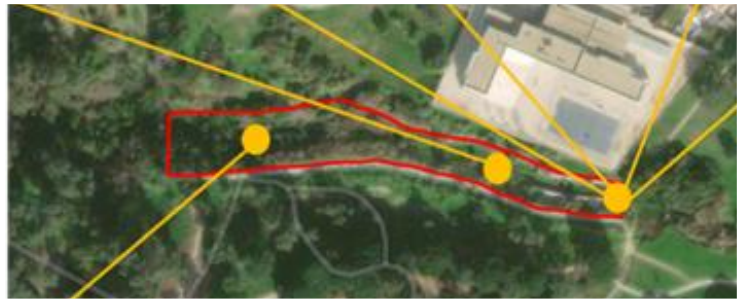
HOW TREES CAN HELP US DEAL WITH AIR POLLUTION IN CITIES

EVALUATING CITIZENS NEEDS FOR CITIES GREEN AREAS

(…)

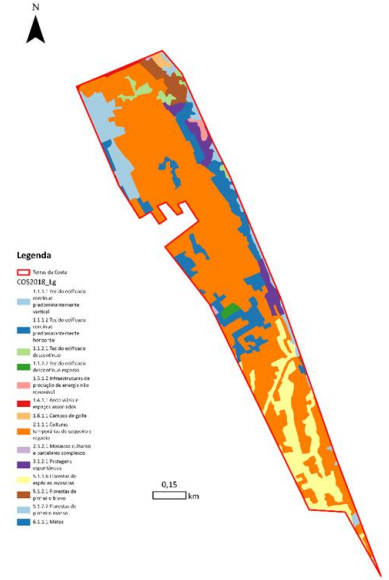
Need for restoration in peri-urban context

Restoration in riparian habitats



Controling invasive species

Promoting biodiversity in agro-systems



Project ALMADA - Desenvolvimento de Estudos e Projetos no Domínio da Biodiversidade (CMA, 2022-2024)

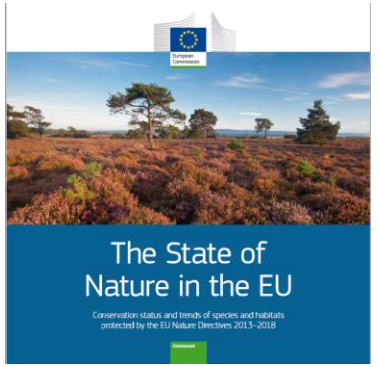
1. Coastal extent and vulnerability in Portugal

Physical and socio-economic indicators	*Atlantic Ocean*
Sea Level Rise	High
Coastline length	1 187 km
10 km coastal zone below 5 metres elevation	<5%
Coastline subject to erosion	338 km (28%)
GDP in 50 km zone (€ million)	122 082 (72%)
Population in 50 km zone	8 379 748 (80%)

Source: EEA, 2006, European Commission Eurostat 2004

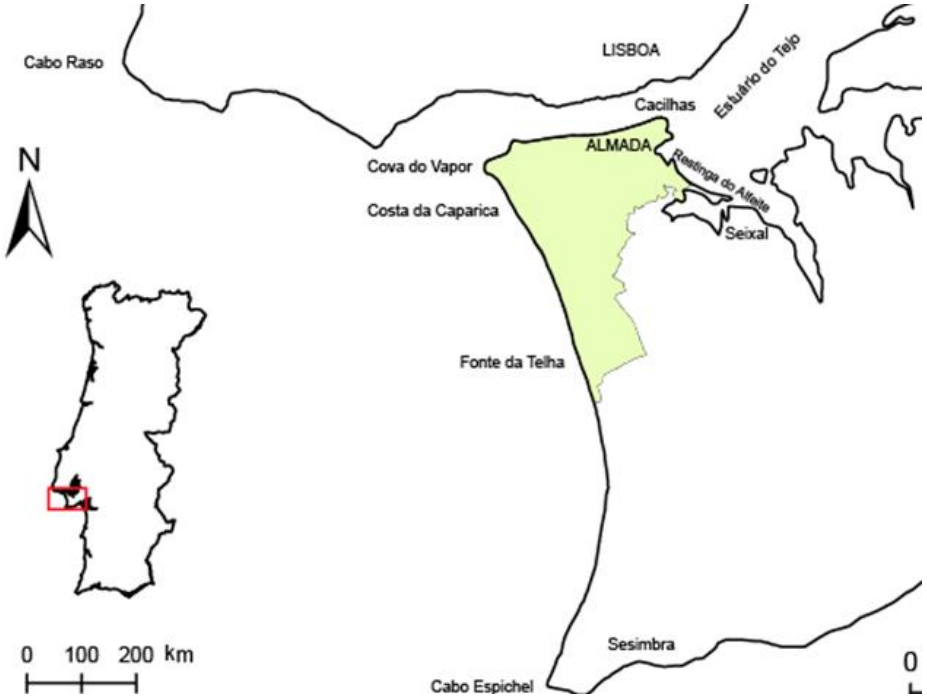
Globally under great pressure, **being rapidly lost and degraded**

- > 85% of the coastal dune habitats in a bad or poor status in Europe



European Commission, 2021

Coastal sand dunes in Almada Municipality



13 km Ocean front sand beaches

Increasingly frequent storms causing the disruption of the frontal dune and inundation of urban areas

Need for restoration of coastal habitats

Patrícia Pinto da Silva – Câmara Municipal de Almada

https://www.ser.org/news/602944/SER-E-Webinar-State-of-Ecological-Restoration-in-Portugal.htm

ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

Goal: associating artificial sand nourishment with dune ecological restoration, to strengthen dune resilience to current (coastal dynamics) and future (climate change) erosive agents

- Started in 2014, promoted by the Almada Municipality
- Long-term project and monitoring
- Initial area under restoration 50m x 1000m (5ha)

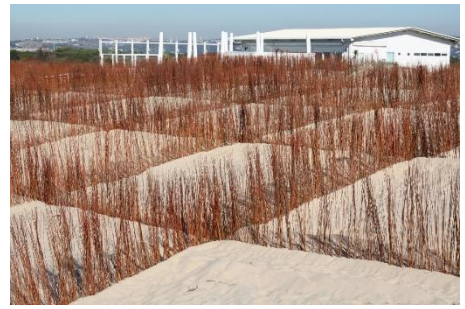
New area

CMA CÂMARA MUNICIPAL DE ALMADA
PROJETO COFINANCIADO PELA UNIÃO EUROPEIA
Fundo de Coesão
QREN QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL PORTUGAL 2007.2013
POVT PROGRAMA OPERACIONAL TEMÁTICO VALORIZAÇÃO DO TERRITÓRIO 2007 - 2013

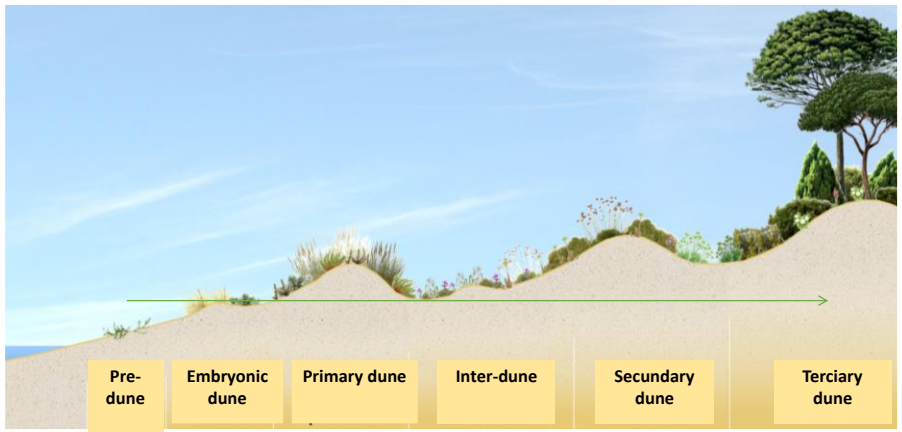
ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

Restoration actions include:

1. Installation of sand traps - willow palisades to promote the retention of sand transported by wind; length 1.1km and average width of 50 m, grouped into sedimentary cells of ~ 5 x 5 - 7 x 7 m; adapted to the morphology of the terrain)



2. Plantation of 10 native species from local origin for sediment fixation seeds collected locally to preserve the genetic integrity; plant species distributed according to ecological zonation



ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

Restoration actions include:

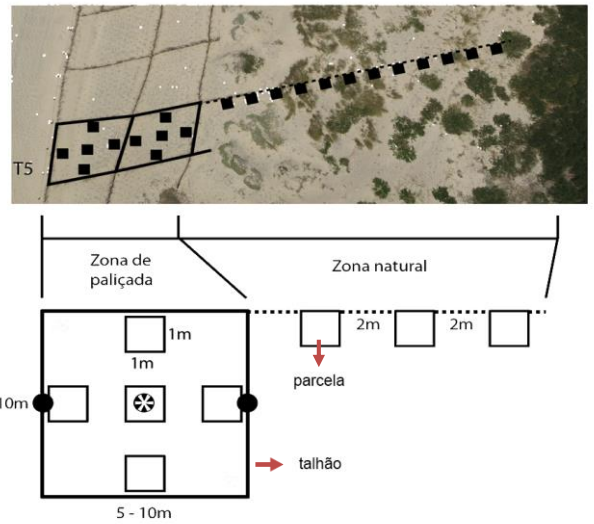
3. Trampling conditioning through pathways and viewpoints

4. Strong communication and community involvement
awareness and information boards and materials

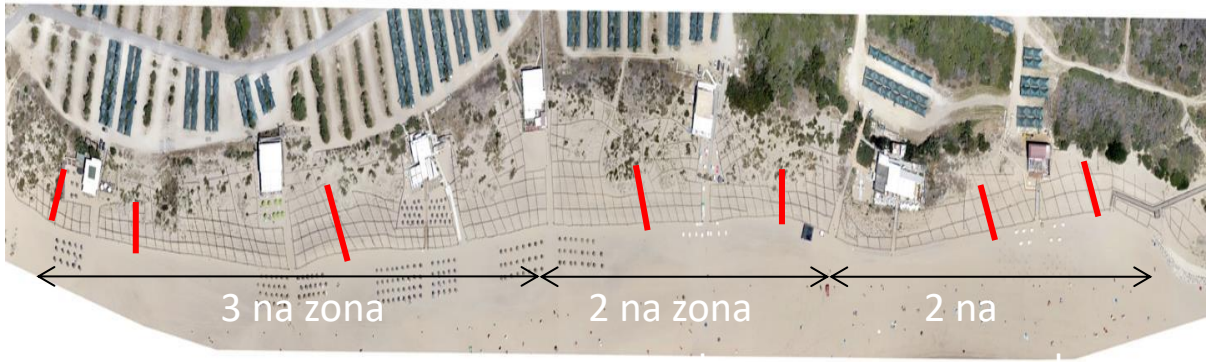
ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

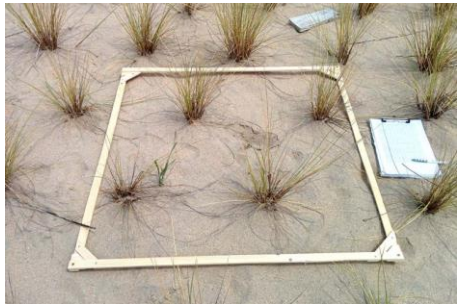
5. Ecological recovery assessment through monitoring (2014 – ongoing)

Planted species survival and growth, evolution of the seed bank
Plant species richness and cover
Animal species richness and abundance

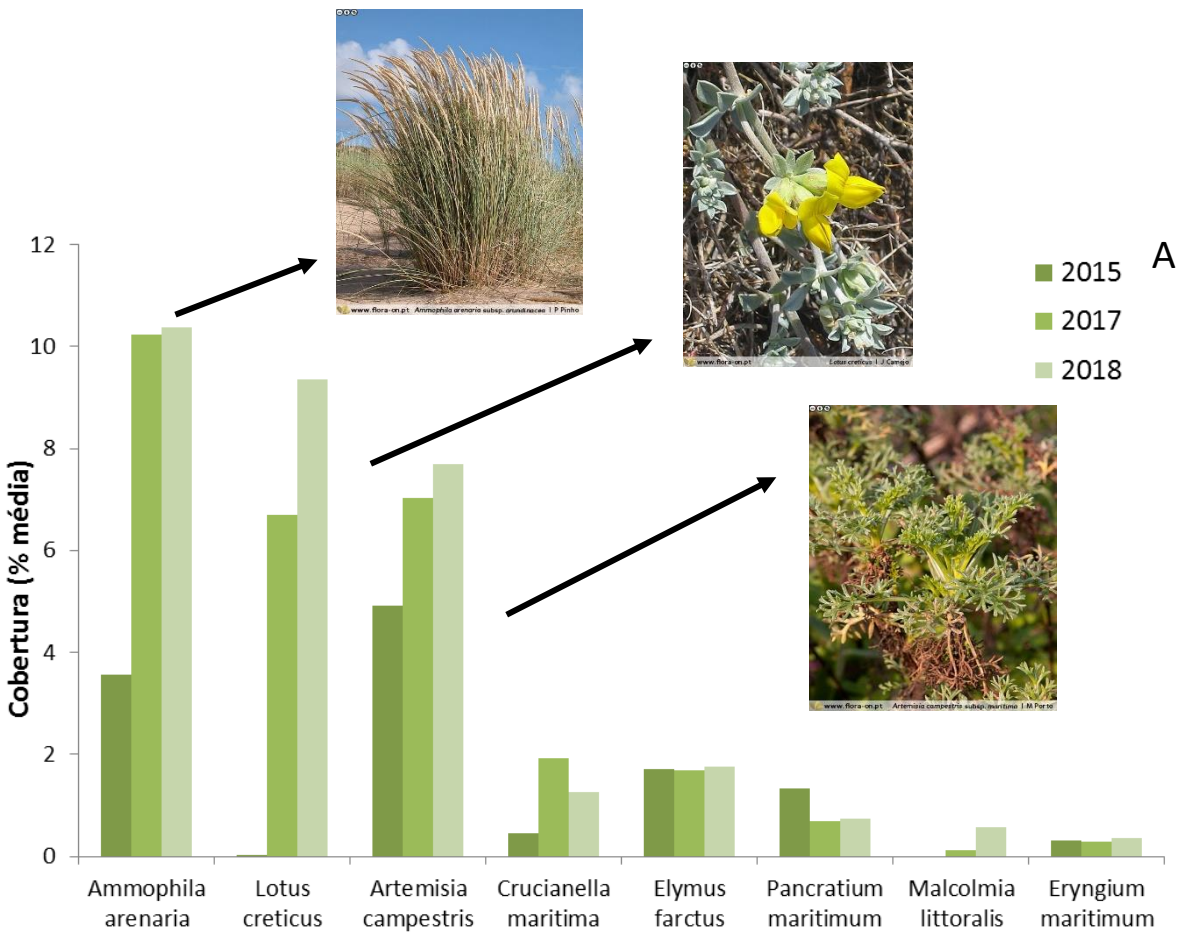


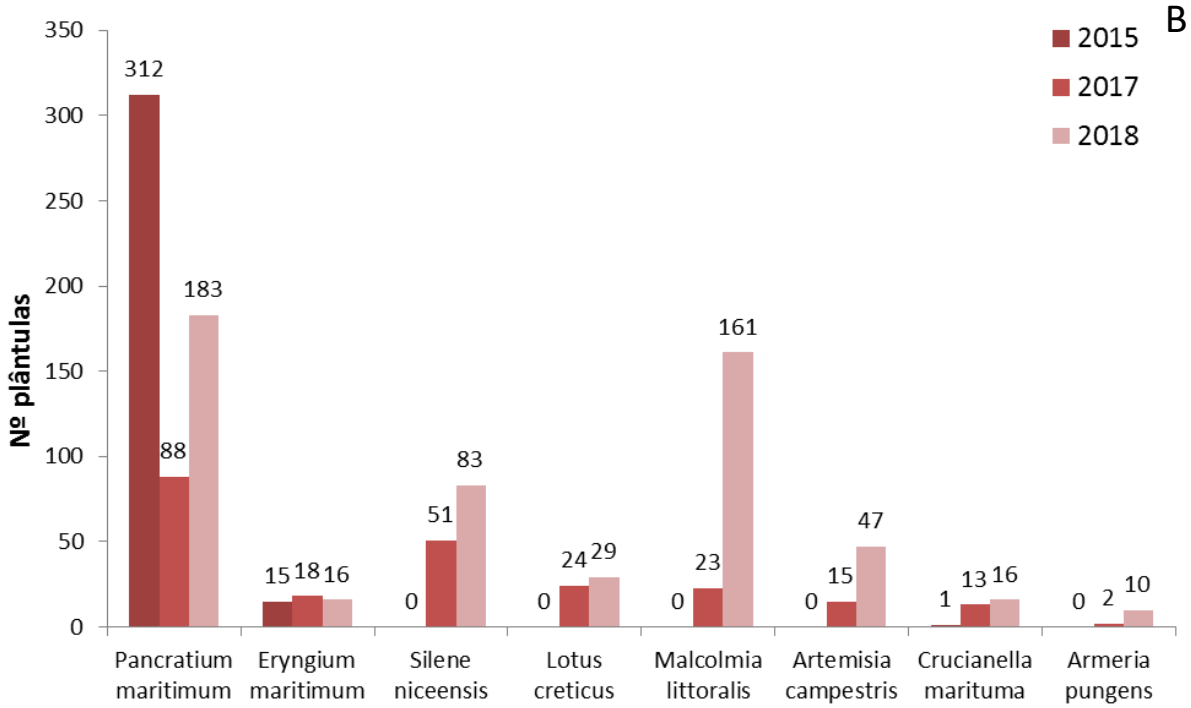
- essential for adaptive management and improvement





