Integrating biodiversity value in quarry restoration: Linking business and applied science

19 March 2021

14:00 – 16:00 CTE

SECIL

Ciências ULisboa

UNIVERSIDADE DE ÉVORA

Part of the WE VALUE NATURE 10-DAY CHALLENGE

WEBINAR RULES

keep the
microphone off

Turn on
the camera

Use the chat for
spontaneous messages

The session
will be recorded

PROGRAME & SPEAKERS

1. Presentation and Q&A

2. Discussion
Breakout Rooms Sessions

3. Final Discussion
Main room

Alexandra Silva
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University of Évora I **UBC MED Institute**

TEAM

SECIL

Where we are

4 Continents

8 Countries

8 Plants

Products

Cement
Concrete
Aggregates
Mortars
Hydraulic lime

People

+ 2000 Employees

Quarries

66% Active quarries


Portugal


Tunisia


Lebanon


Angola

Cape Verde


Brazil


The Netherlands

Spain

http://www.secil-group.com/

QUARRIES & MINES

Extractive industry

Raw material of interest is the rock itself.

Raw material of interest is the mineral that needs extraction from the bed rock or sand

Other sub-products of exploitation

Quarries

Mines

Open cast

Underground

Stockpiles
Sludge (with heavy metals)
Acid ponds
Alkaline soils
…

- Limestone
- Basalt
- Clay
- Gypsum
- Marble
- Granite
- Ornamental rocks
- Sands
- Gravel
- …

- Metals
  - Gold
  - Lithium
  - Iron
  - Copper
- Coal
- Oil/Tar sands

Non-Energy Extractive Industries | **Energy Extractive Industries**


Limestone , CZ


Lithium, PT


Coal, DE


Copper/zinc, PT


Wolfram, PT

What are the **main impacts** of extractive industry on biodiversity and ecosystem services?

MAIN IMPACTS

Visual and ecological impact | Ecosystem degradation | Habitat fragmentation





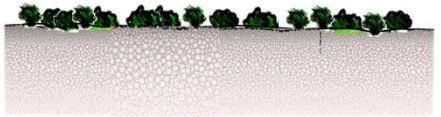
Removal of soil and vegetation | Decreased availability of resources for fauna | Pollution (dust)

Alteration in the topography and hydrology (surface and ground water)

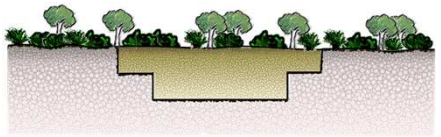
RESTORATION PROJECTS

is a challenging process…

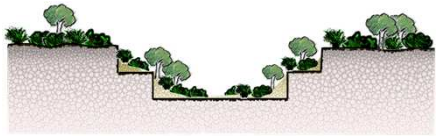
- Ecological value
- Budget & resources
- Social context
- Safety
- Exploitation technique
- Legal obligations
- Planing *versus* Implementation
- Scientific knowledge
- Stakeholders involvement
- Surrounding areas



Reference ecosystem



Restoration



Rehabilitation

Reclamation

Adapted from: Gann et al., 2019. International principles and standards for the practice of ecological restoration. Restoration Ecology

SECIL Outão

Case Study

SECIL OUTÃO PLANT

1904 — SECIL-Outão Plant

1965 — 1st Study of Landscape Rehabilitation

1973 — Landscape Rehabilitation & Exploitation Plans
Submitted to the authorities

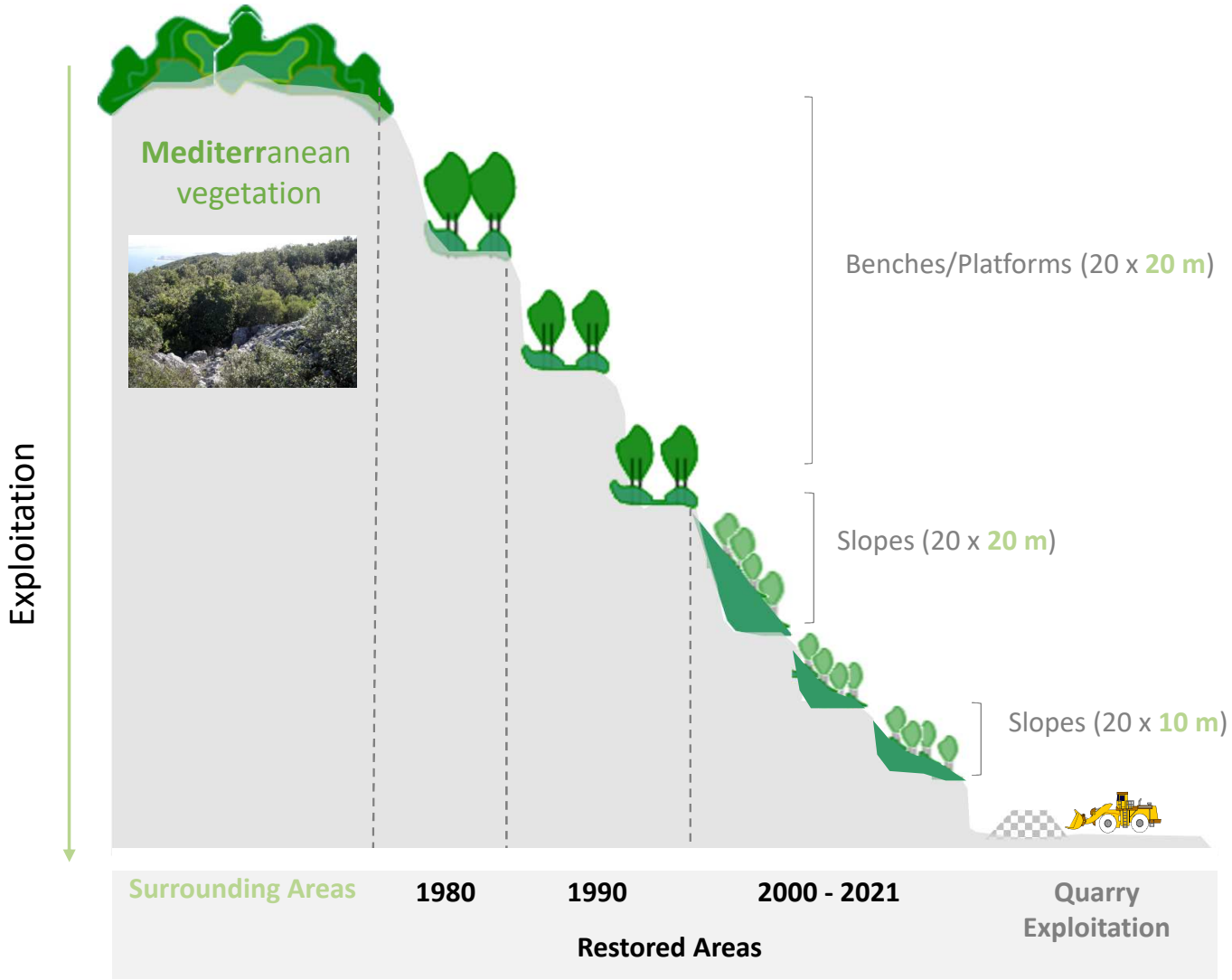
1976 — Arrábida Natural Park

1982 — Beginning of the exploitation

1998 — Partnership
Faculty of Sciences of the University of Lisbon

2007 — Biodiversity Action Plan
Partnership with the University of Évora

PROGRESSIVE QUARRY RESTORATION



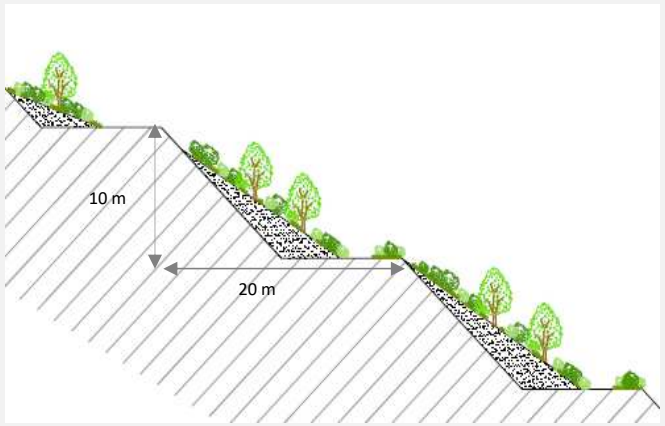
Habitats with different plant communities, age and cover have been established


Rehabilitated Area = 45 ha
(quarry area ≈100 ha)

OUTÃO QUARRIES REHABILITATION PLAN

Main Stages

Slope/platform construction
- **Reintroduction of soil**



Revegetation
- **Hydroseeding**
- **Tree and shrub planting**

Maintenance & Surveillance
- **Monitoring**

SECIL NURSERY PLANT

Production of 17 Native Plant Species












Limestone (Slopes 20 m)


Marl (Slopes 20 and 10 m)


Limestone(Platform 320 m)


Platforms 20 m

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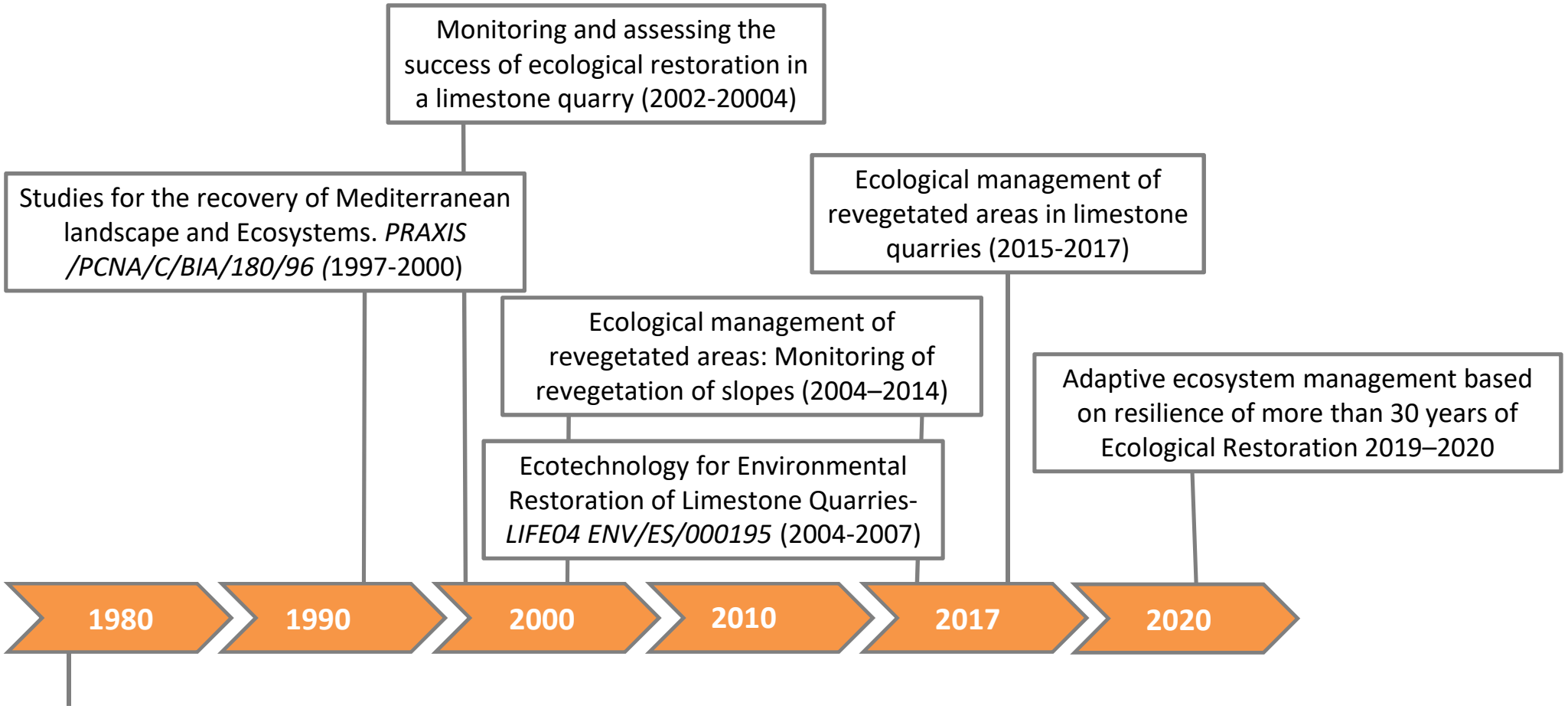
30 YEARS OF SECIL-FCUL COLLABORATION ON VEGETATION



Actions implemented since 1983

URGENCY IN ECOSYSTEM RESTORATION

The UN Decade on Ecosystem Restoration (2021 – 2030)

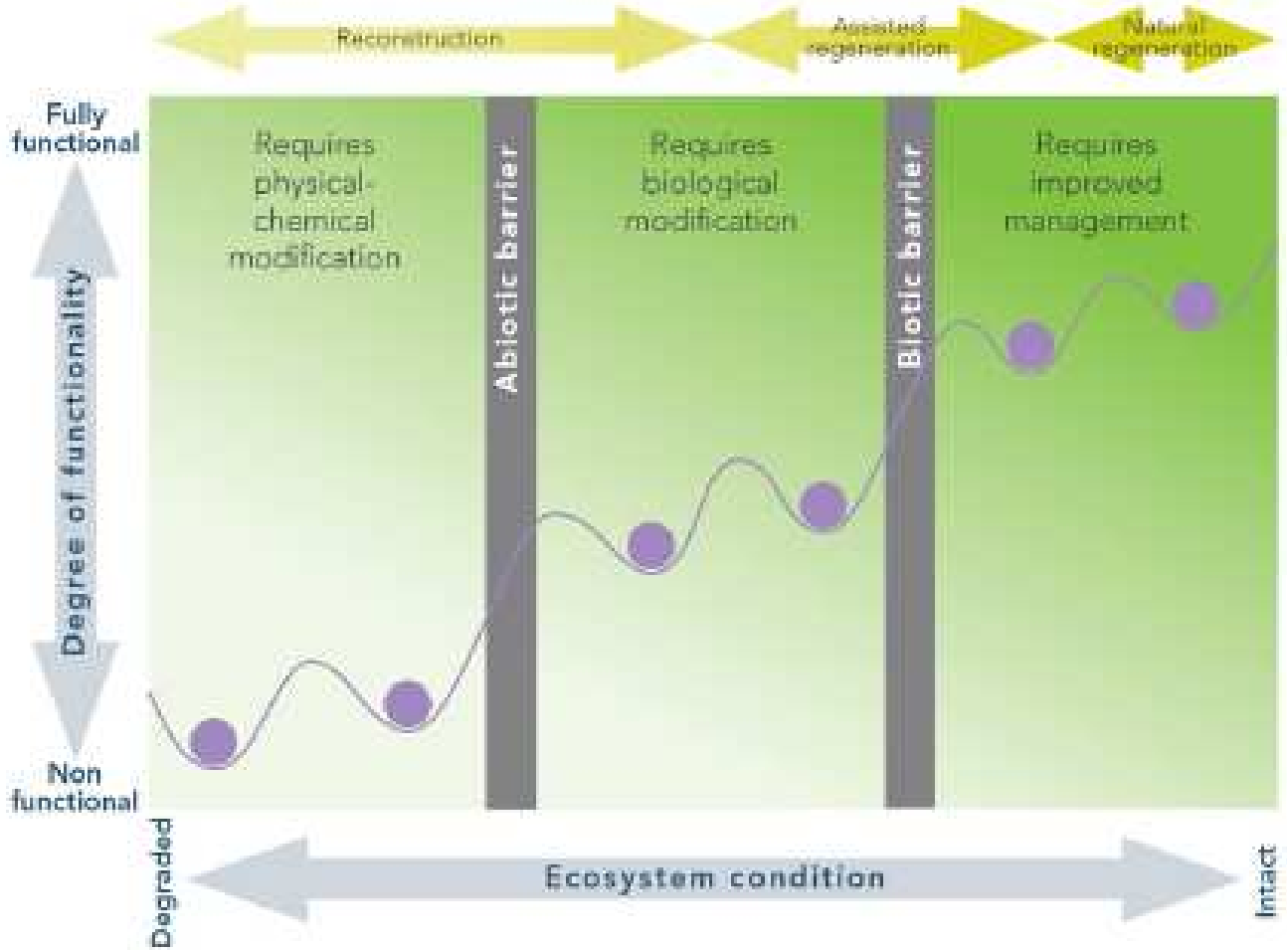
"to combat climate change impacts and loss of biodiversity, increase food safety and water supply"

The EU Green Deal (presented at the end of 2019)

key objectives of the action plan are to preserve and restore ecosystems and biodiversity, including the Biodiversity Strategy for 2030

RESTORATION GOALS

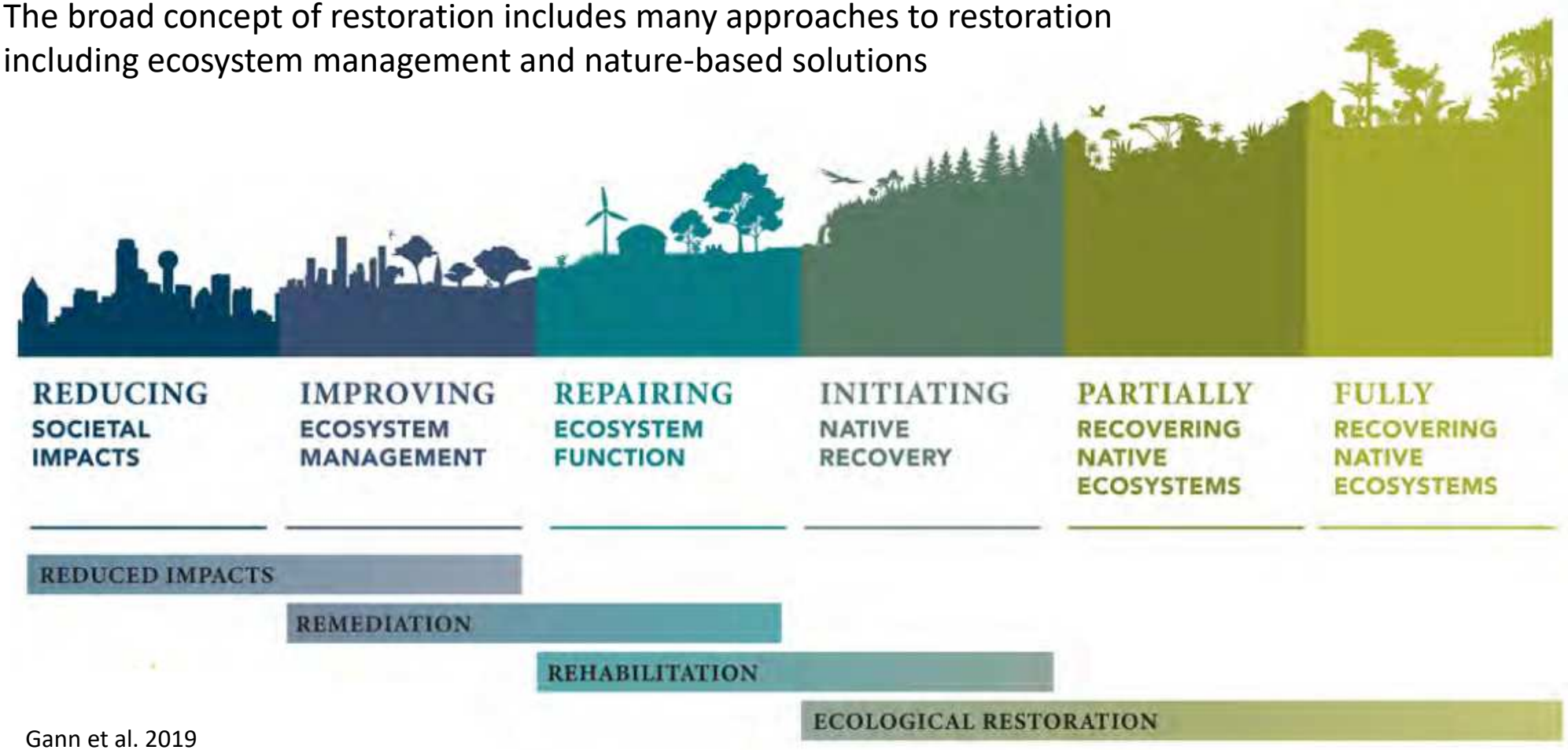
The level of restoration intervention needed depends on the degree of degradation



McDonald et al. 2016

RESTORATION *CONTINUUM*

The broad concept of restoration includes many approaches to restoration including ecosystem management and nature-based solutions



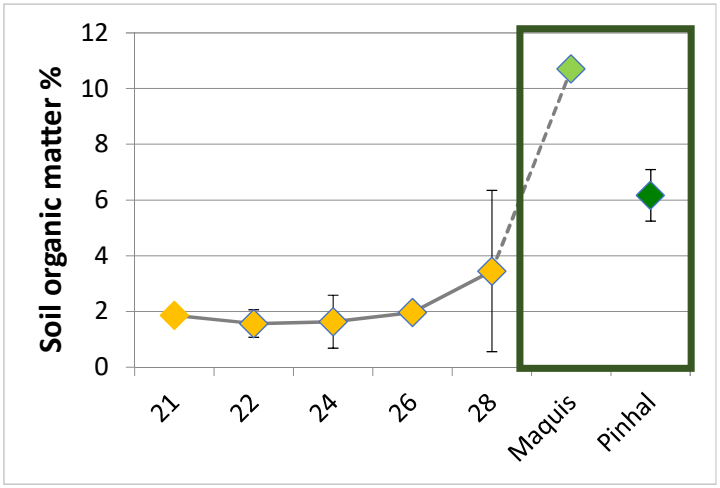
Gann et al. 2019

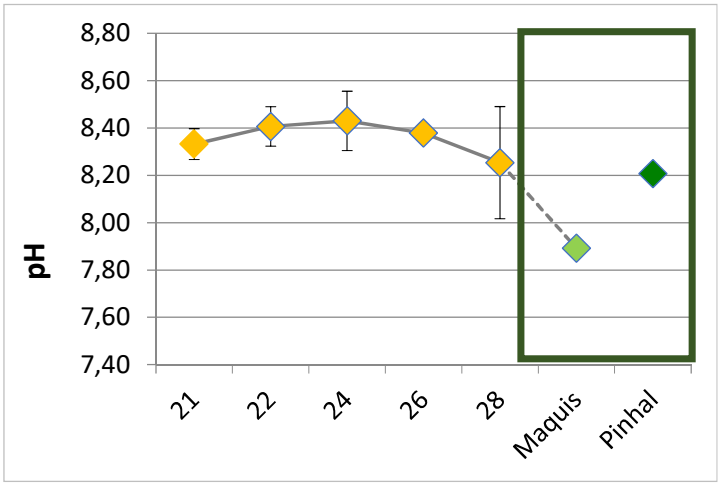
RESTORATION *CONTINUUM*

The broad concept of restoration includes many approaches to restoration including ecosystem management and nature-based solutions