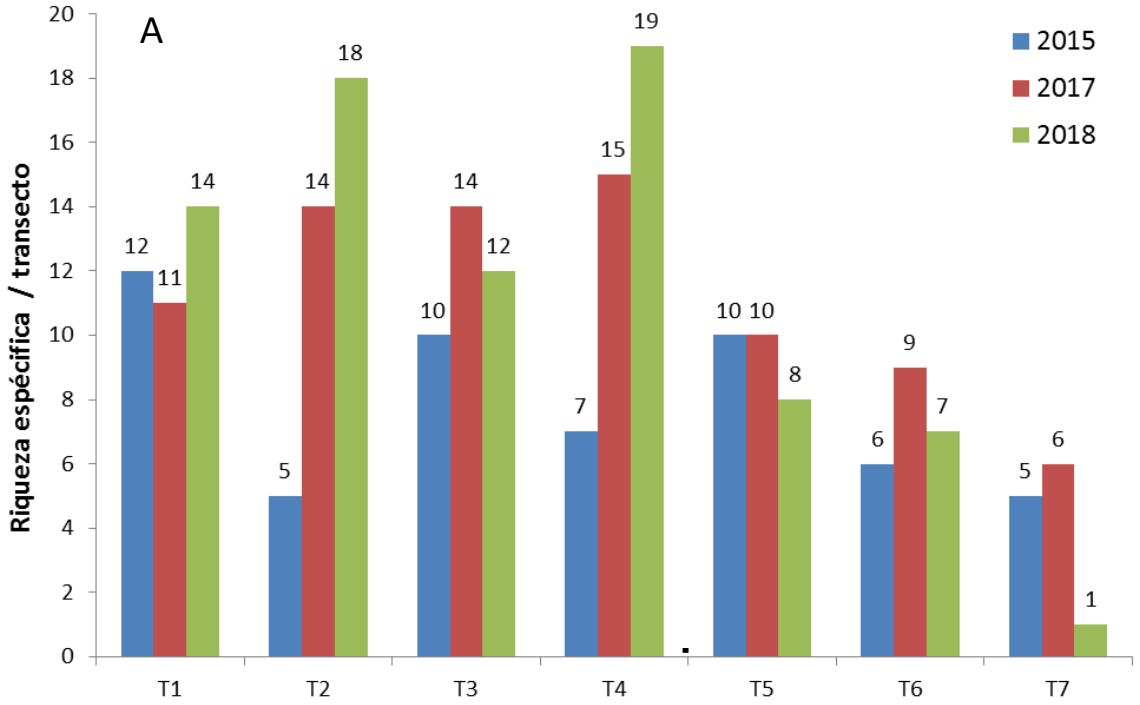
ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

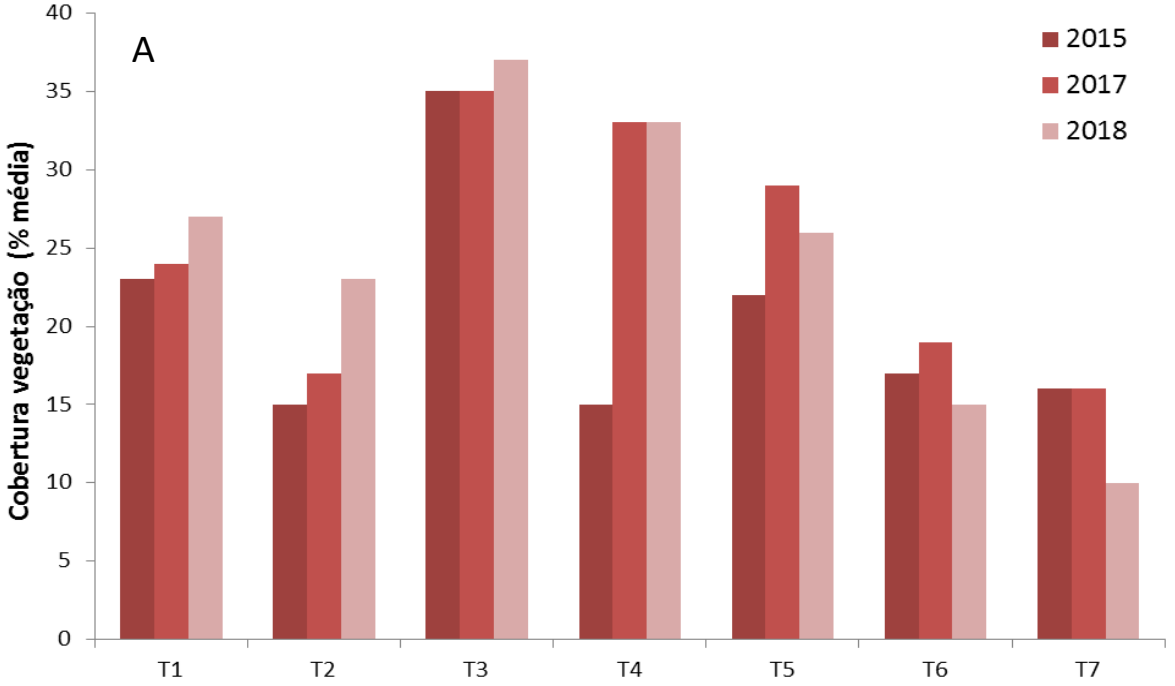




- High planted species´ cover and regeneration over time;
- *Ammophila arenaria, Artemisia campestris* and *Lotus creticus* had the most significant growth

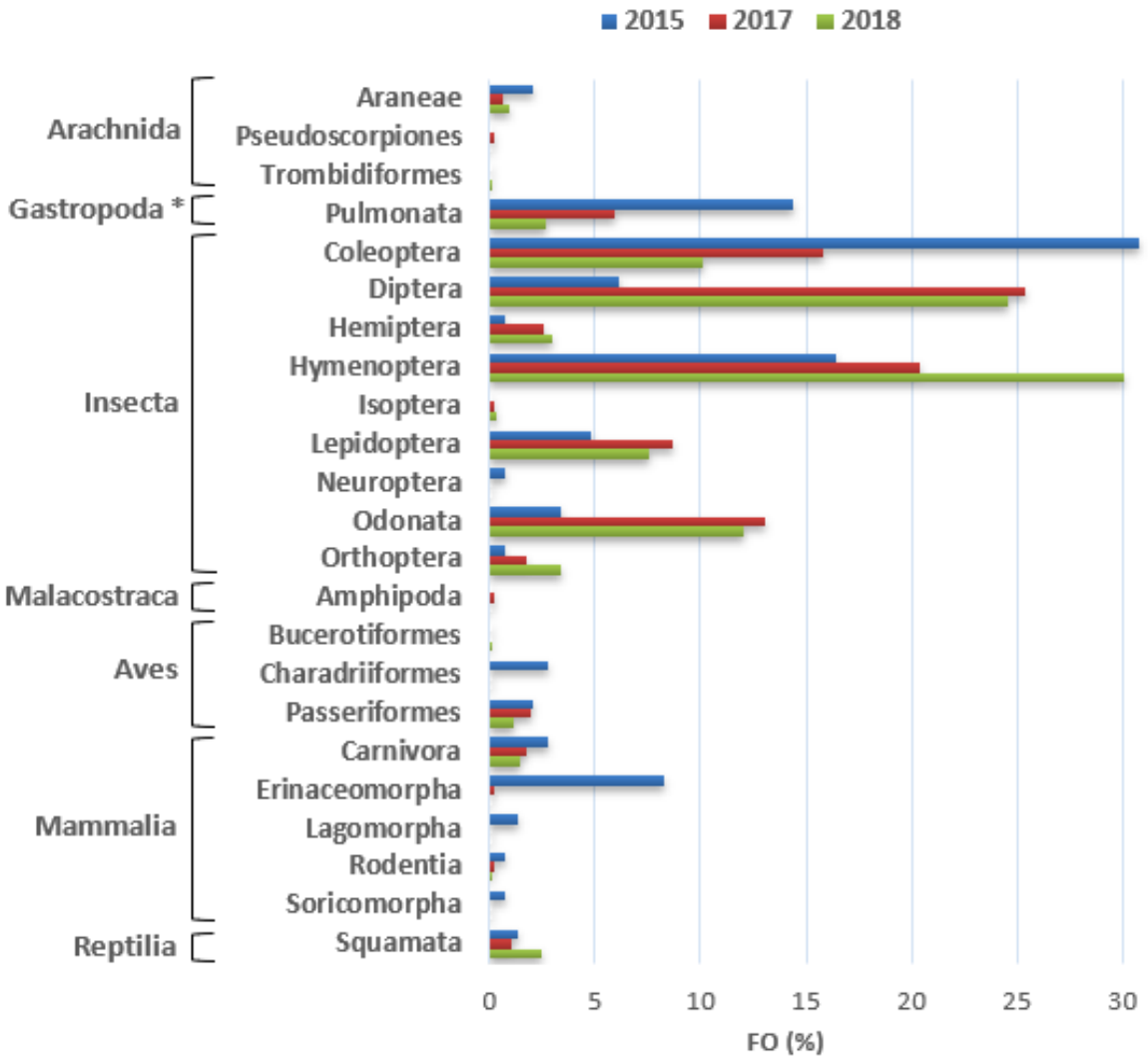
ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica



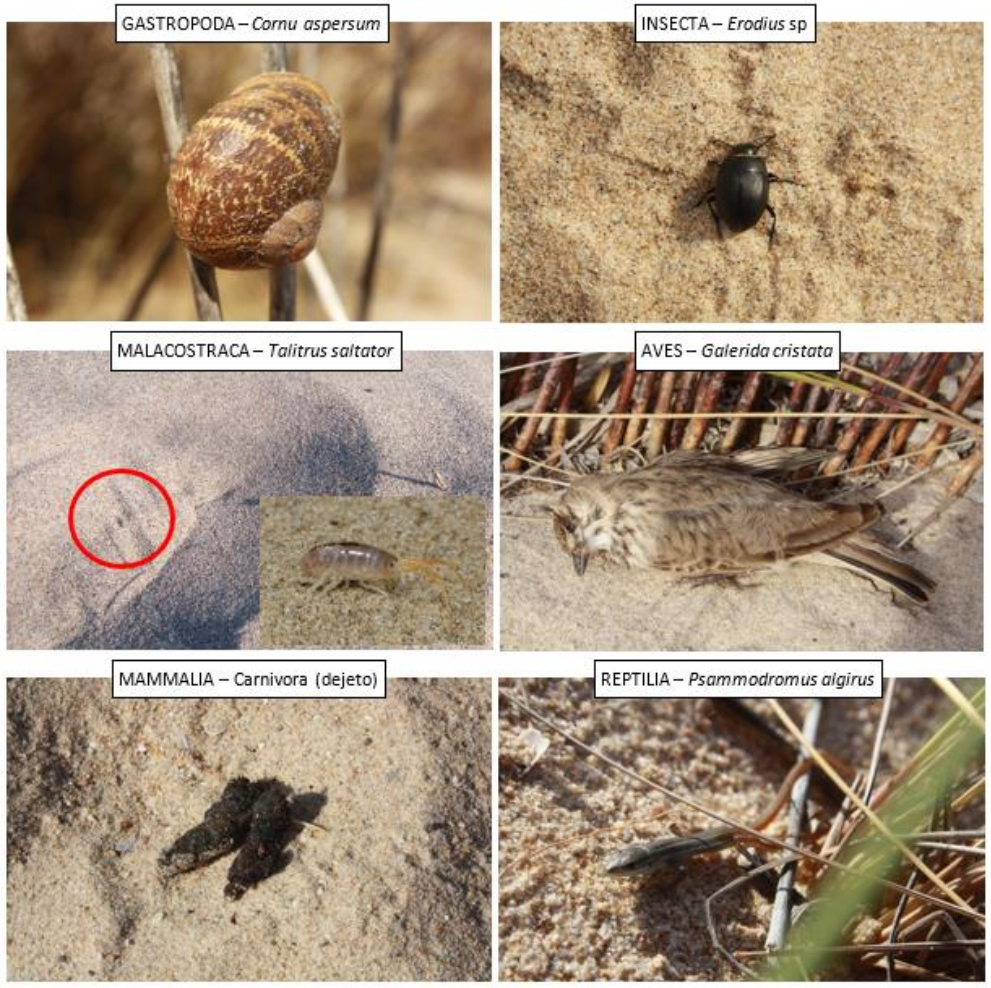


- Increase in overall plant species richness and cover over time

ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica



Frequency of occurrence (FO, %) of the different orders



- increase in the number and abundance of faunal species over time

ReDuna - Ecological restoration of the coastal dune system in S. João da Caparica

Lessons learned – Restoration of coastal dune systems

- **Dune ecological restoration** is an **effective lower-cost, easy-to-maintain and long-lasting solution** for the protection of costal ecosystems, which should complement artificial sand nourishment

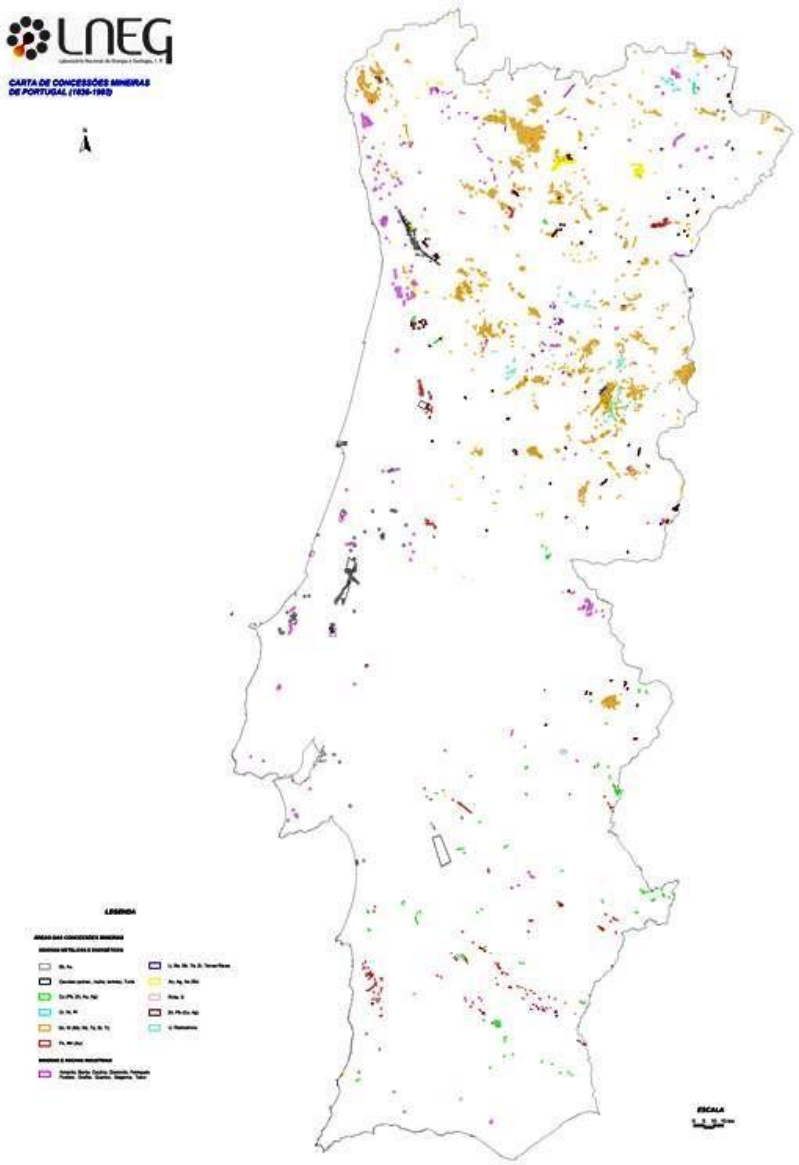
- **Scientific knowledge about the ecosystems to be restored**, as well as the **initial diagnosis of its vulnerabilities** are key steps for the success of the intervention

- **Strong communication and community involvement** are essential to the success of this type of restoration project

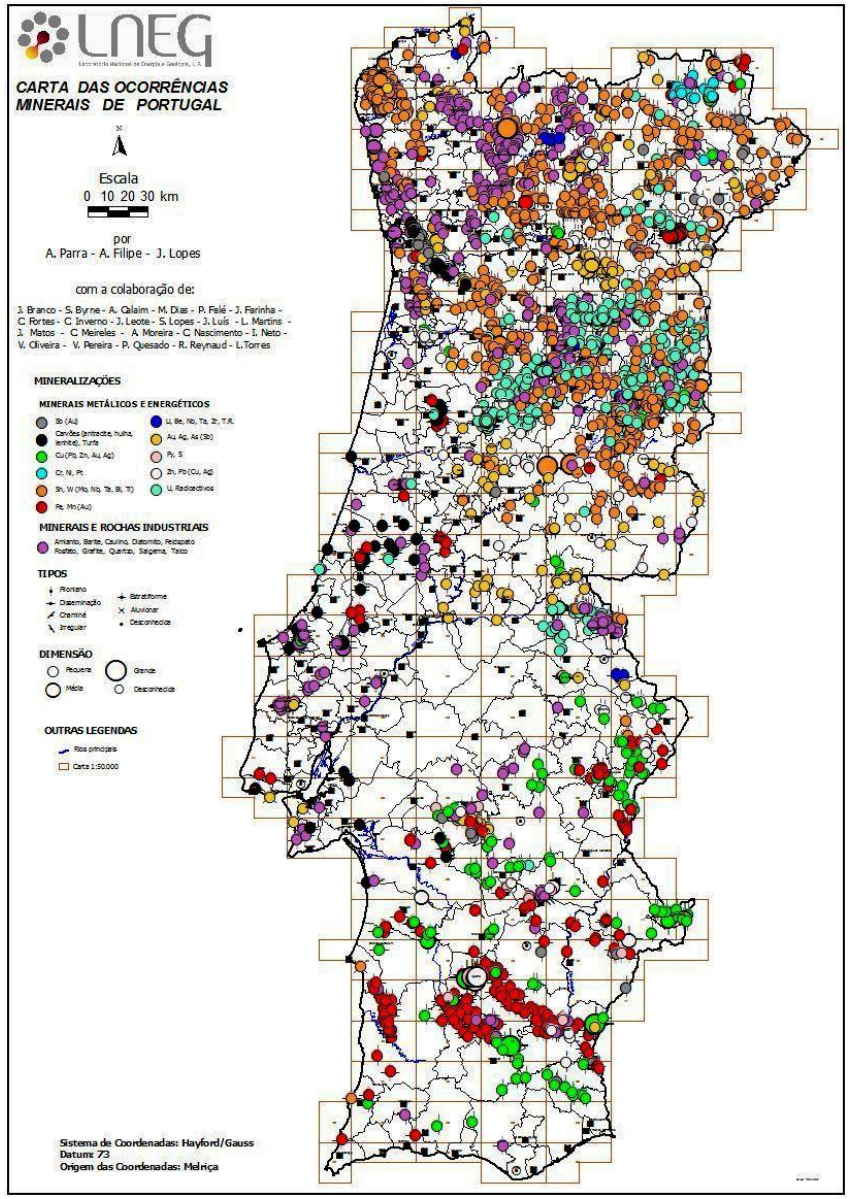
- **Long-term monitoring** allow **to evaluate** the effect of restoration measures and, if necessary, **to adjust**, optimizing them for future interventions

2. Need for restoration after extractive activities (e.g. mines and quarries)

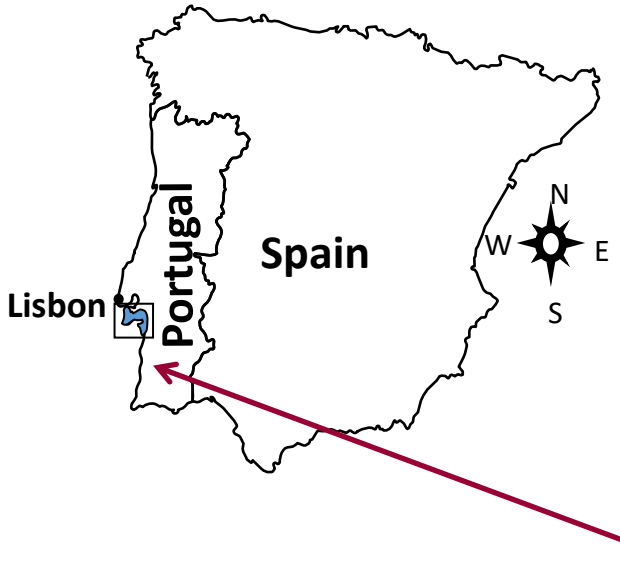
Map of mining concessions of Portugal (1836-1992)



Map of mineral occurrences



Quarry site Secil-Outão



Within Serra da Arrábida Natural Park: reference ecosystem is a Mediterranean maquis

Secil-Outão quarry

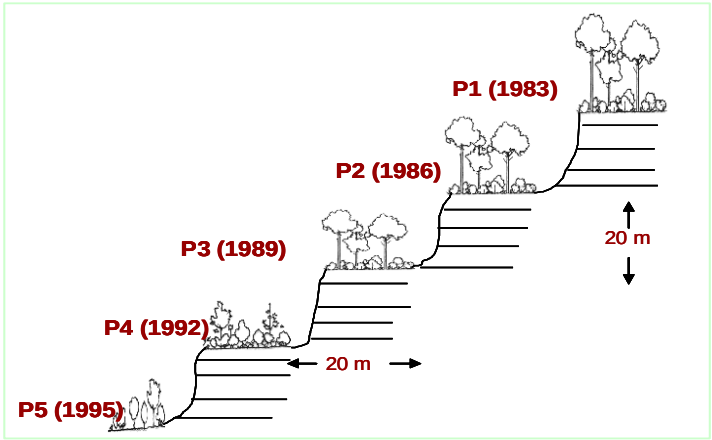
Quarry site Secil-Outão

Restoration since 1983 of quarry platforms and slopes through the planting of woody species and sowing of herbaceous species, mostly native.

Plantation of seedlings produced in a local nursery

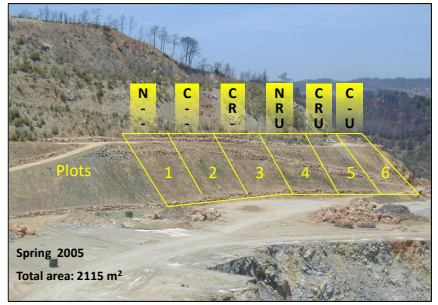
Hydroseeding in slopes

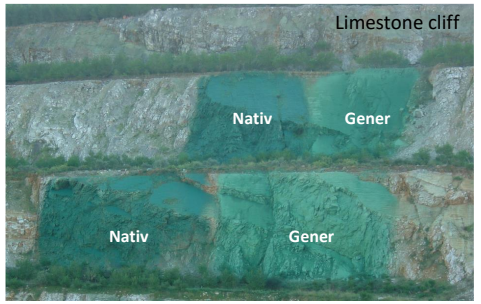
Platforms with sequential post-revegetation ages (chronosequence)



Long-term monitoring (> 30 years of Secil-FCUL collaboration)

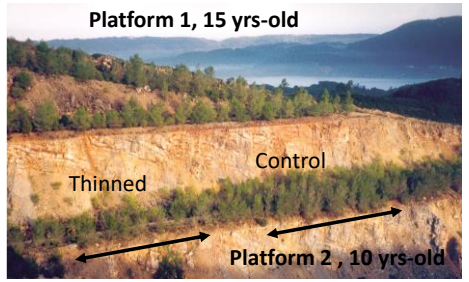
Monitoring and assessing the success of ecological restoration in a limestone quarry (2002-20004)

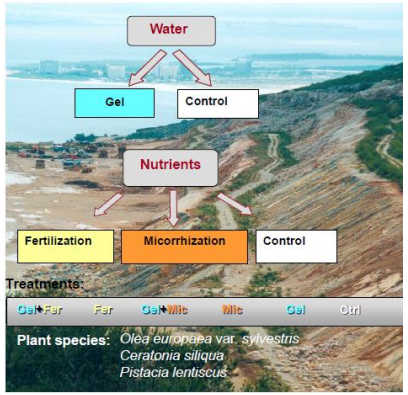




Studies for the recovery of Mediterranean landscape and Ecosystems. *PRAXIS /PCNA/C/BIA/180/96 (*1997-2000)

Ecological management of revegetated areas in limestone quarries (2015-2017)





Ecological management of revegetated areas: Monitoring of revegetation of slopes (2004–2014)

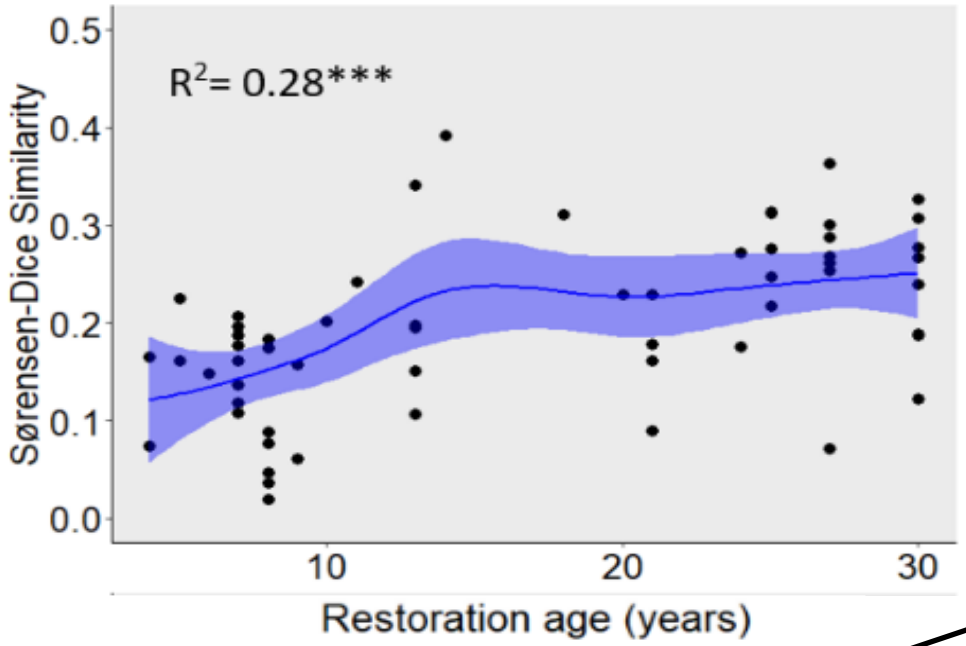
Ecotechnology for Environmental Restoration of Limestone Quarries- *LIFE04 ENV/ES/000195* (2004-2007)

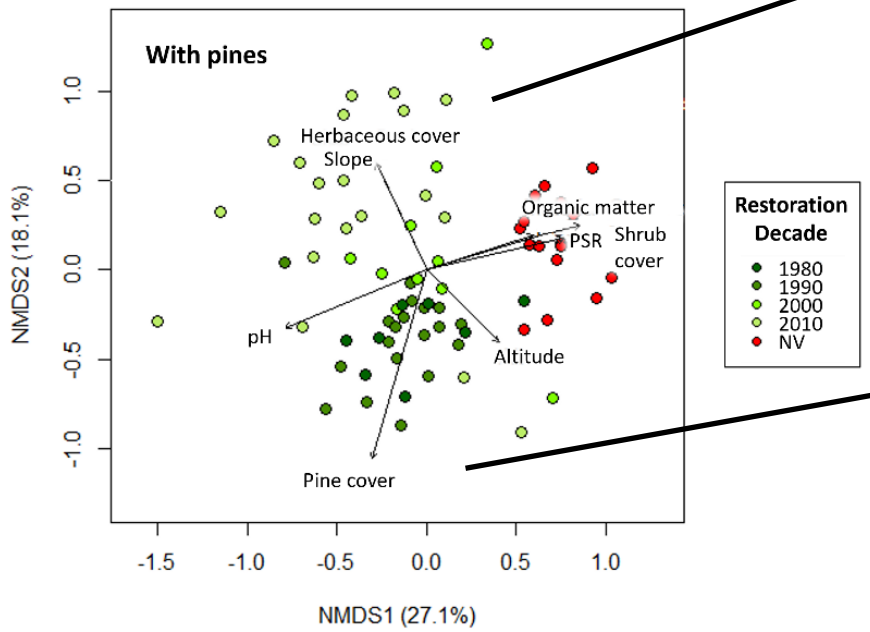
Adaptive ecosystem management based on resilience of more than 30 years of Ecological Restoration 2019–2021

1980 | 1990 | 2000 | 2010 | 2017 | 2020

Actions implemented since 1983

Plant species composition and similarity with natural vegetation





Hydroseeding with herbaceous species mix in younger slopes

Plantations with Aleppo pine in older platforms

Quarry Ecological Restoration at Outão-Secil (Arrábida Natural Park)

1983 – present; Quarry ~100 ha (Area under restoration~44ha)

Restoration at Secil quarries

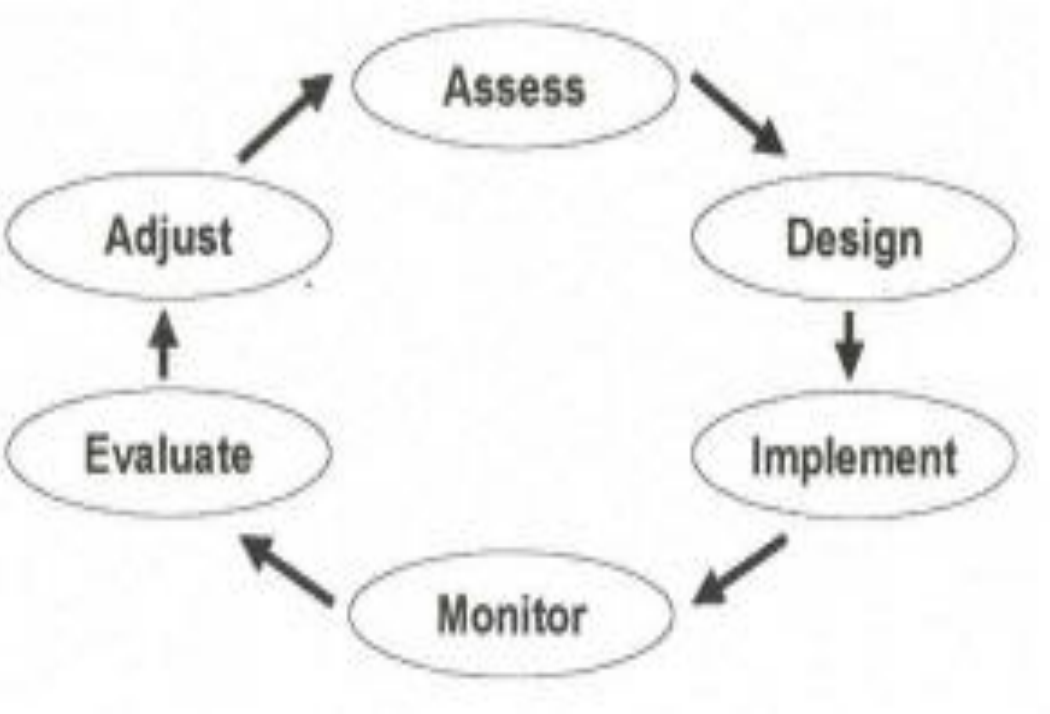
Aleppo pine (*Pinus halepensis* Mill.) has been widely used in reforestation as a pioneer nurse species

- Low diversity, high vulnerability
- Became dominant in height and attained 40-60% relative cover
- Main difference from surrounding vegetation (Correia *et al*. 2001)

Would pine thinning enhance biodiversity and ecosystem functional recovery?