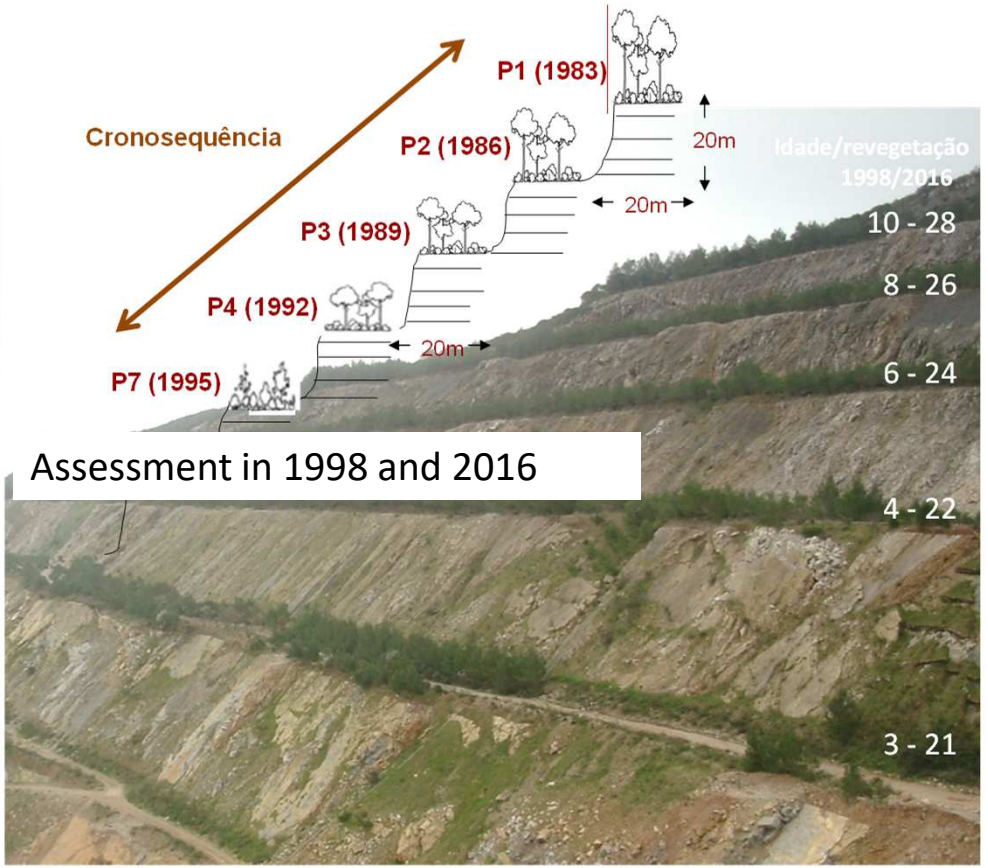
Restoration activities contribute to “reversing the loss of biodiversity, recovering connectivity, improving ecosystem resilience, enhancing the provision of ecosystem services, mitigating and adapting to the effects of climate change, combating desertification and land degradation, and improving human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

ASSESSMENTS AT THE LOCAL SCALE: SOIL QUALITY





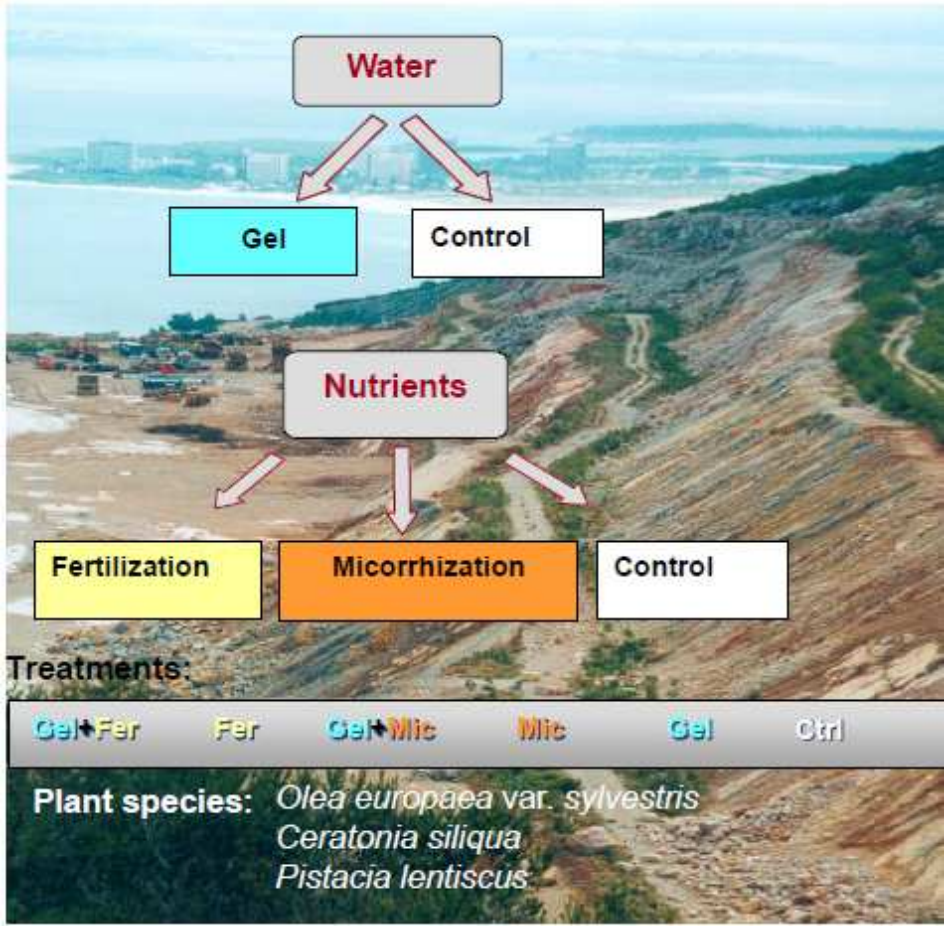
Post-intervention years Reference

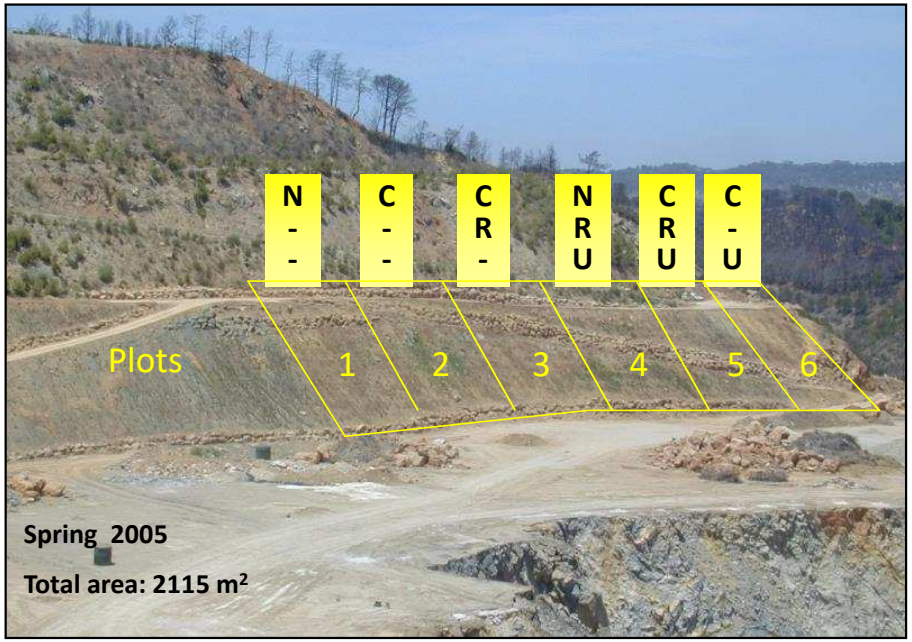


Assessment in 1998 and 2016

IMPROVING SOIL QUALITY

Small scale trials with soil amendments: hydrophilic gel, fertilizers, mycorrhiza





N - "Native" seed mixture

C - "Commercial" mixture

R - Irrigation (2006)

U - addition of USWC

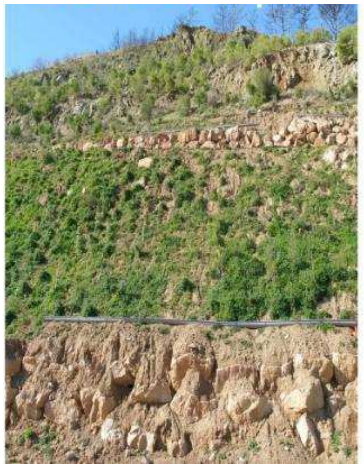
TREATMENTS

IMPROVING SOIL QUALITY

Slope revegetation with soil amendments: Municipal solid waste

Without RSU

With RSU



IMPROVING SOIL QUALITY – LESSONS LEARNED

- ✓ Soil requires a lot of time to recover its physicochemical characteristics and biotic communities - whenever possible, save and use original topsoil!

- ✓ Information on the effectiveness of different soil amendments (from other studies or the suppliers) may not match your conditions (e.g. soil type, climate) or species

- ✓ The target plants are adapted to nutrient-poor soils, so improving “too much” the soil can favor undesired species (e.g. ruderal or invasive species)

What are in your opinion the **most important criteria** for the choice of plant species to be used in restoration?

ASSESSMENTS AT THE LOCAL SCALE: PLANT SPECIES

Taxonomic composition and diversity:
in space and time and convergence with natural reference

Functional diversity: important for the structure and functioning of the ecosystem and, therefore, for the provision of ecosystem services

Functional redundancy: important for system resilience when dealing with changes (e.g. climate, fire)

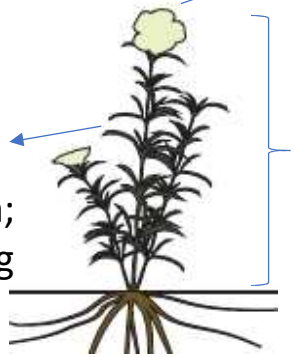
Dispersal mode
Post-fire regeneration strategy

Flowering onset and duration

Pollination

Leaf traits

Decomposition;
Nutrient cycling



Max. height

Biomass accumulation; food and shelter

Soil fertility

C sequestration

Root type

Erosion control

PLANT SPECIES

Regeneration and establishment of new individuals – reproducing populations

Key functional groups

Ecological resilience

Burned terrace

Burned natural vegetation

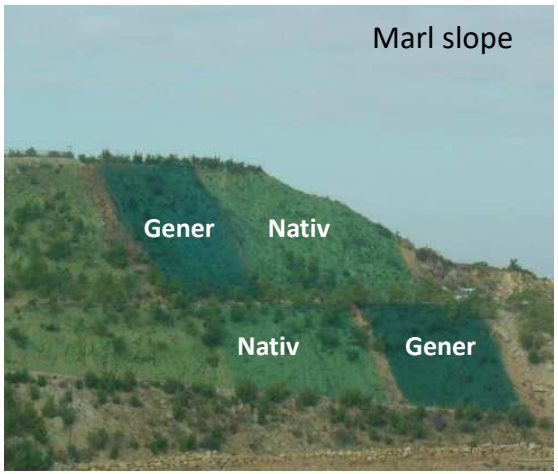
Self-sustainability

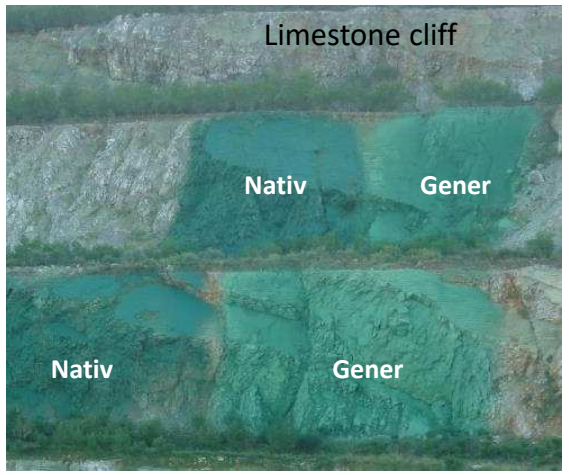
Colonization by species from the surrounding areas – biotic fluxes