Adaptive management in restoration

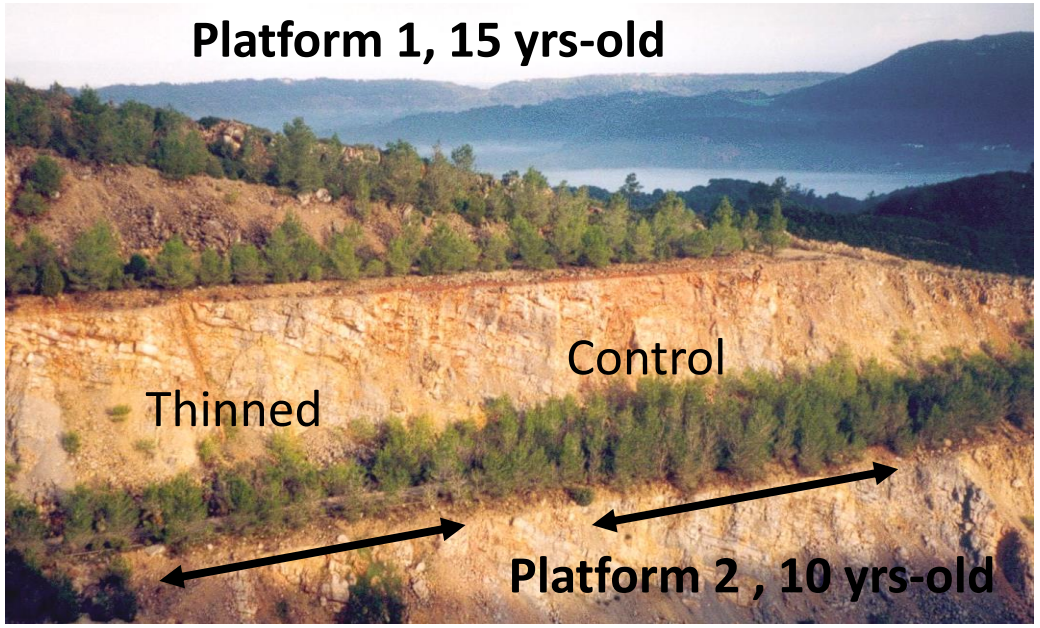
Adaptive management: flexibility to deal with surprises/uncertainties by making adjustments in management decisions

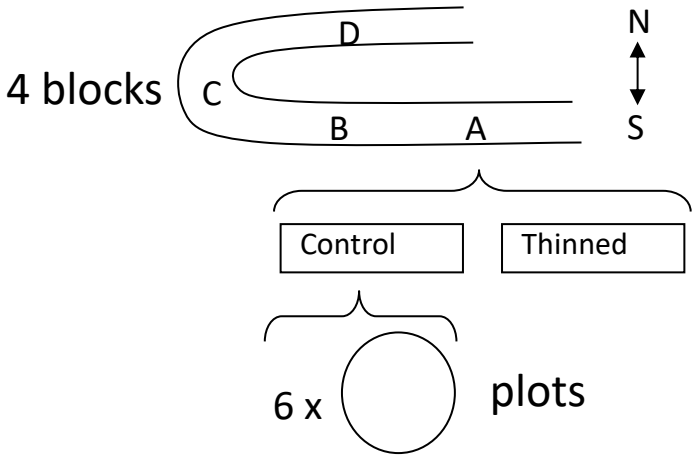


Research + Active management

Adapted from Nyberg 1999

Pine thinning experimental design





	Treatment	Initial density (pines.m^{-2})	Final density (pines.m^{-2})	Removed density (%)	Removed pine cover (%)	Initial pine height (m)
P1	Control	0.21 ± 0.12	0.21 ± 0.12	–	–	4.7 ± 1.5
	Thinned	0.25 ± 0.10	0.17 ± 0.07	33.5 ± 5.8	28.5 ± 11.0	5.5 ± 1.7
P2	Control	0.82 ± 0.40	0.82 ± 0.40	–	–	3.5 ± 1.4
	Thinned	0.87 ± 0.36	0.55 ± 0.23	36.6 ± 4.5	40.4 ± 4.4	3.4 ± 1.1

Nunes et al. (2014). Beneficial effect of pine thinning in mixed plantations through changes in the understory functional composition. Ecol. Engineering

Conclusions on pine thinning effect

- No effect on species richness and diversity
- Increase of N-fixing species, annuals, seeders and anemochorous and barochorous dispersal

↓

Relevant traits in the restoration of highly degraded areas
(nutrient input and cycling, biotic fluxes and ecosystem resilience)

- **Important management tool** to alleviate pine competition in mixed plantations

↓

Interest and utility to a broad audience; promote **more diverse and resilient ecosystems**

Nunes et al. (2014). Beneficial effect of pine thinning in mixed plantations through changes in the understory functional composition. Ecol. Engineering

Restoration at Secil quarries

Species mixtures for hydroseeding: do they promote ecosystem recovery?

Main goals: establish plant cover, detain erosion and/or foster succession

Restoration at Secil quarries

Experimental design

Generalist

Eurocontrol + Prado Sadino + shrubs, no micorhiza + NPK (N12: P25: K12) – **15g/m2**

Native

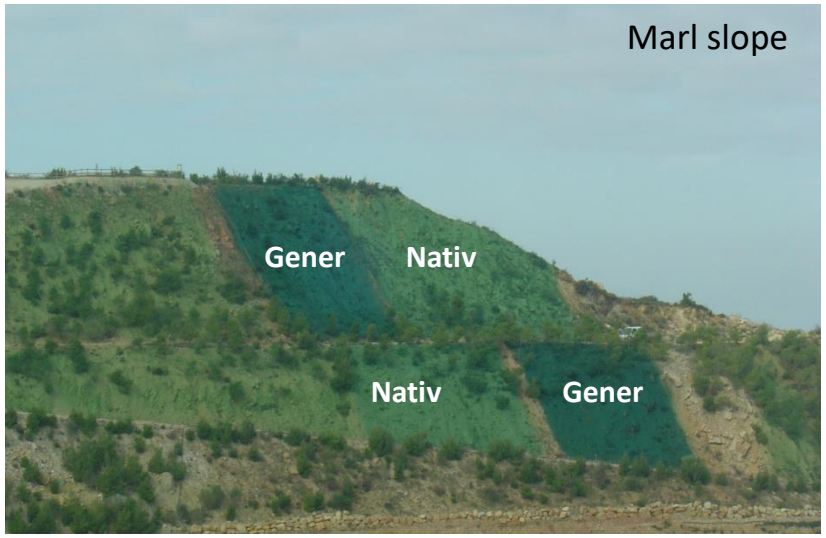
New mixture with micorhyza + NPK (N9: P20: K8) – **7g/m2**

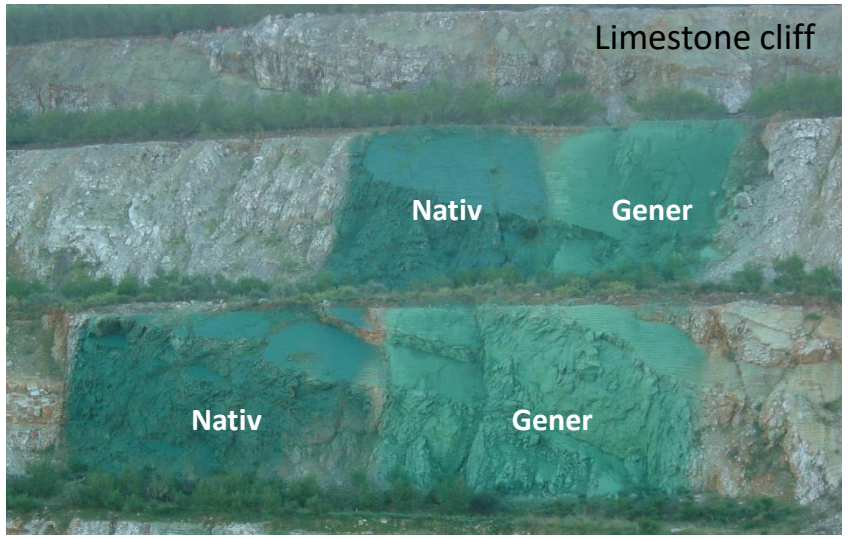
Both mixtures with relative seed weight of 45% for **Poaceae**, 45% for **Fabaceae** and 10% for **other families**

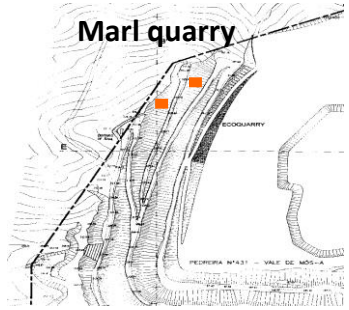
Seeded species	Origin	% Nativ	% Gener
Avena sativa	A/C	5	-
Dactylis glomerata	A/C	15	8,3
Lolium perenne	A/C	15	19,3
Festuca arundinacea	C	-	8,7
Festuca ovina	C	-	4
Festuca rubra	C	-	3,7
Lolium multiflorum	C	-	4
Lolium westerwoldicum	C	10	-
Psoralea bituminosa	A	12	-
Lotus corniculatus	A/C	3	-
Cytisus grandiflorus	C	-	4,9
Medicago sativa	C	15	4,3
Retama monosperma	C	-	13
Sparteum junceum	C	-	5,1
Trifolium incarnatum	C	5	1
Trifolium pratense	C	-	3,3
Trifolium repens	C	8	1,7
Trifolium subterraneum	C	4	4,3
Juniperus phoenicea	A	-	1,8
Lavandula luisieri	A	-	1,6
Myrtus communis	A	-	2,9
Phillyrea angustifolia	A	-	2,3
Rosmarinus officinalis	A	-	1
Sanguisorba minor	A/C	8	0,7
Lavandula latifolia	C	-	0,8

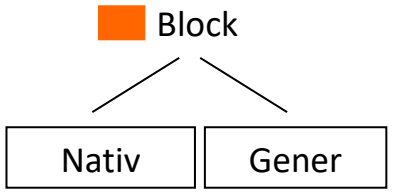
Restoration at Secil quarries

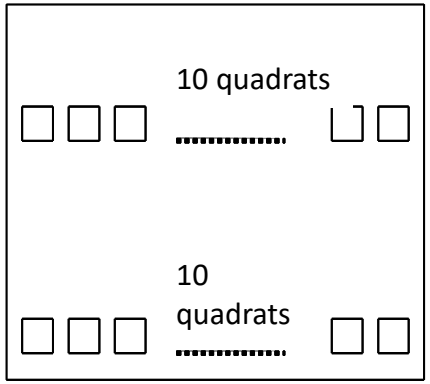
Experimental design

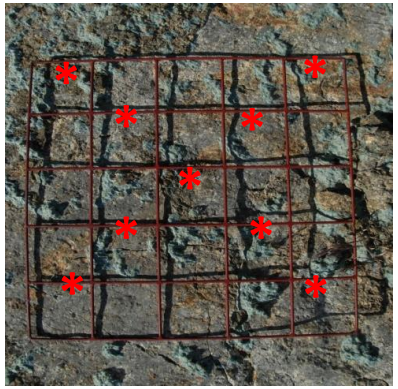












Monitored at May 2007, 2009 and 2010 (1-3 years): presence, cover, density

Conclusions on seed mixtures

Amended marl slope

Limestone cliff

Marl slope

Diferent outcomes depending on abiotic conditions of the target site:

100% cover of seeded species 3 years after: **undesired trajectory**

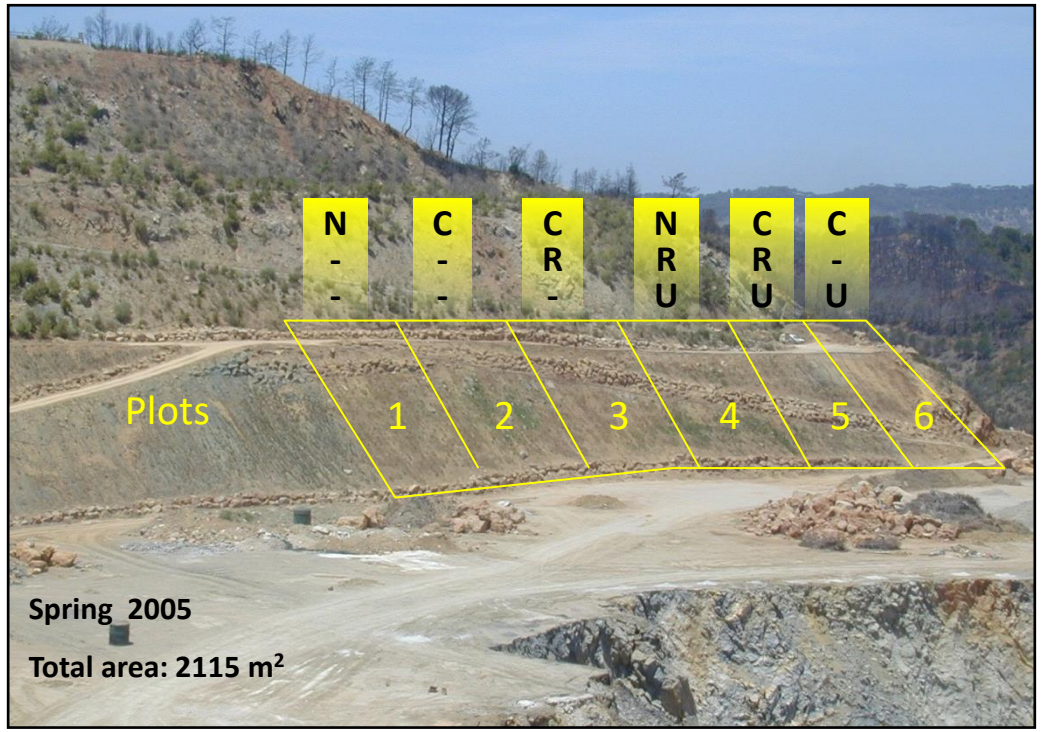
low cover (< 30%) dominated by spontaneous species: **useless effort**

50% cover with gaps and native mixture with better results

Promotion of functional recovery

Restoration at Secil quarries

Slope reforestation using soil amendments



N - "Native" seed mixture
C - "Commercial" mixture

R - Irrigation (2006)

U - addition of USWC

TREATMENTS

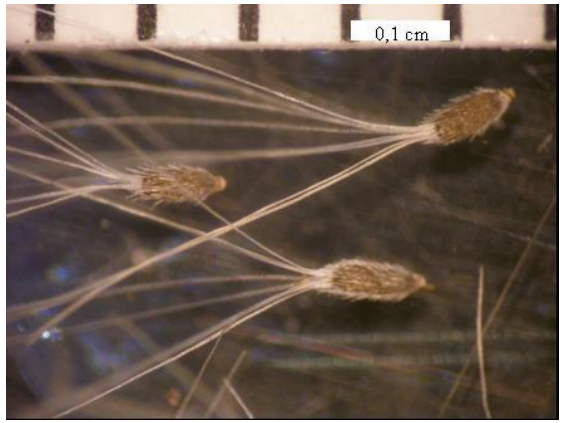
Ecotechnology for Environmental Restoration of Limestone Quarries *(LIFE04 ENV/ES/000195)*

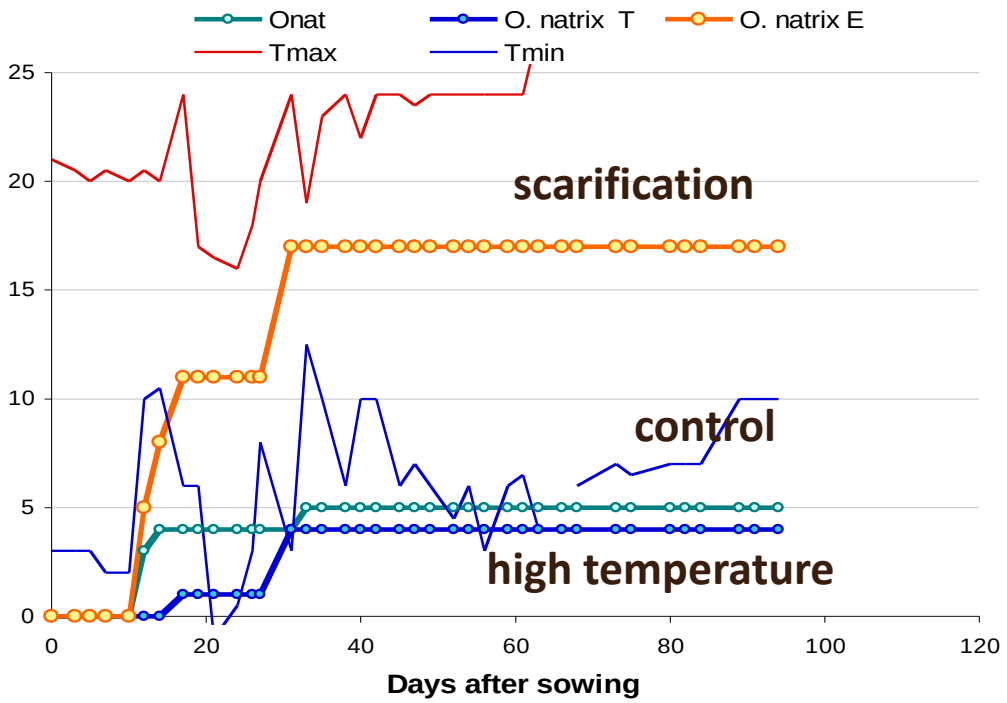
Restoration at Secil quarries

Slope reforestation using soil amendments

Restoration at Secil quarries

Greenhouse trials with different seed mixtures





Restoration at Secil quarries

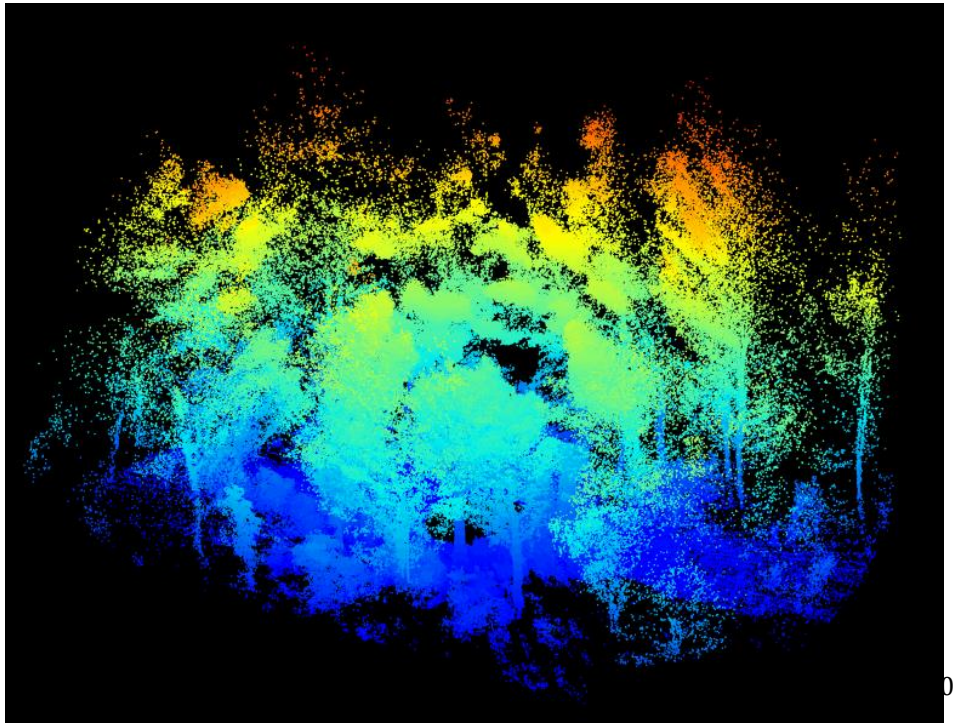
Greenhouse trials with different seed mixtures

Restoration at Secil quarries

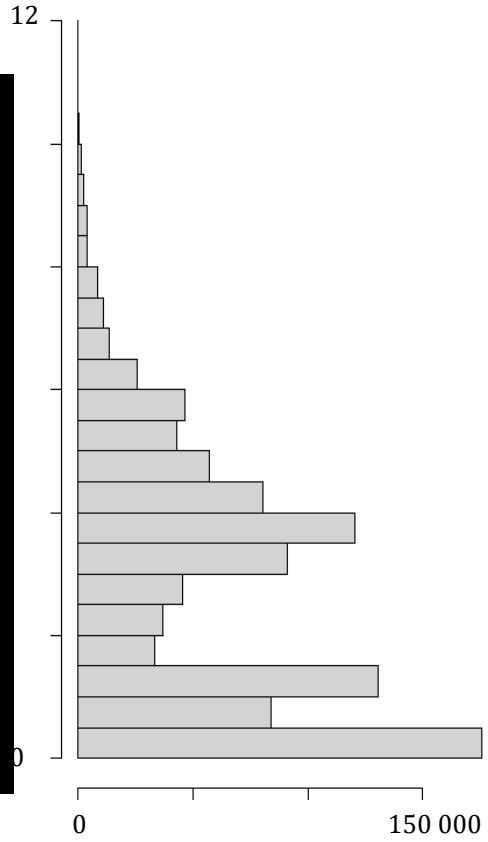
New monitoring methodologies based on Remote Sensing

LIDAR Terrestre, UAV – drone, LIDAR Aéreo

LiDAR Point cloud



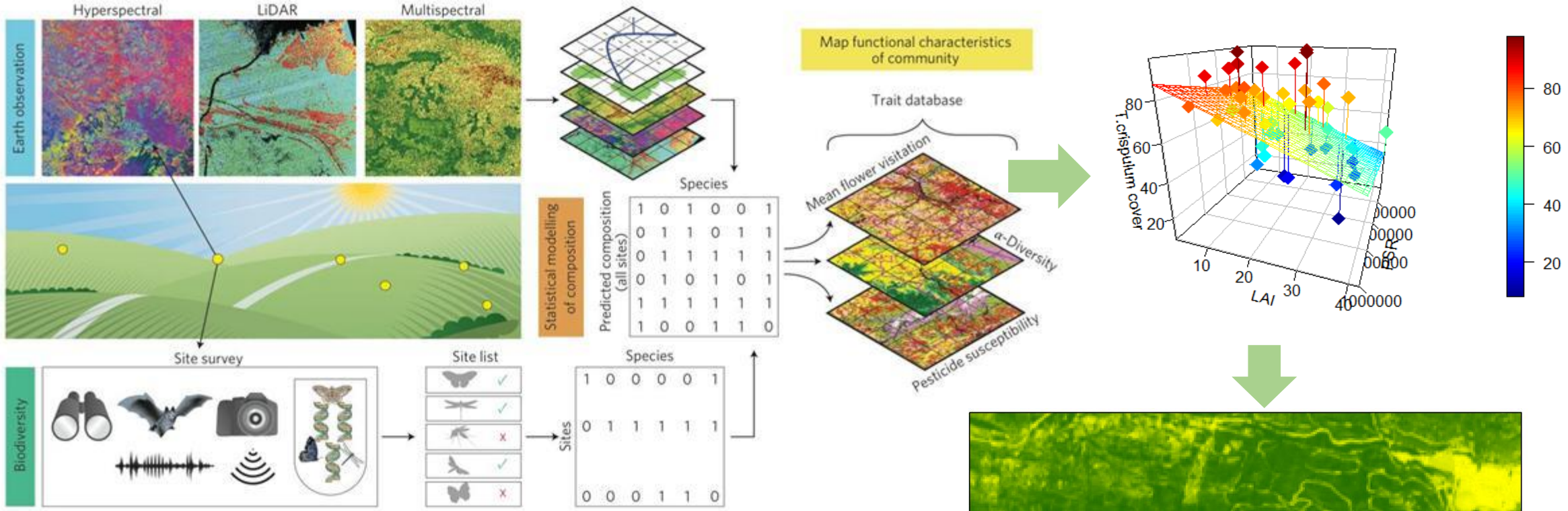
Vegetation structure



LIDAR (*light detection and ranging*) measures distance to a target by illuminating the target with laser light and measuring the reflected light with a sensor. Differences in laser return times and wavelengths can then be used to make digital 3-D representations of the target.

Restoration at Secil quarries

Modeling different facets of biodiversity with remote sensing information



Upscaling of model results to quantify and map ecosystem services, and their trade-offs, at the landscape scale

Nunes *et al.* - *Ecologia Vegetal 2022/2023*

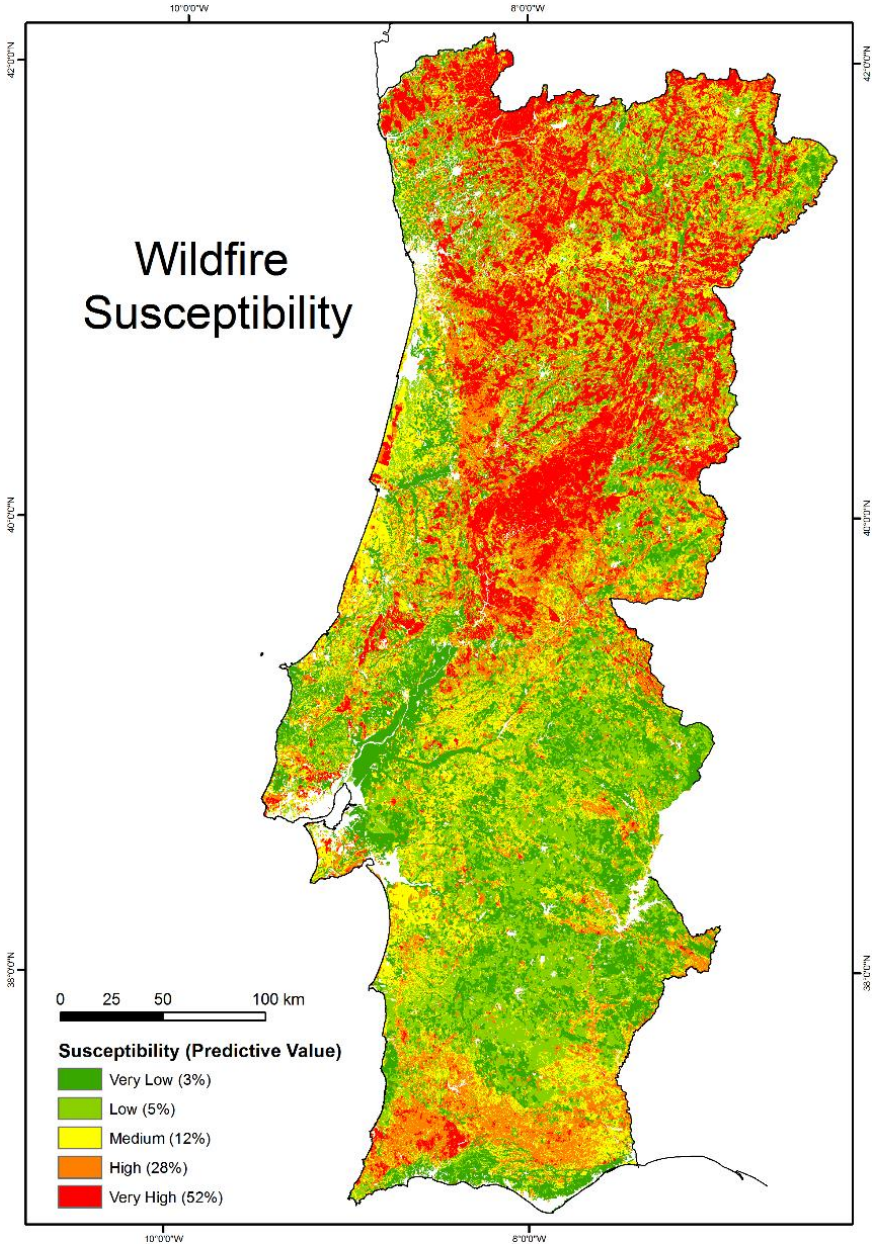
Lessons learned – Restoration of limestone quarry

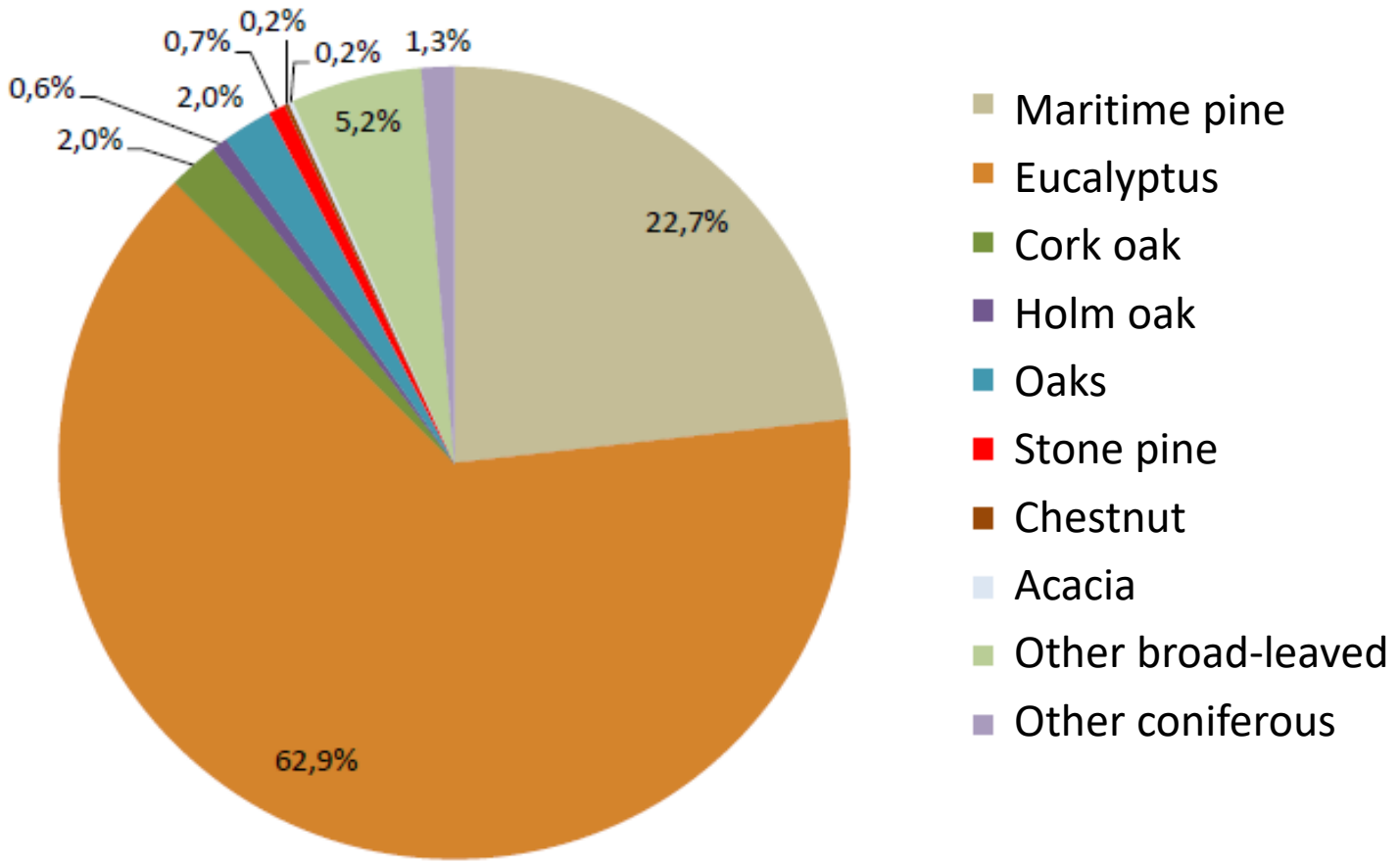
Long-term monitoring allowed to **assess the successional trajectory** of restored areas and to **identify limiting factors**, to **recommend adaptive management** actions to improve restoration success.