Presence of species important for conservation in the longest revegetated sites

SEEDED PLANT SPECIES

Experimental trials with different species mixtures for hydroseeding





Main objective: establish vegetation cover, control erosion and promote natural succession

SEEDED PLANT SPECIES – LESSONS LEARNED

- ✓ Replacing generalist species for native species is key (e.g. functional role, resilience towards disturbance, interactions with fauna, cost-benefit, etc.)
- ✓ But it presents its challenges: many need pre-treatments to germinate, and it is necessary to adjust the best combination of species, and adapt the dosages for different contexts
- ✓ The sowing season is a key aspect for the success of their establishment
- ✓ Sowing should be seen as a first step that then gives way to processes of natural colonization (succession)

PLANTED SPECIES (mostly woody species)

Revegetated areas

Natural reference

time

Plantations with mostly native Mediterranean shrubs, but also non-native Alepo pine as a “nurse plant”

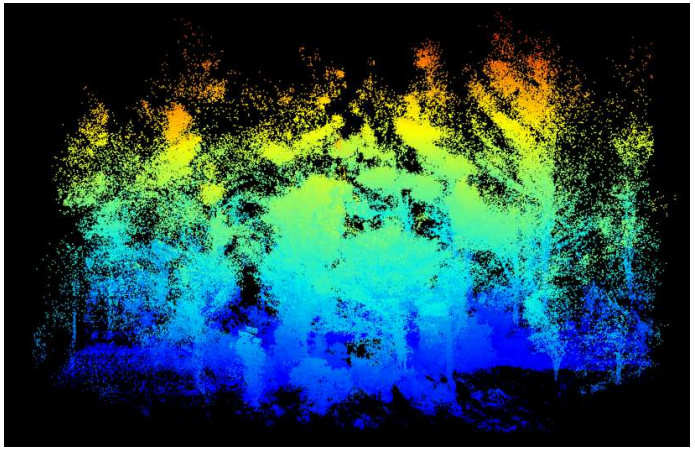
PLANTED SPECIES – LESSONS LEARNED

- ✓ Some species (introduced or spontaneous) may tend to dominate - need for adaptive management to redirect the restoration trajectory
- ✓ Pine may have played an important role in the beginning of revegetation, but later became a competitor - limitation to restoration desired trajectory
- ✓ Assisted and spontaneous establishment of native species is key (presence of key functional groups, biotic flows, resilience)
- ✓ The origin (provenance) and quality of the plants and seeds used are essential for the success of the restoration, and the maintenance of the genetic heritage that can be essential for adaptation and resilience to current and future conditions/disturbance

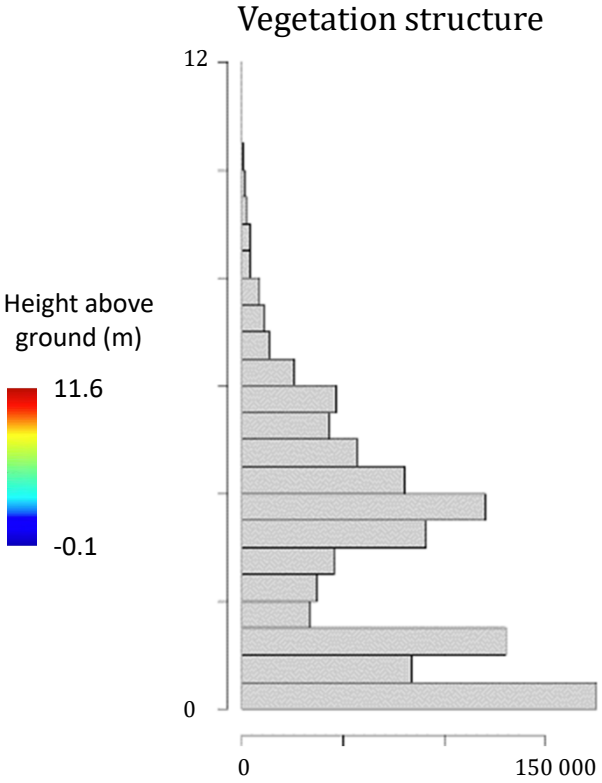
UPSCALE TO LANDSCAPE: ECOSYSTEM SERVICES

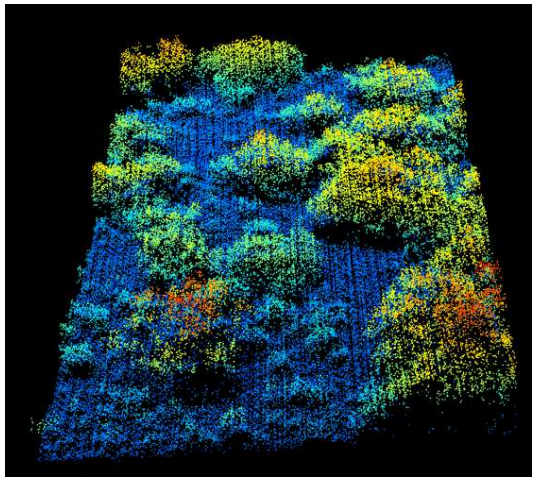
Ecosystem service	Field indicator	Remote sensing indicator
Climate and water regulation	Aboveground biomass (AGB), carbon stocks, vegetation density, cover and height	LiDAR metrics NDVI, fractional vegetation cover, NPP, NDVI, PRI, WBI, MODIS Land Surface Temperature and Emissivity, MODIS/Landsat evapotranspiration
Air purification	Pollutant concentration; Deposition velocity; Tree cover; LAI	AVHRR, Landsat ETM+, MODIS
Erosion prevention	Stratified vegetation cover index (StrVC)	LiDAR metrics, Vegetation cover: NDVI (Landsat, MODIS)
Pollination	Vegetation phenology, primary productivity, pollination data, land cover	Landsat, NOAA-AVHRR, GLOBCOVER map
Soil fertility	Soil organic matter content, Soil depth, litter cover, Soil physical properties-texture	NDVI, Non-Photosynthetic Vegetation (NPV), Green vegetation (GV), shade, soil spectra (Landsat, MODIS, SPOT VGT)
Regulation of fire risk	Vegetation canopy closure, functional traits, fire risk ratings	Normalized Difference Vegetation Index (NDVI), Fire potential index (FPI)
Carbon sequestration	Biomass, NPP	NDVI, LAI (Landsat, Sentinel-2 R)

LANDSCAPE SCALE: REMOTE SENSING (LiDAR)

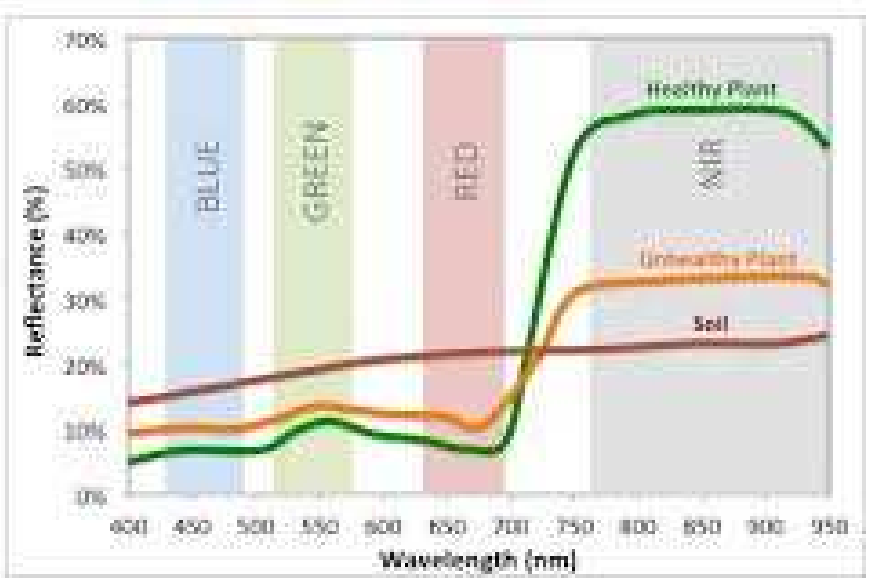


LiDAR (light detection and ranging) measures the distance to a target, illuminating the target with laser light and measuring the reflected light with a sensor. Differences in laser return times and wavelengths are used to make 3D digital representations of the target

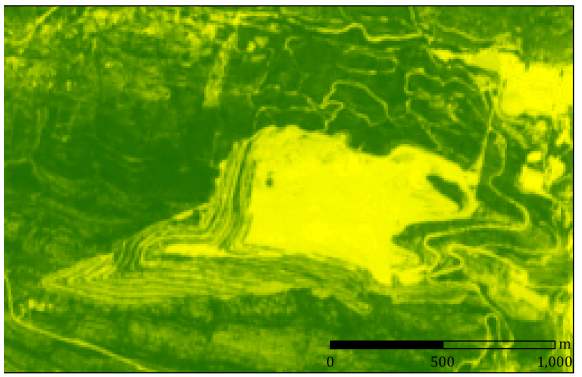


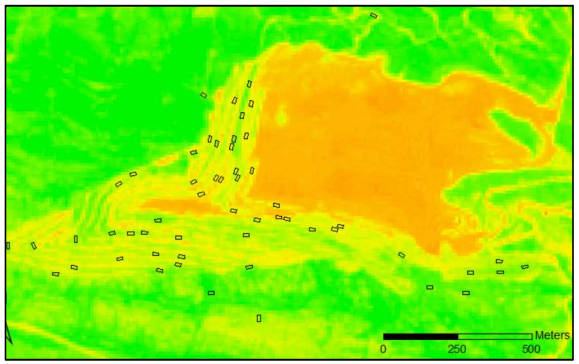


LANDSCAPE SCALE: REMOTE SENSING (SATELITE)