- Species diversity increases with restoration age but the restored vegetation is only 25% similar to natural vegetation after >30 years, showing stabilization after 15-20 years - **arrested succession**?
- Restoration succession primarily influenced by **soil characteristics with slow evolution** and far from reference (chemically and biologically); even with the high abundance of pine trees, the **productivity is lower than in reference**;
- **Trade-offs:** higher vertical structural complexity with pines, and higher pollination service in hydroseeded slopes which could provide habitat for some species, but greater difference from reference;

Example of adaptive management actions: progressive pine thinning, adjustment in hydroseeded species mixture and density and in irrigation, promote native shrub cover and connectivity with natural vegetation

Need for restoration after wildfire





Percentage of burned area by forest species in 2016

ICNF 2017. Relatório anual incêndios

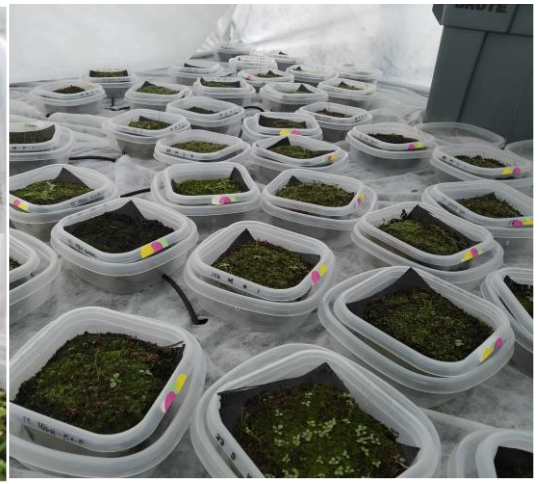
Restoration in burned lands

Goals: stabilize slopes, silvicultural recovery, control invasive species



Post-fire restoration (Bragança)





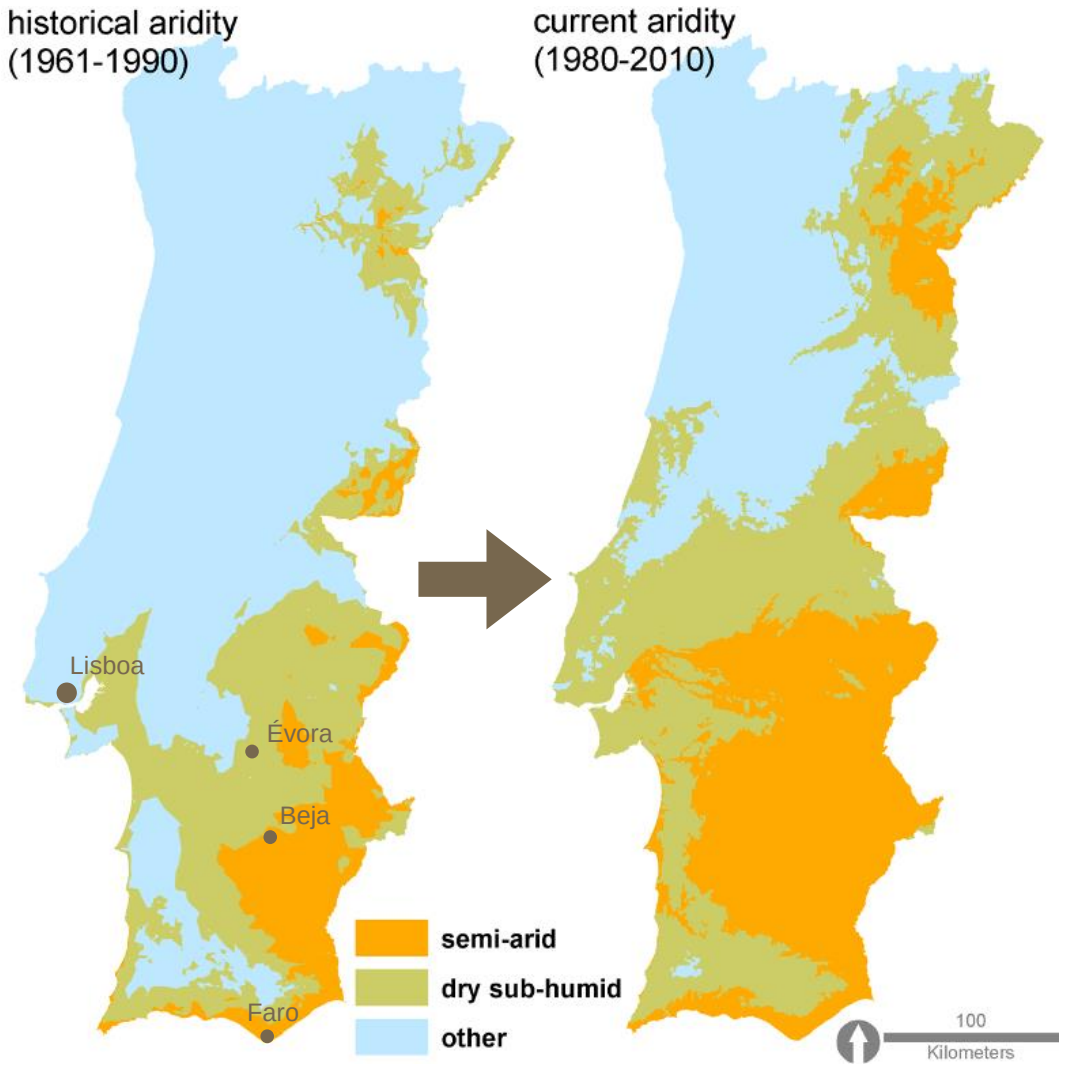
®Juliana Monteiro

SOILING - Innovative nature-based solutions to restore ecosystems services of areas degraded by Picões large wildfire, Portugal (EEA Grants – 2022-2023)

Example of measures to promote sustainable forestry

- Adopting **selection harvesting** instead of clear-cutting
- **Protect aquatic habitat** by retaining buffer strips of uncut forest along watercourses
- Retaining cavity trees and greater reliance on **natural regeneration** rather than on plantations
- **Protect large areas** of natural forest from intensive resource harvesting (connected network that is sufficient to conserve species and ecological communities threatened by forestry use)

3. Dryland agroforestry systems: climate change and desertification



Fonte: do Rosário, Lúcio. Comunicação pessoal.

Importance: Ecosystem Services

REGULATING
Soil conservation; climate regulation; pest control; cleaning water and air; polinization, etc.

PROVISIONING
Cork; wood; livestock production; habitat; food; genetic resources, etc.

CULTURAL
Heritage and identity; landscape; education; gastronomy, etc.

SUPPORTING
High biodiversity; nutrient cycling; primary productivity; soil formation

Millenium Ecosystem Assessment, 2004.

Threats:

Low natural regeneration

High tree mortality

Low reforestation success

Biodiversity loss

Low productivity

Ferraz-de-Oliveira, et al., 2016. Agroforestry Systems

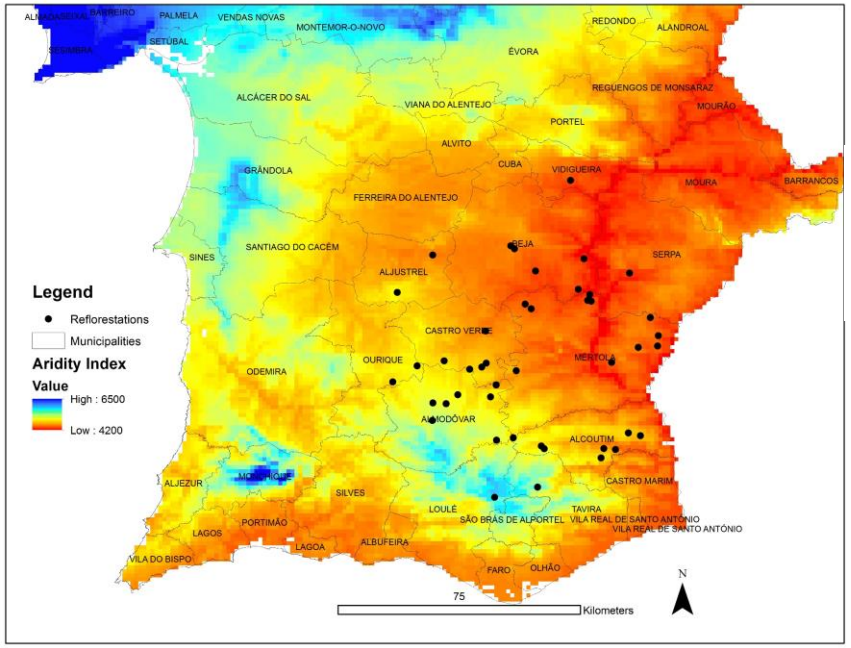
Evaluating oak (re)afforestation success to combat desertification

Period	Funding source
1938 -1964	Plano de Povoamento Florestal
1964 - 1983	Fundo de Fomento Florestal
1981 - 1988	Projecto Florestal Português/Banco Mundial
1988 - 1996	Programa de Acção Florestal (PAF)
1991 - 1993	Regulamento (CEE) 2080/91
1994 - 1999	Programa de Desenvolvimento Florestal (PAMAF)
1994 - 1999	Regulamento (CEE) 2080/92
2000 - 2006	AGRO
2000 - 2006	RURIS
2004 –	Fundo Florestal Permanente

Source: Direcção Geral dos Recursos Florestais, 2006

Pine-dominated afforestation

Oak-dominated afforestation



Mean annual precipitation
519-616 mm

Aridity index 0.42-0.58
Semi-arid and dry sub-humid

Reforestation age
11 – 37 years (mean 20 yrs)

Evaluating oak (re)afforestation success to combat desertification

Natural regeneration

Biomass/productivity

Resilience to climate change

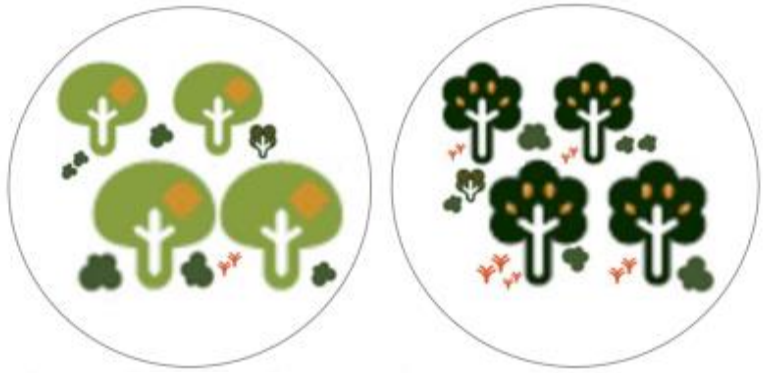
(Re)afforestation

Soil quality

Biodiversity and habitat structural complexity

Evaluating oak (re)afforestation success to combat desertification

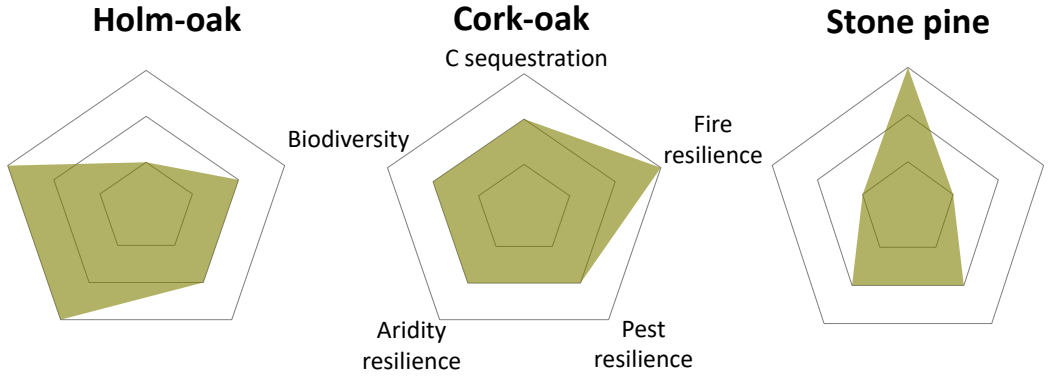
- Oak natural regeneration: decreased with aridity
- Habitat complexity: higher in oak-dominated reforestation
- Productivity: oaks grow more without pines
- Soil quality: decreased with aridity



Pine-dominated

Oak-dominated

Scores for Ecosystem services:

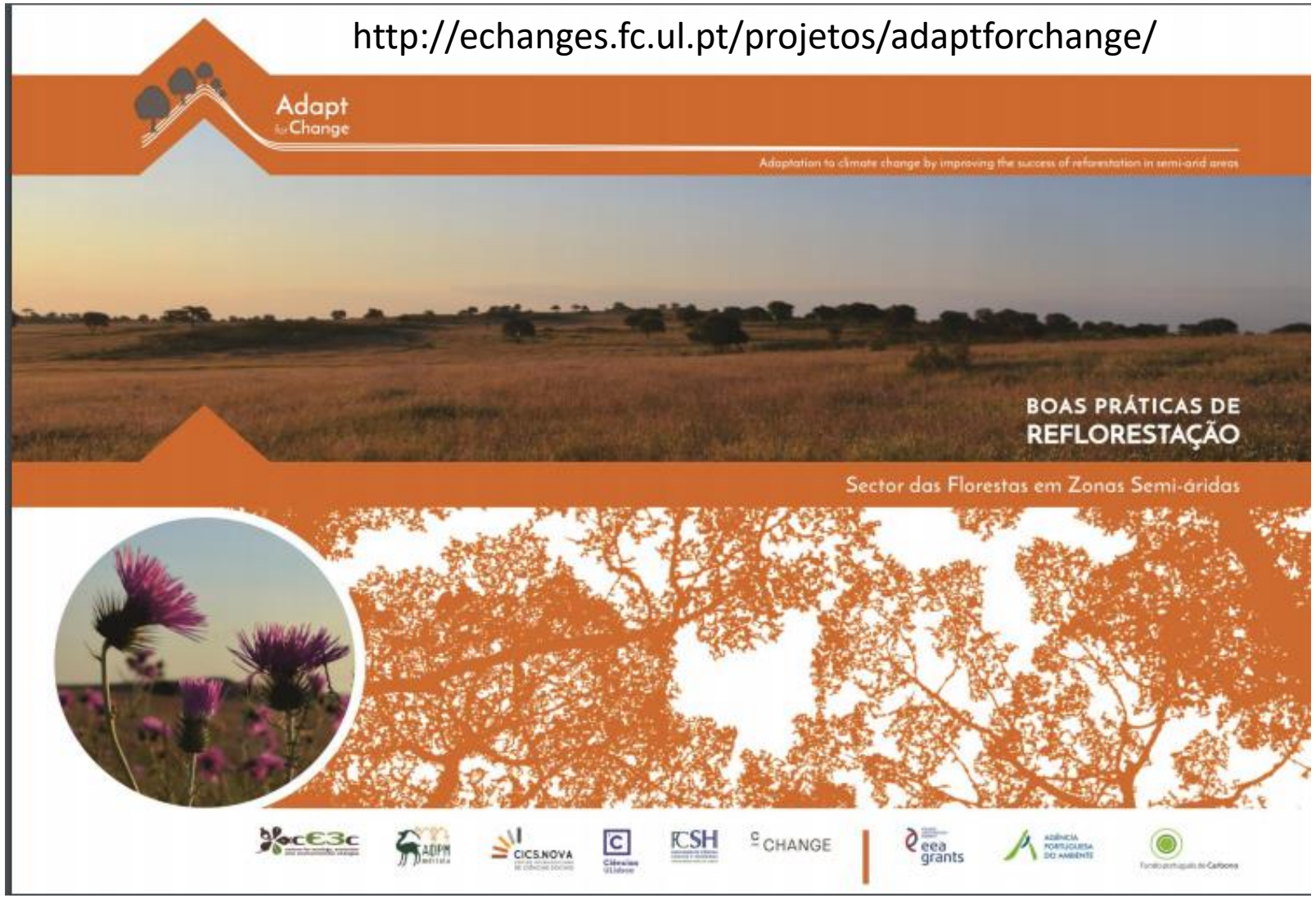


Lessons learned:

- Adapt reforestation type to objectives and context (e.g. climate and topography)

- Promote higher heterogeneity in reforestations as an adaptation to climate change

Ebook: Good practice for reforestation (available in PT and EN)



AdaptForChange –Improve the success of reforestation in semi-arid areas: adaptation to climate change scenario. Programme Adapt Sectorial projects (2015-2016)

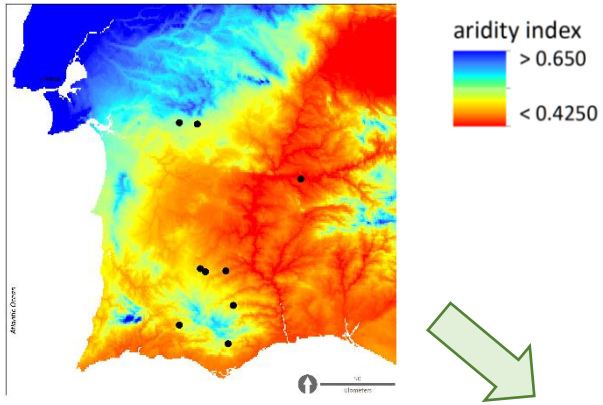
Ebook: Manual de boas práticas para conservação do solo e da água (PT)

http://echanges.fc.ul.pt/projetos/adaptforchange/

Roxo et al. 2016

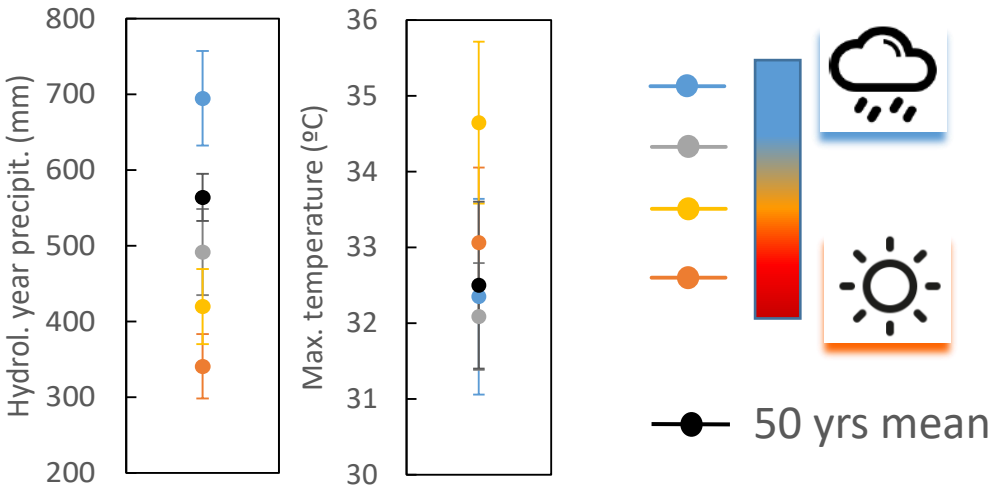
Studies over time: response of the plant community to dry and wet years

Sampling sites (13)



Resilience of the plant community to climatic fluctuations, particularly under climate change

Each site sampled in four climatically contrasting years



Several restoration trials installed at LTER sites

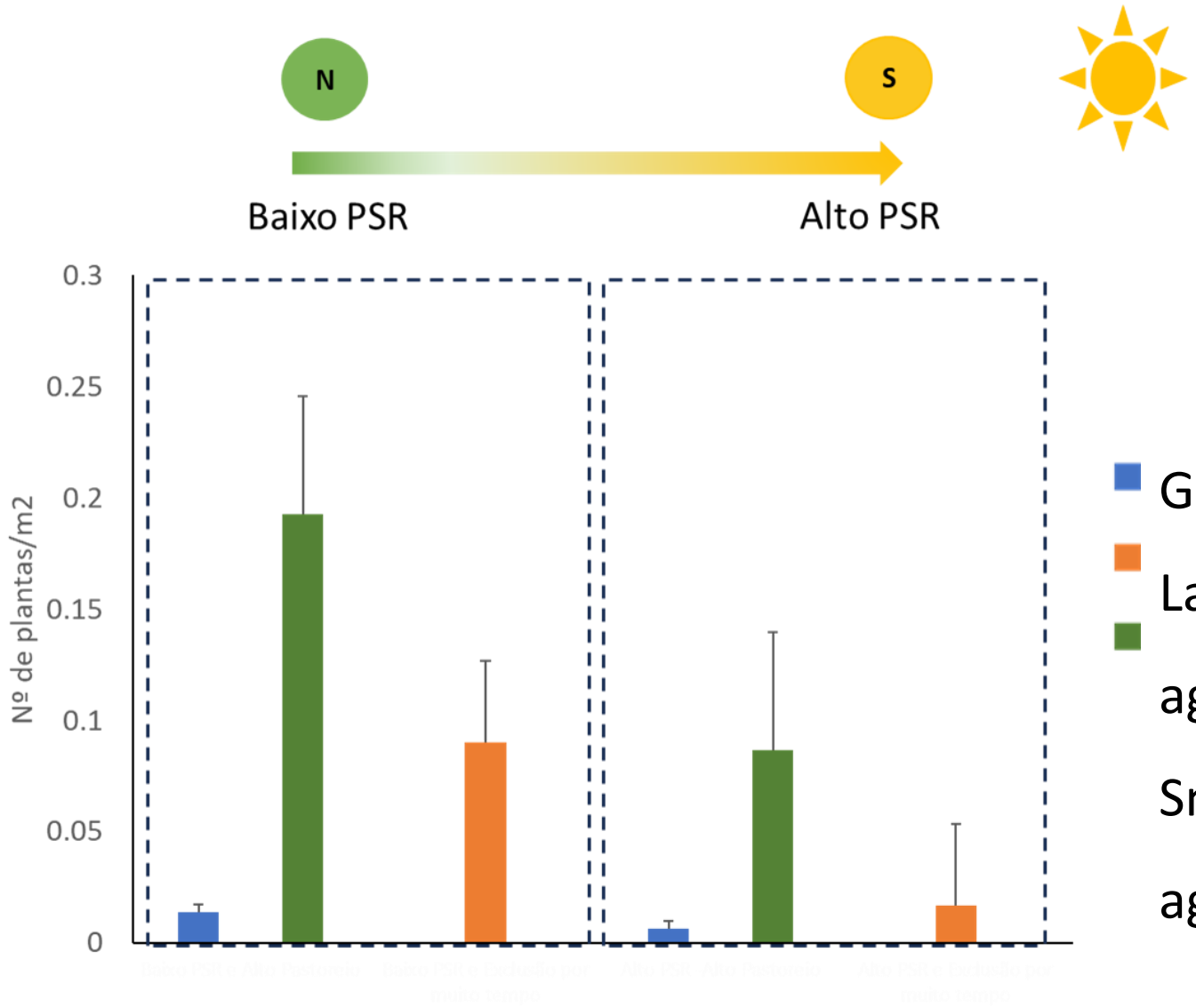
LIFE DESERT-ADAPT - LIFE16 CCA/IT/000011 (2017-2023); REA Alentejo - COMPETE 2020 REACT-EU/2021 (2022-2023); Fight Desert - COMPETE 2020 REACT-EU/2021 (2022-2023)

Small grazing exclusion areas (9 x 9 m) within grazed areas

Small grazing exclusion areas (9 x 9 m) within grazed areas

After ca. 1 year

Small grazing exclusion areas (9 x 9 m) within grazed areas



- Grazed (control)
- Large area excluded (>1 ha, > 5 yrs ago)
- Small area excluded (<100m^2; 1 yr ago)

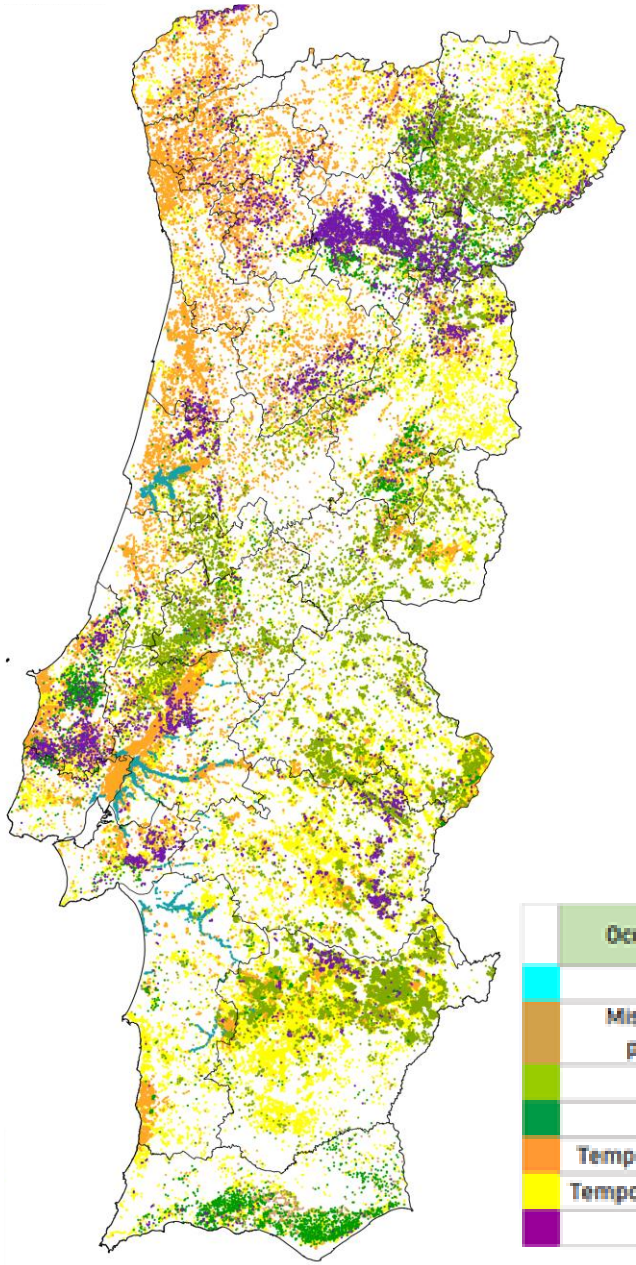
Individual protection of natural regeneration in grazed areas

Monitoring livestock movements for precision grazing management

Lessons learned – Dryland agroforestry systems

- **Adapt** reforestation type to objectives and context (e.g. climate and topography)
- Promote **higher heterogeneity** in (re)afforestations as an adaptation to climate change
- Assess and consider **interanual variability** – resilience to climatic fluctuations
- Limitation in short-term results: **time nedeed** to detect changes or effects, particularly in **water limited and slow growing environments**

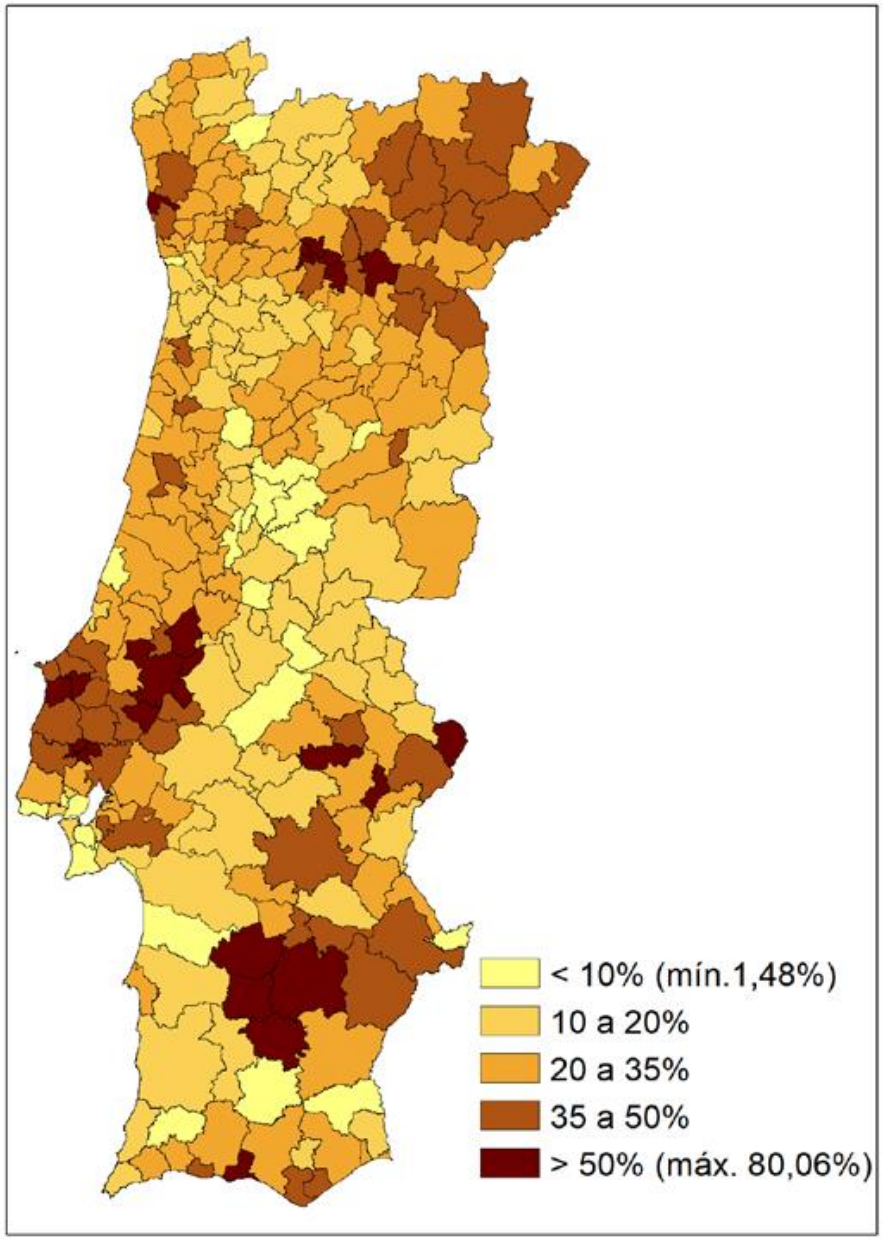
Degradation causes: Agriculture expansion and intensification



IFN 2016

Transfer of uses between temporary rainfed and irrigated crops for olive groves, orchards and vineyards. Conversion to olive groves was very important in the Alentejo region (about 60,000 ha) and conversion to vineyards was more evident in the North region (52,000 ha)

Ocupação do solo	Área (hectares)	% das florestas
Arrozal	37614	1,8
Misto de culturas permanentes	38252	1,8
Olival	438442	20,9
Pomar	114170	5,5
Temporária de regadio	499008	23,8
Temporária de sequeiro	770320	36,8
Vinha	195092	9,3



Carta de Uso e Ocupação do solo – COS 2018

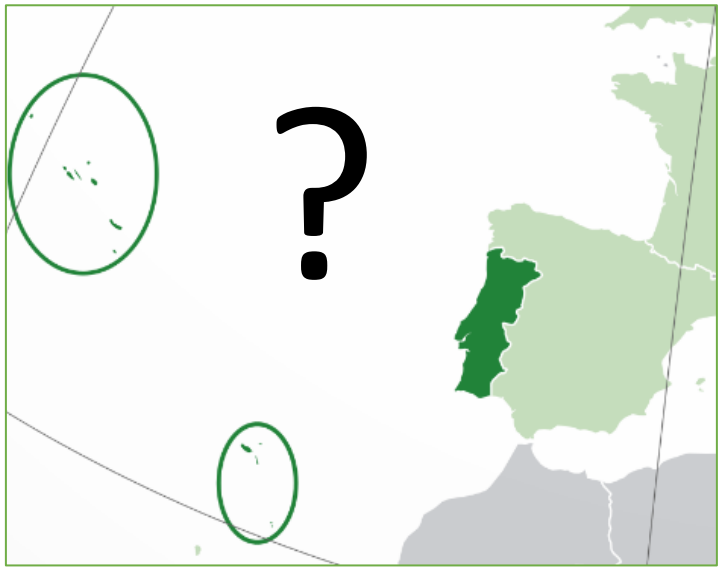
Measures to promote biodiversity and sustainable use in agricultural ecosystems

Increase the sustainability of food production as part of SDG 2

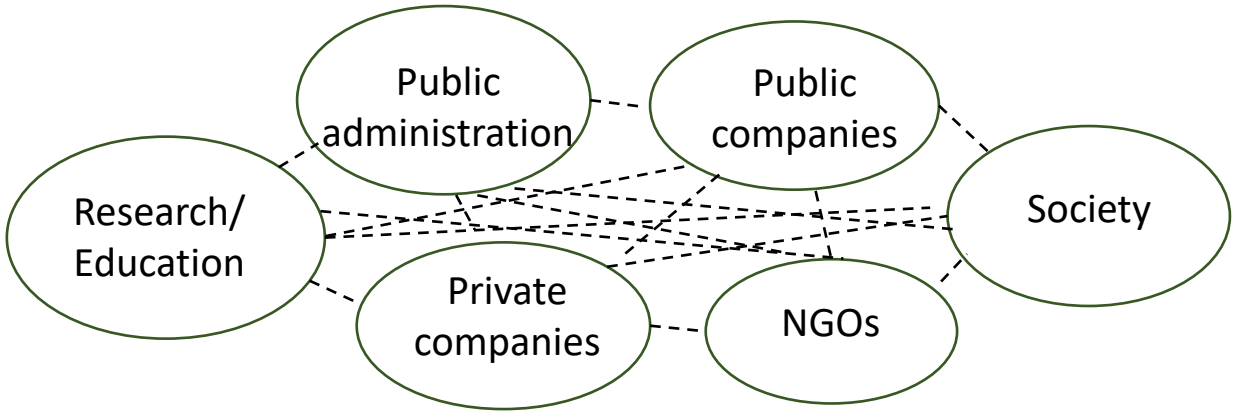
- Reduction/efficiency application of herbicides and fertilizers
- **Cover crops** in bare soil zones; pollinator strips
- Soil **non-mobilization** or conservation mobilization
- Ground cover with green material (**mulching**)
- Installation/maintenance of **hedgerows** in margins
- Installation/maintenance green corridors, including **riparian galleries**
- Increase/conservation of **genetic diversity** of cultivars and traditional varieties
- Maintenance of natural and semi-natural vegetation patches and **landscape heterogeneity**
- Restore/promote ecological niche from threatened species, including birds and bats
- **Control and eradication of invasive species**

Can we get an overview of restoration projects in Portugal?