$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$



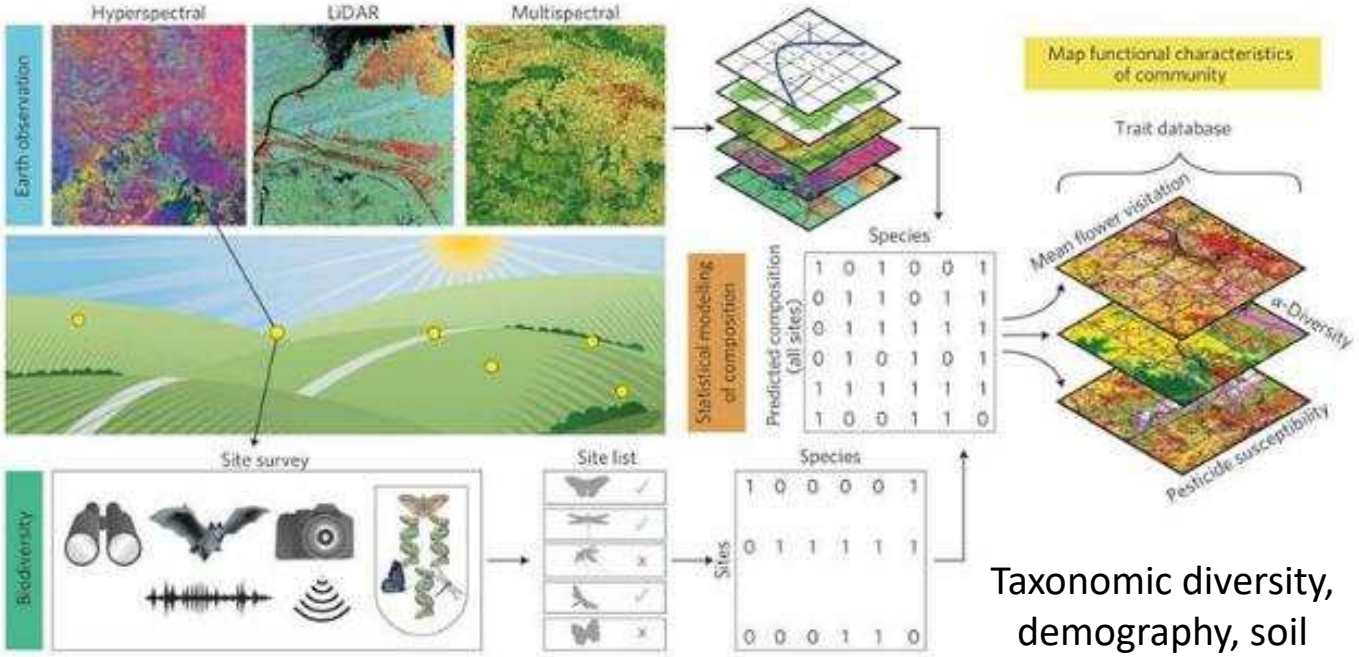


Vegetation Indices

- Electromagnetic wave reflectance information from canopies using passive sensors;
- Reflectance of light spectra from plants changes with plant type, water content within tissues, plant health, etc.

INTEGRATING SPATIAL AND TEMPORAL SCALES

LiDAR and satelite data

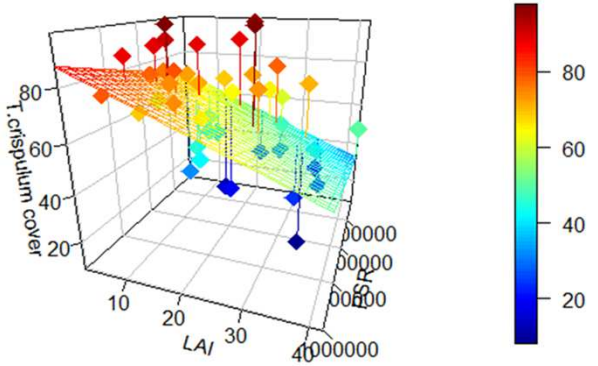


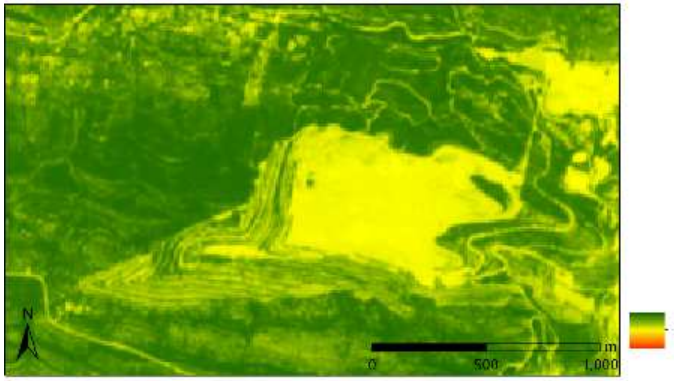
Bush et al 2017

Functional diversity

Taxonomic diversity, demography, soil

Integrated modeling of different facets of biodiversity





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

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SECIL PROJECT, FAUNA COMPONENT

2007/08: Project begins

- Animal community inventory
- Action Plan for biodiversity

2008/10: Phase 2

- Implementation of actions
- Monitoring of animal communities

2011/14: Phase 3

- …
- Scientific studies

2015/18: Phase 4

Quarries alive

2018/20: Phase 5

- …
- Net Impact assessment

Challenges:

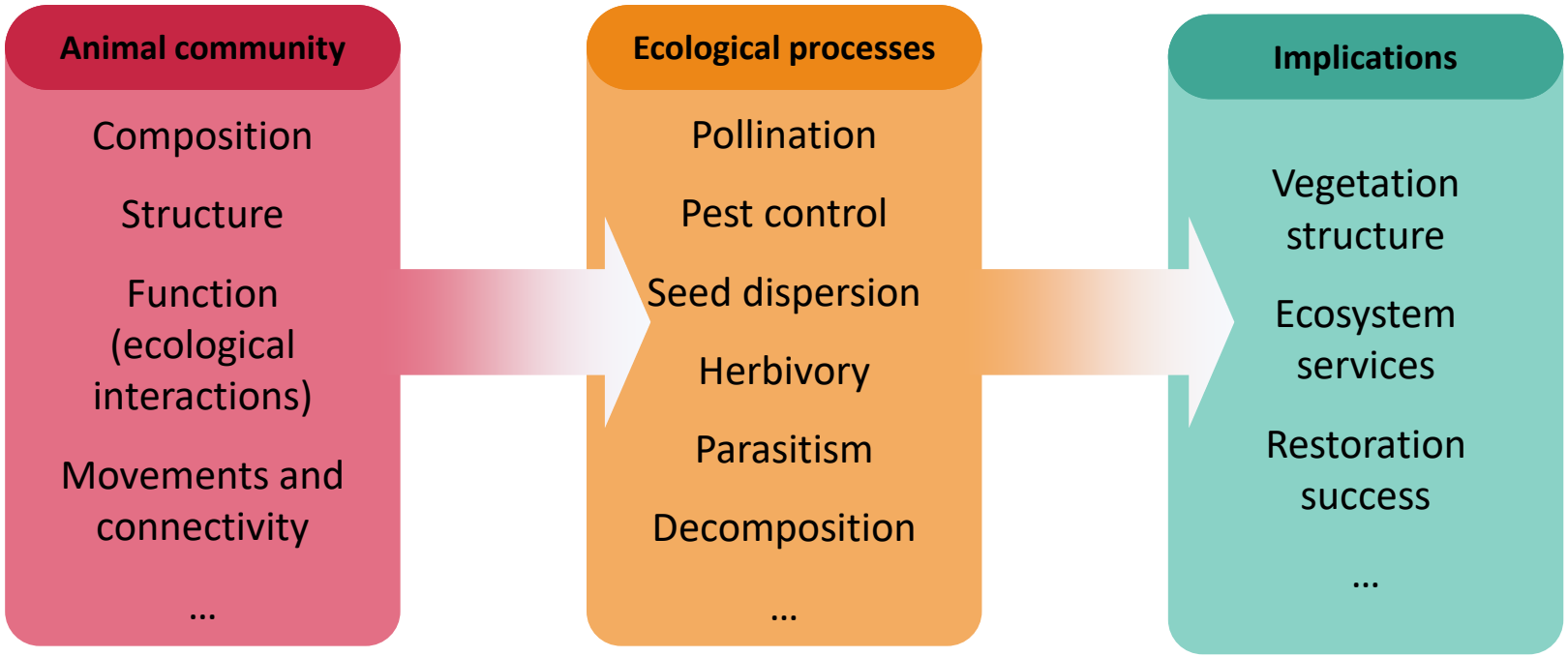
- Minimization of impacts
- Promotion of natural processes of colonization
- Restoration of the structure and functioning of ecosystems
- Approach the animal community

Opportunity:

SECIL-Outão
a full-scale living laboratory

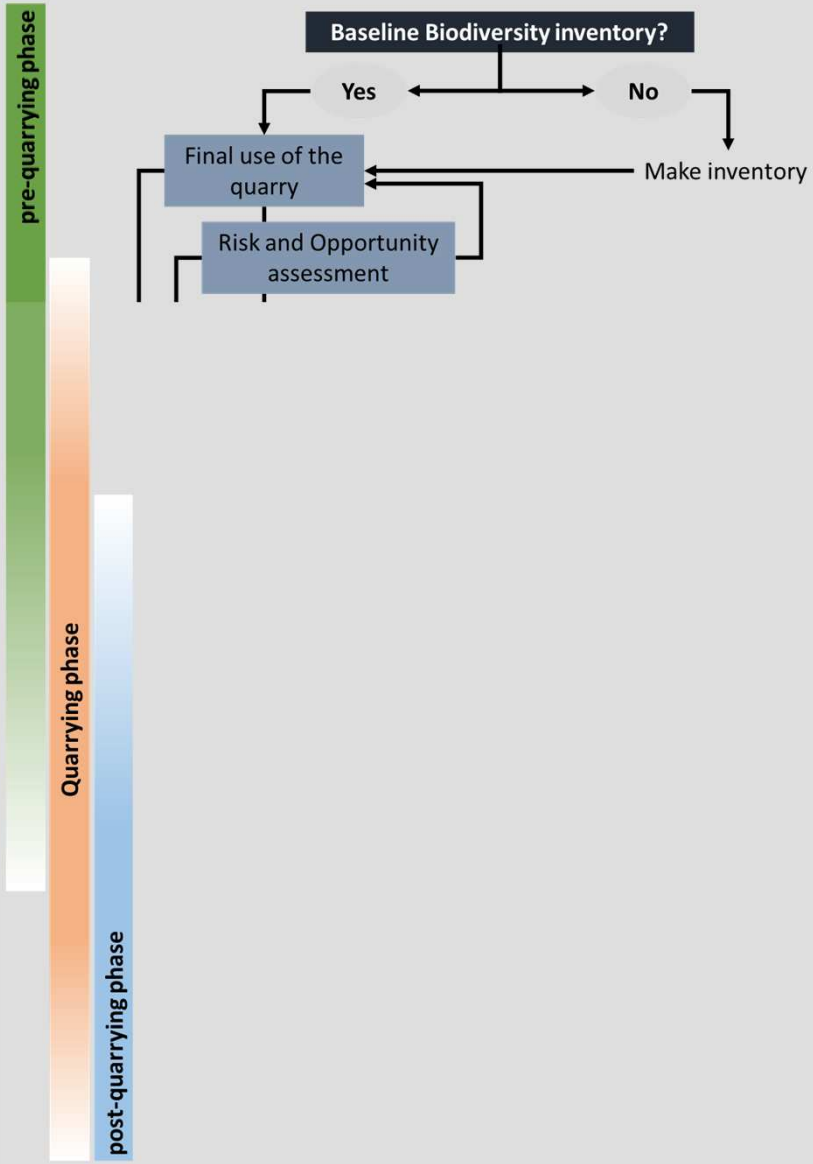
Why should we approach animal communities in restoration processes: what is their **role or importance**?

WHY SHOULD WE APPROACH ANIMAL COMMUNITIES IN RESTORATION PROCESSES: WHAT IS THEIR ROLE OR IMPORTANCE?