- Who are the main actors?
- How many projects are there and where?
- What means and approaches are used?
- How successful is it? How are they evaluated?
- How are they financed?
- What are the main limitations? What are the priorities?

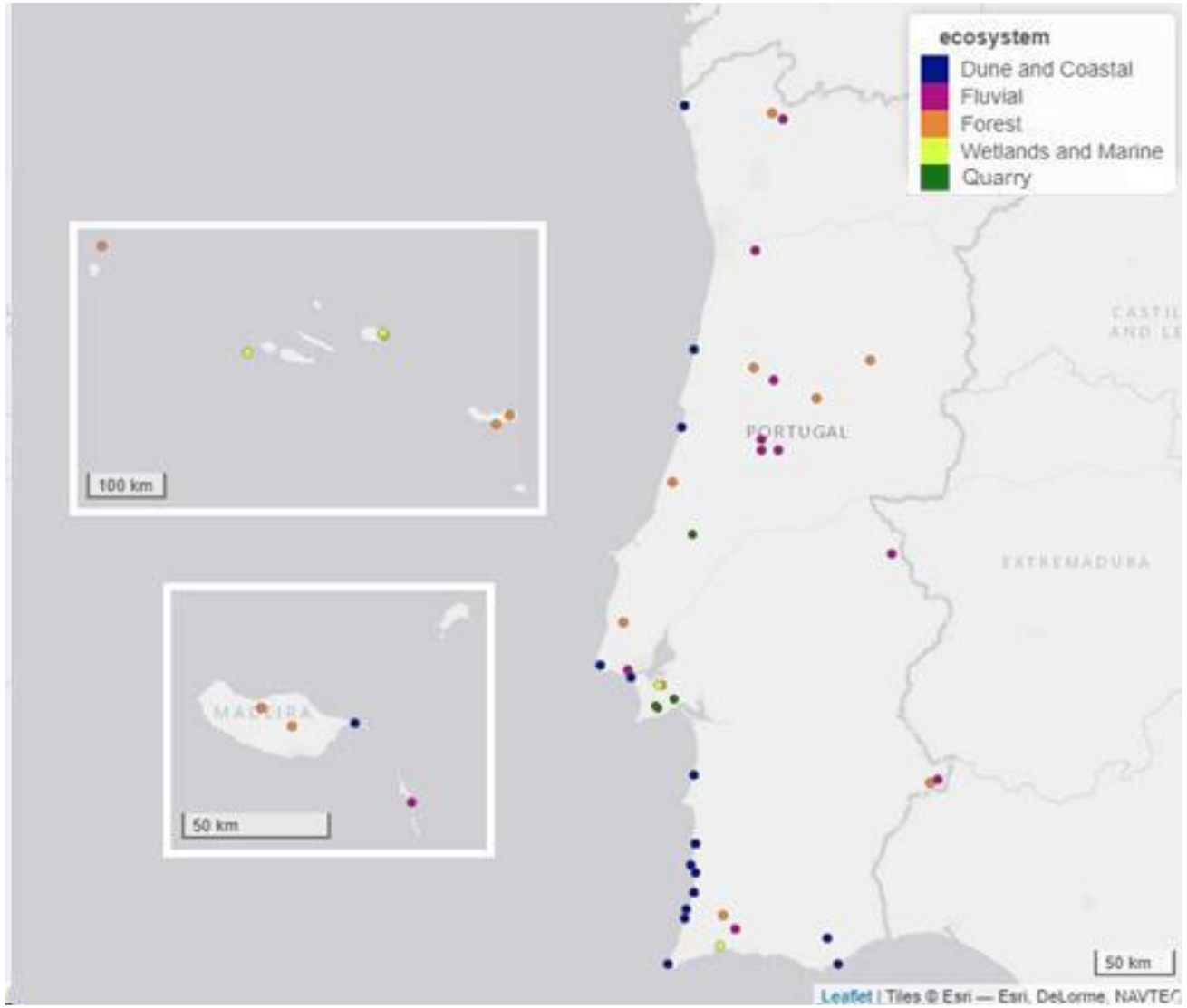


How can we share knowledge, experience, resources, tools, projects, opportunities?



Synthesis of Ecosystem Restoration projects implemented in Portugal

- 83 restoration projects, based on information available online
- Include forests, dune systems, salt marshes, ponds, peatlands, seagrass meadows, mines and quarries, and rivers and streams
- Topics: causes of degradation, restoration techniques, ecological indicators, entities involved, area and location, investment
- Control of exotic species was applied in half of the projects
- Success indicators mostly associated with vegetation structure, followed by biological diversity and, to a lesser extent, ecological processes
- Municipalities, public institutes, and NGOs were the main promoters of the projects

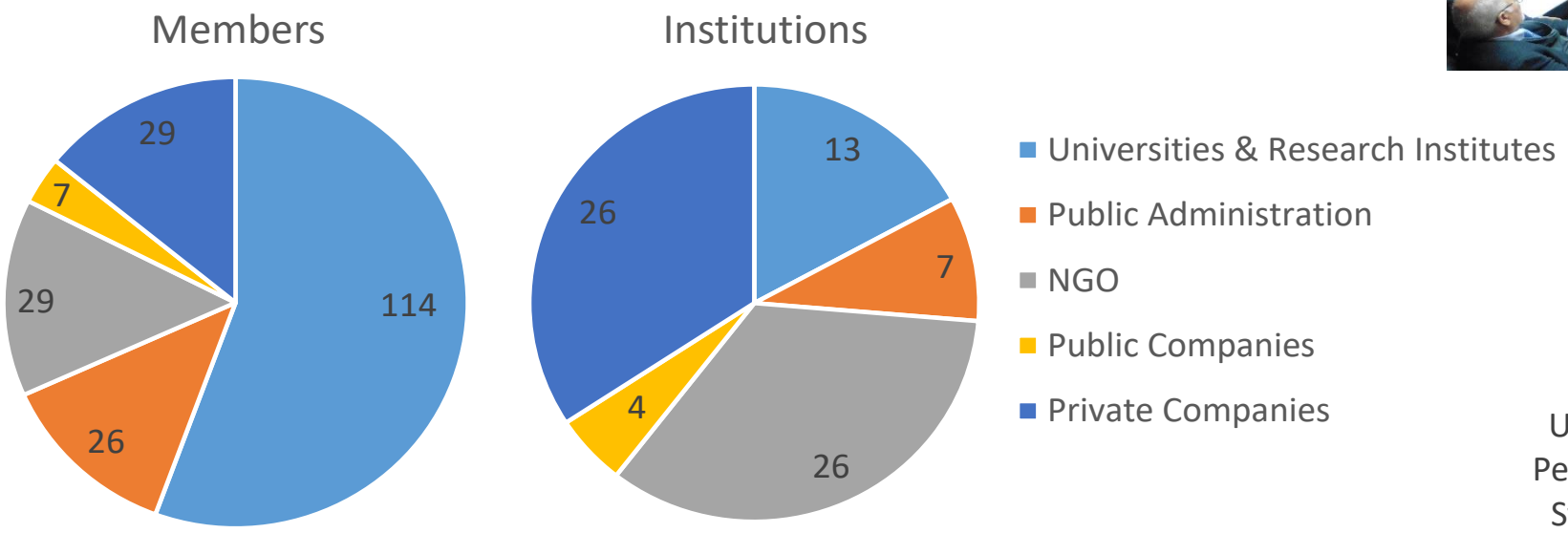


Carlos Marques (2023). *Projetos de recuperação de ecossistemas em Portugal - Contributo para síntese e análise crítica.* MSc thesis.

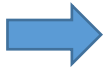
Connecting Restoration in PT: the Portuguese Ecological Restoration Network (ResECO)

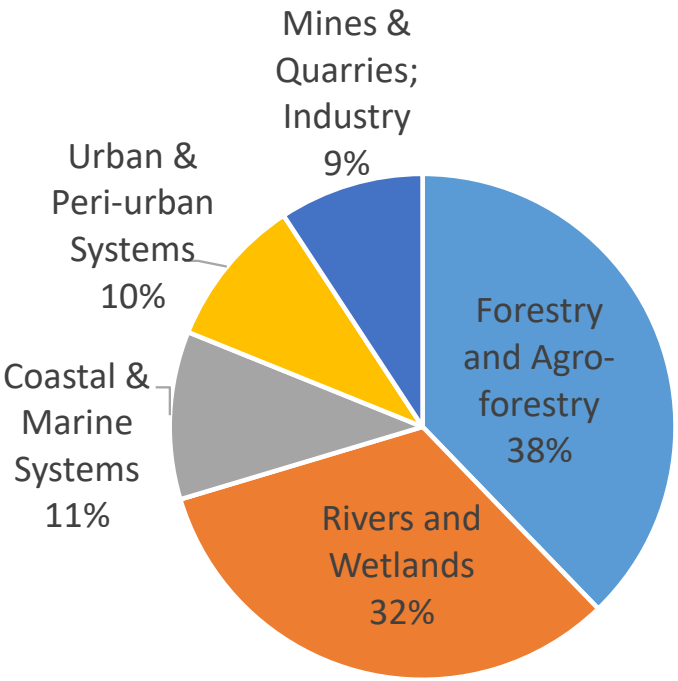
Formalization of ResECO, as a working group of SPECO, in August 2019

More than 260 professionals enrolled in ResECO



Representing all restoration sectors, including transversal topics as postfire restoration and invasive species control





Connecting Restoration in PT: the Portuguese Ecological Restoration Network (ResECO)

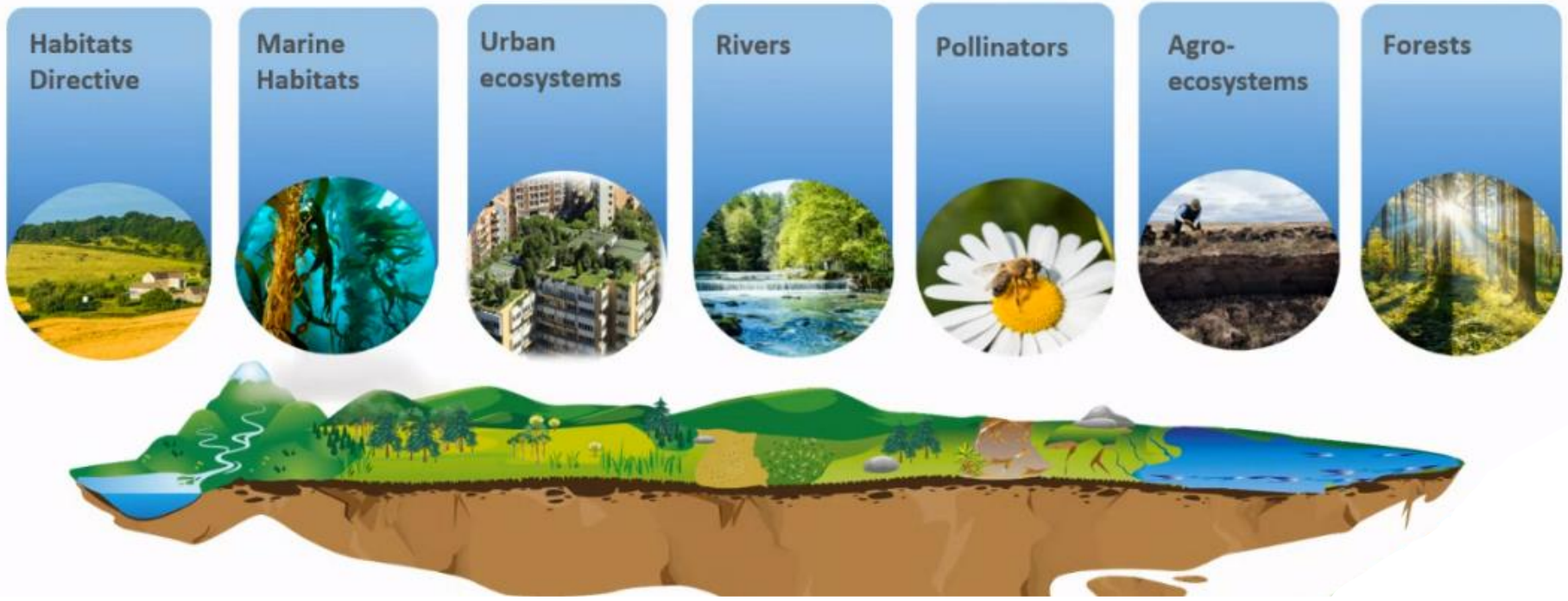
Main objectives	Actions
1. Gather and share information	Develop a database of ecological restoration projects available in a shared platform
2. Communication (within and outside ResECO)	National congress; joint publications (e.g. technical reports, scientific papers, books, manuals of good practice); applicable legislation and funding opportunities
3. Technical training	Promote and support courses, workshops, seminars
4. Dissemination /Public Awareness	For society, private companies and public administration; dissemination of good practice
5. Knowledge transfer	To policy makers and society: support a national strategy for nature restoration

EU the Nature Restoration Law

Overarching objective

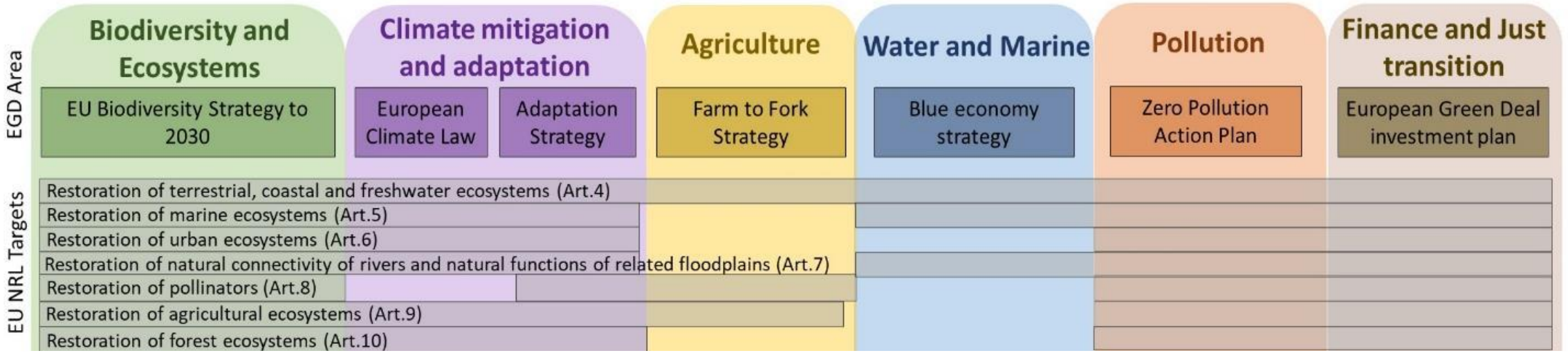
- By 2030 → restoration measures will cover **20%** of EU's land and sea
- By 2050 → measures in place for **ALL ecosystems in need** of restoration

Restoration targets



Challenges to support nature restoration at the national and EU levels

- Need to centralize information on ecosystem restoration in PT and make it available
- Promote knowledge transfer between (and within) academia, the society and policy-makers
- Bring together the various stakeholders and restoration actors
- Raise public awareness of what is already being done in Portugal
- National Restoration Plans



Baroni et al. (2022)

Thank you

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Aknowledgments

http://ce3c.ciencias.ulisboa.pt/team/ECHANGES

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- EEA Grants (LandUnderPressure e SOILING); REA Alentejo e FightDesert (COMPETE 2020 REACT-EU/2021); LIFE DesertAdapt; LTsER montado
- DIACS – Departamento de Intervenção Ambiental, Clima e Sustentabilidade, Câmara Municipal de Almada