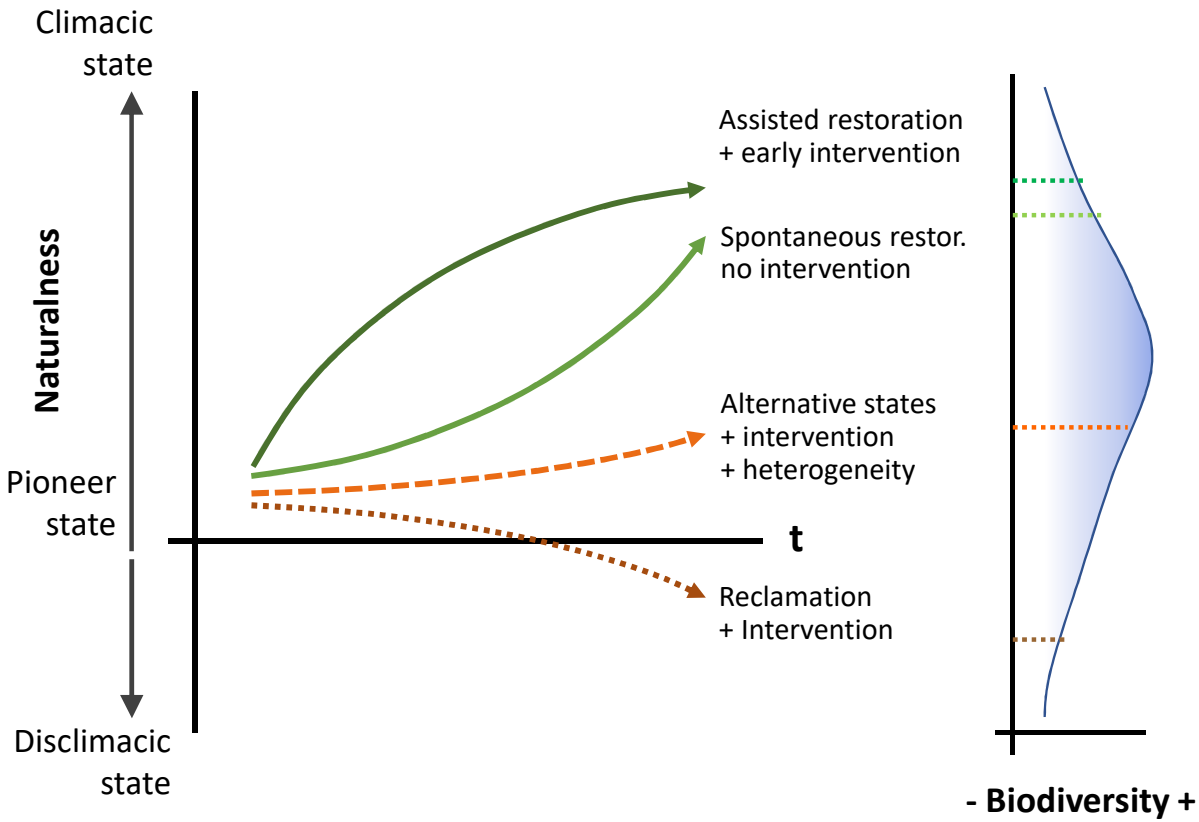
Can we have an entirely restored ecosystem without considering animal wildlife?

ROADMAP TO QUARRY RESTORATION

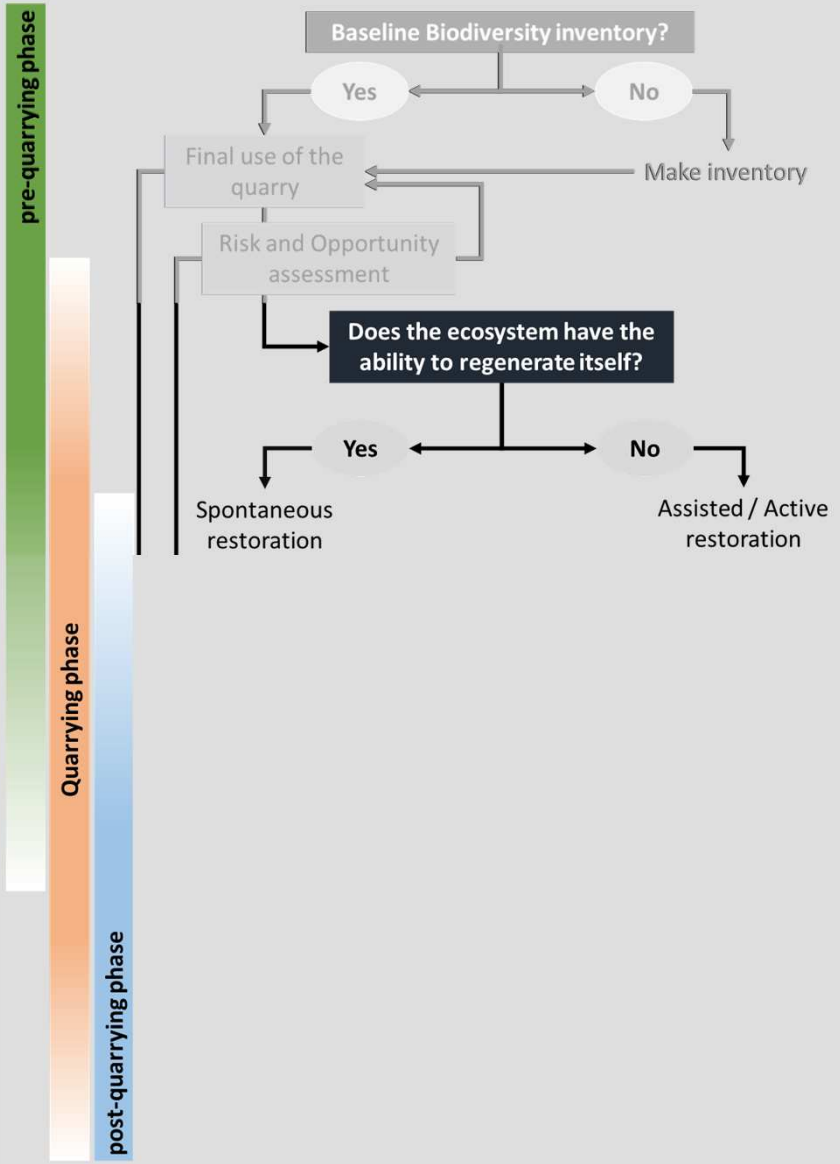


Part of the WE VALUE NATURE 10-DAY CHALLENGE

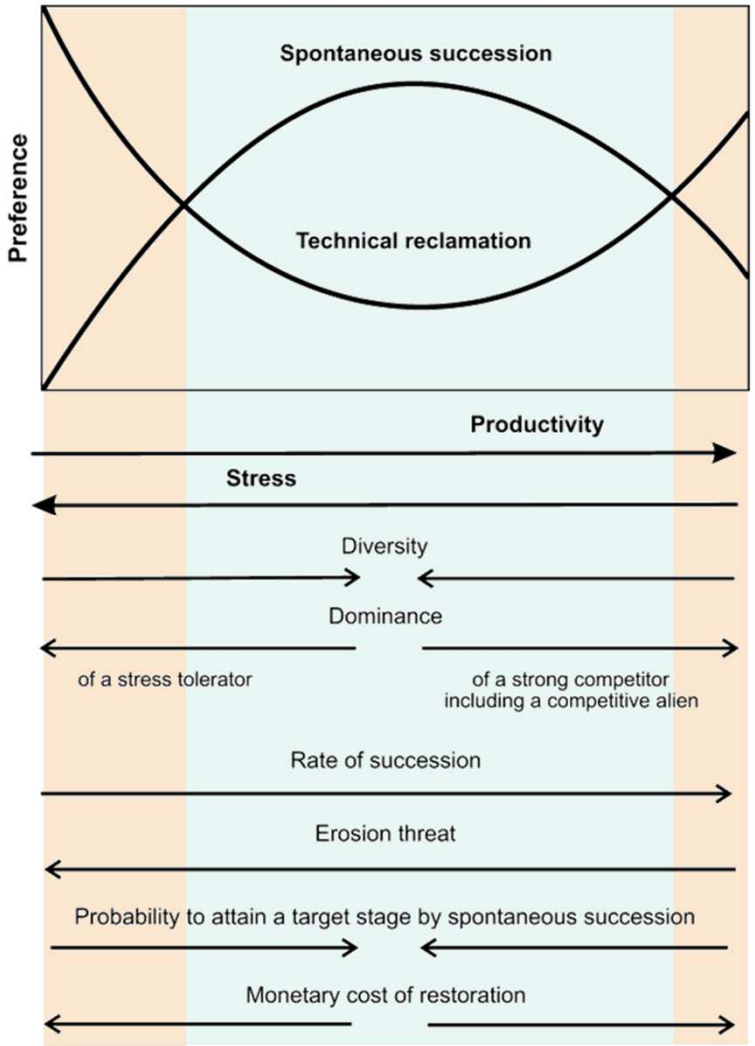
➢ SETTING THE TARGET



ROADMAP TO QUARRY RESTORATION

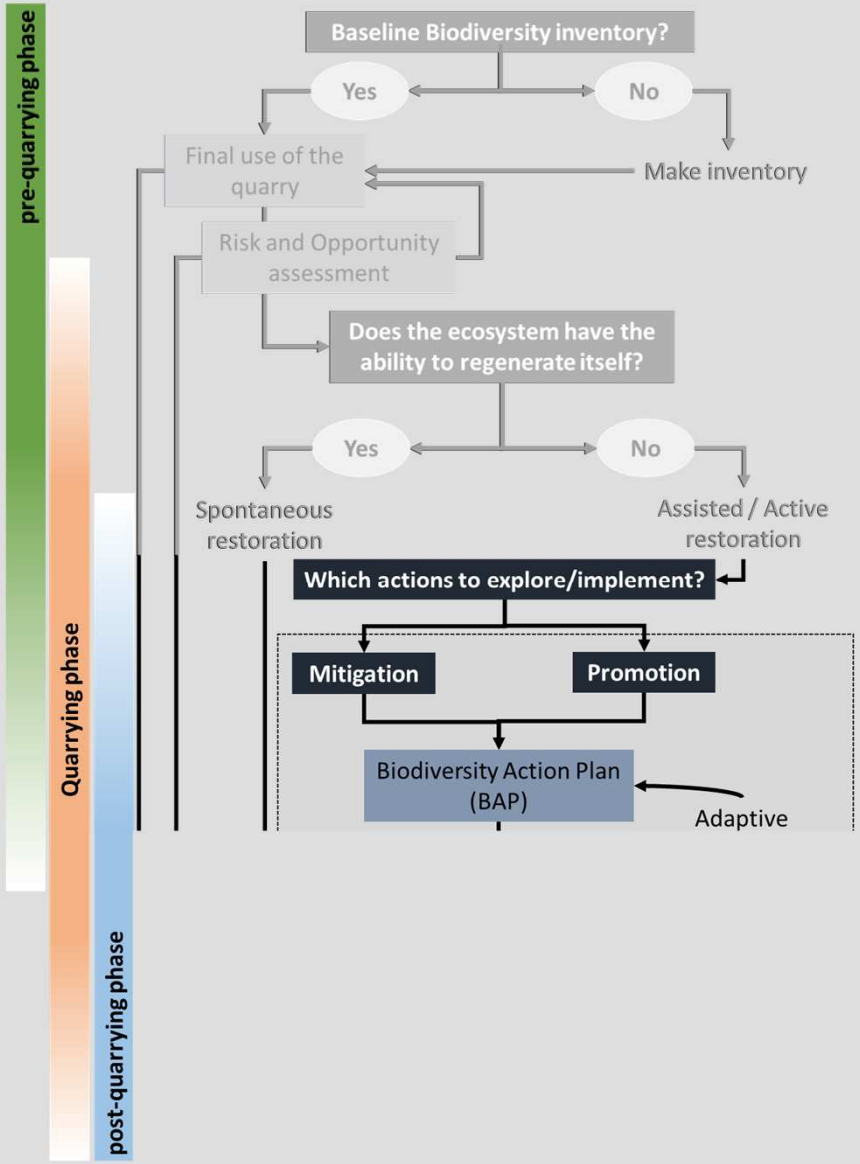


➢ SETTING THE STRATEGY



Adapted from: Prach, Hobbs. Restor Ecol, 2008, 16: 363-366

ROADMAP TO QUARRY RESTORATION



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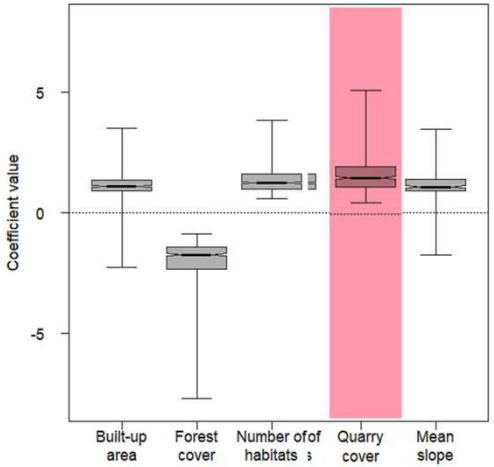
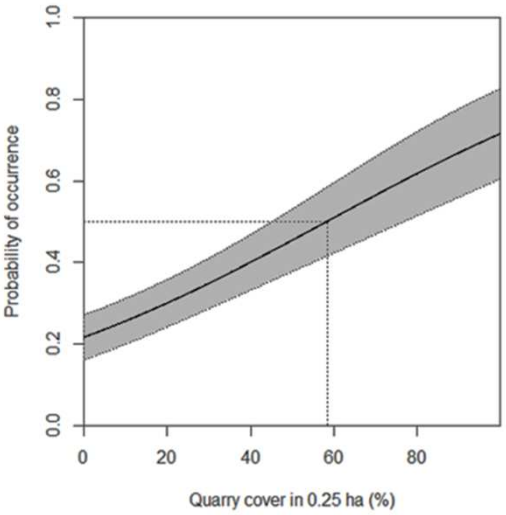
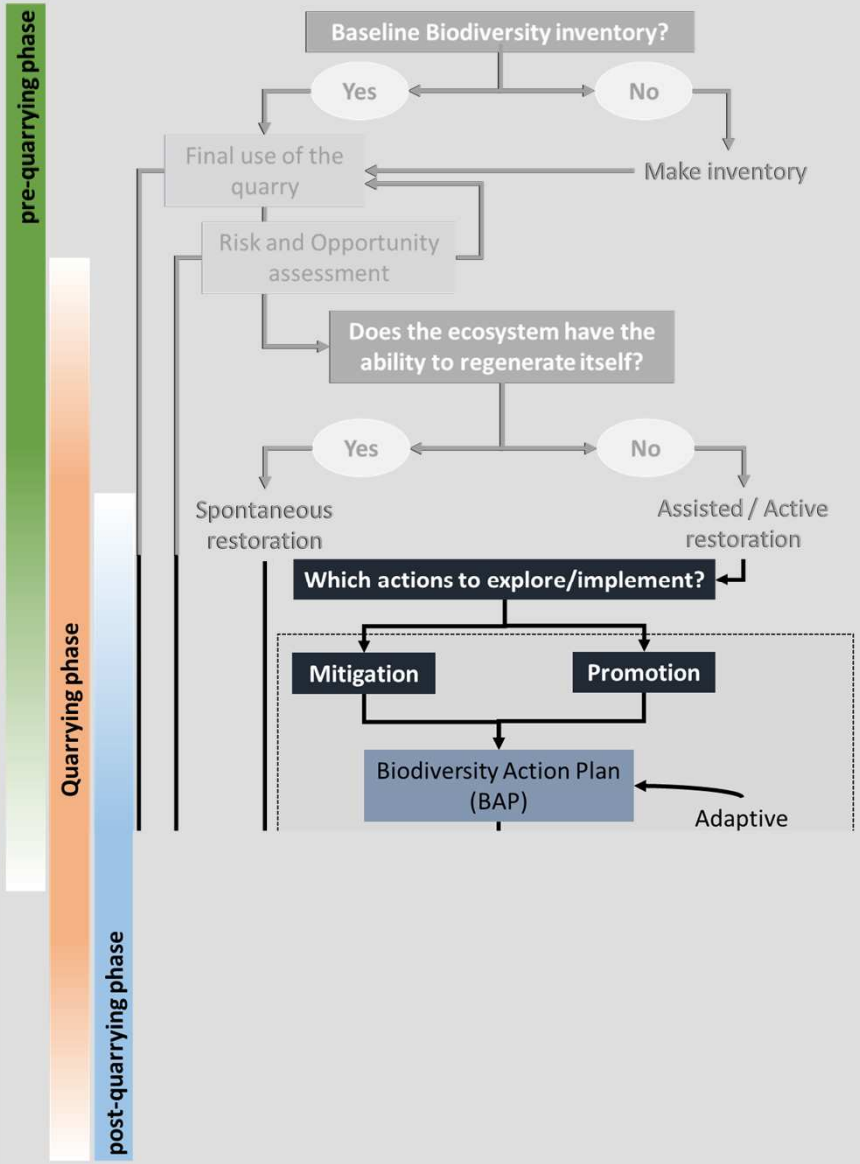
➢ CREATING NEW HABITAT ELEMENTS

Adapted from: Salgueiro et al. Rest Ecol, 2020, 28: 988-994.





ROADMAP TO QUARRY RESTORATION



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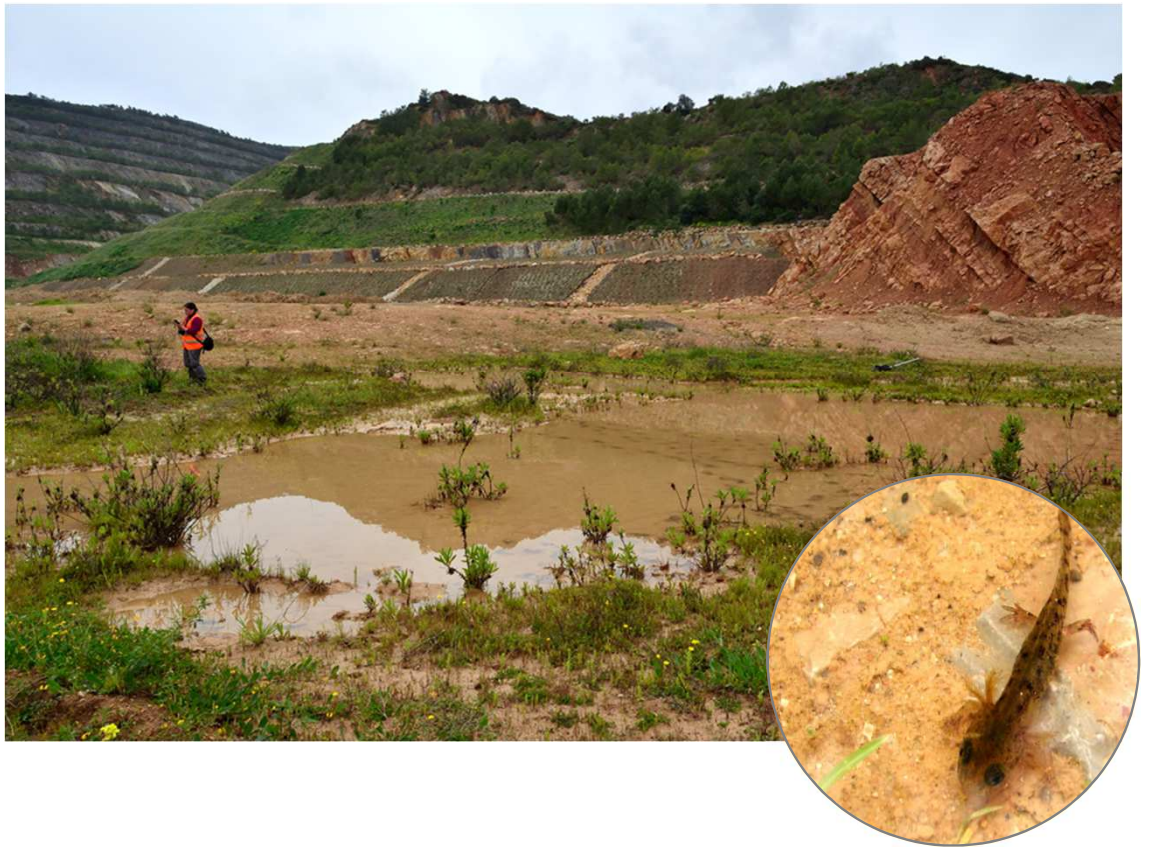
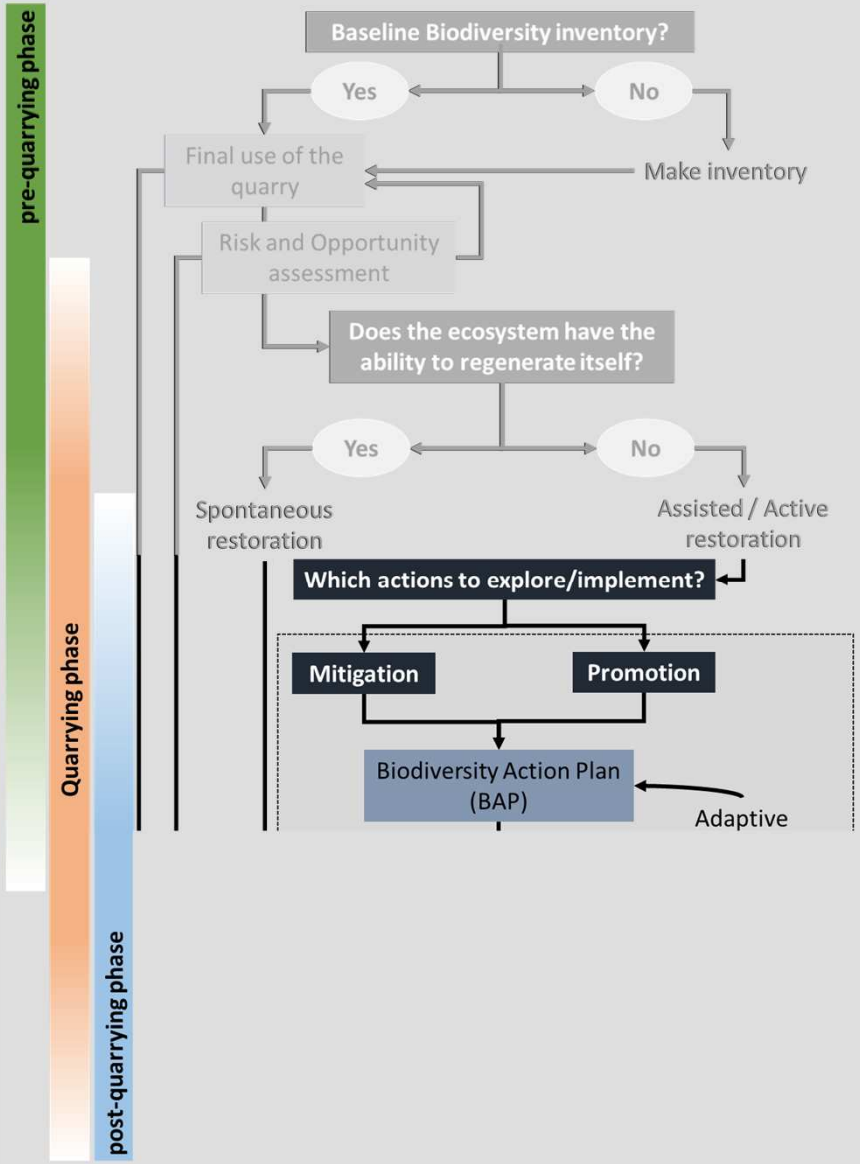
➢ CREATING TEMPORARY HABITATS

Ponds, rock piles, can benefit specific pioneer species amphibians, dragonflies, reptiles, birds.



ROADMAP TO QUARRY RESTORATION



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➢ IMPROVE HABITAT CONDITIONS

Artificial ponds

- Provide water in xeric environments
- Provide habitat for aquatic species

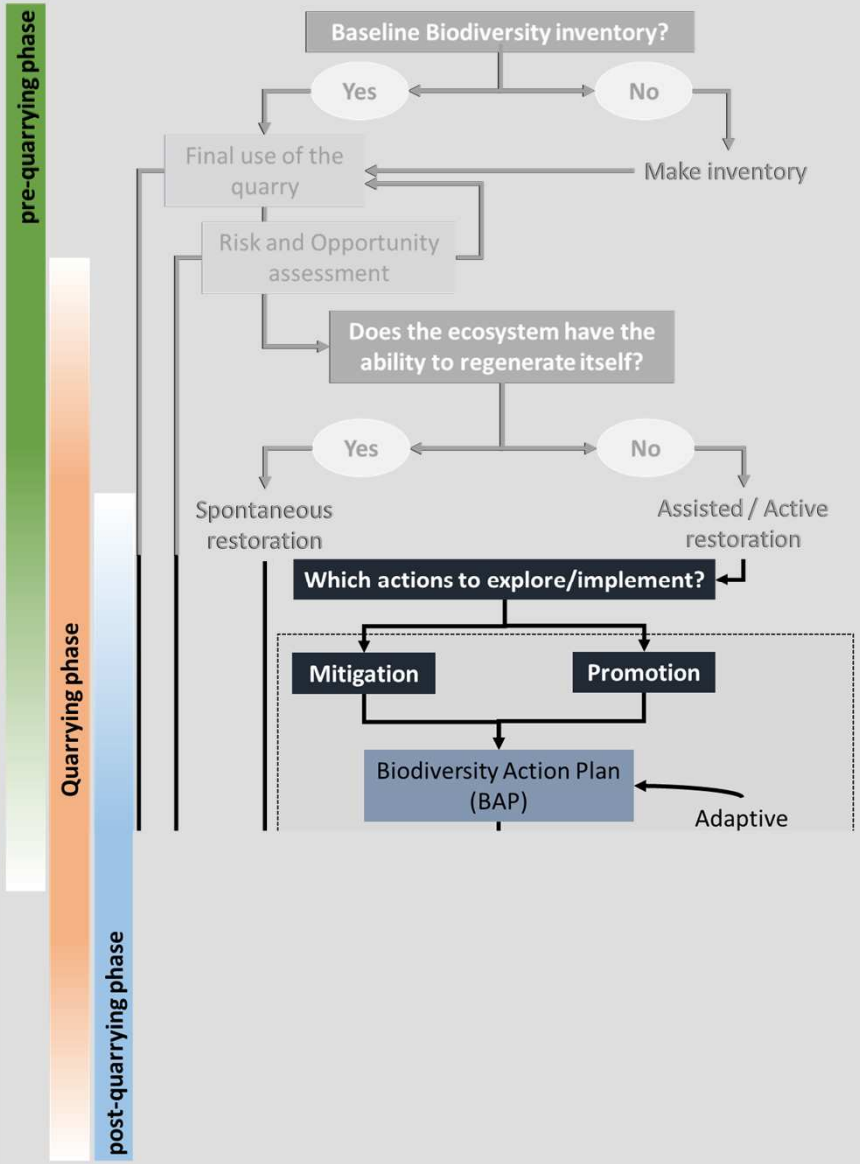
Plant specific species

- Food provisioning
- Nest support (birds)
- Host species
- Pollination

Shelter provision

- Nest and bat-boxes
- Stone walls
- Wood piles

ROADMAP TO QUARRY RESTORATION



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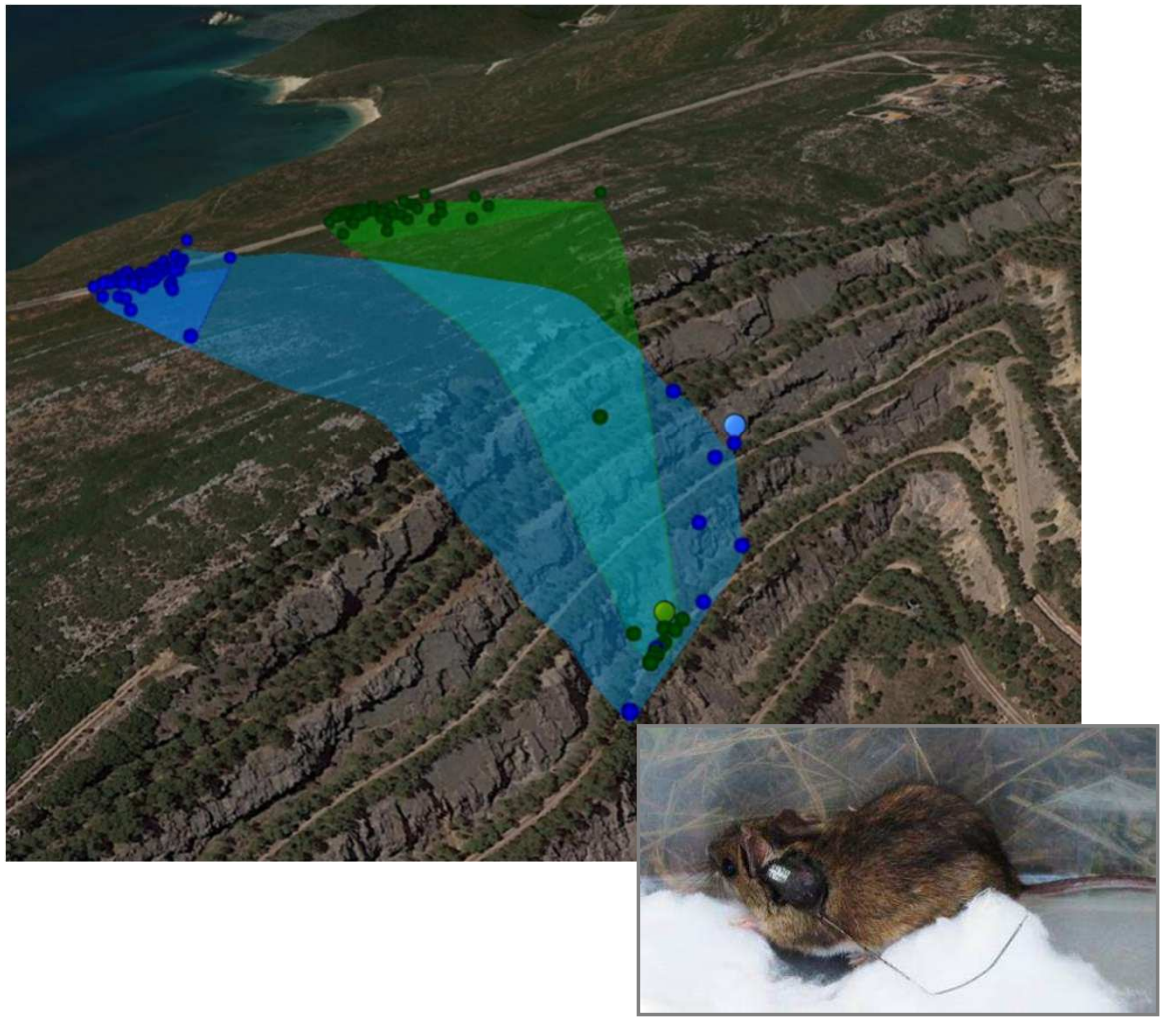
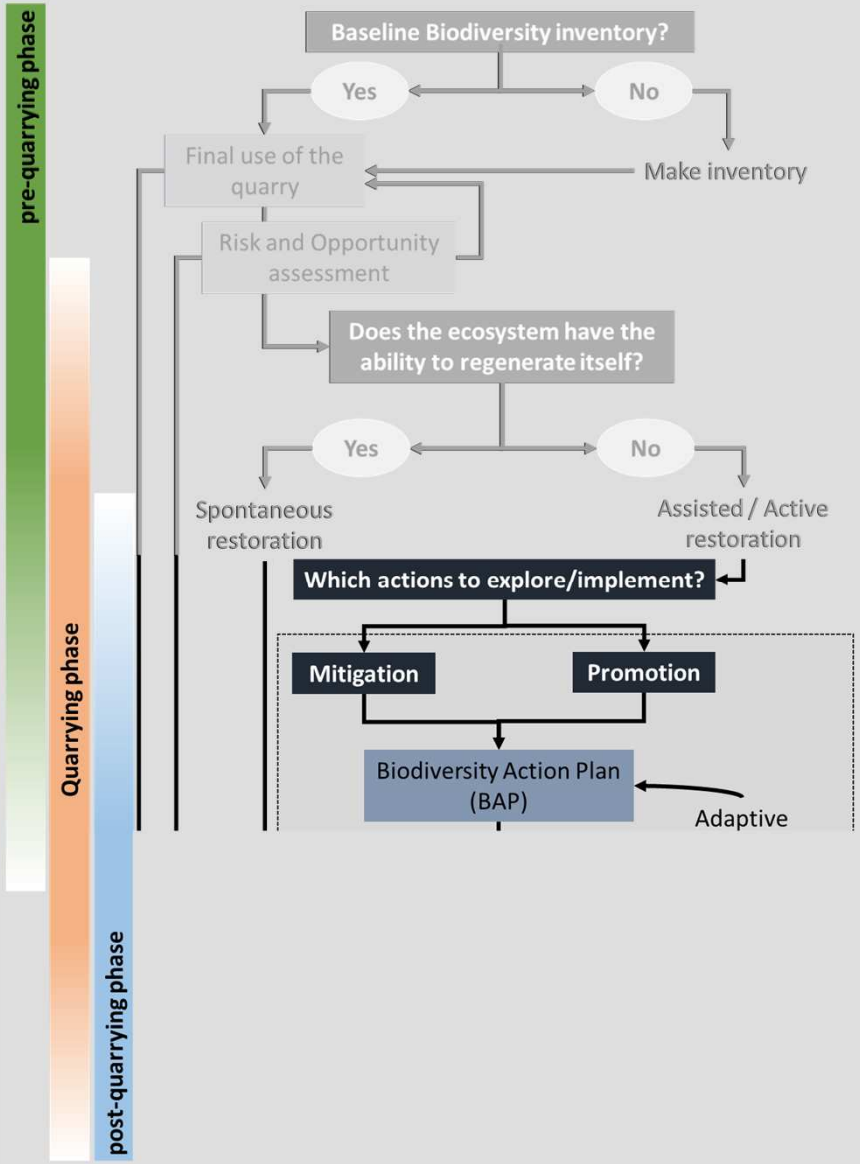
➢ CONNECT RESTORED AREAS



ROADMAP TO QUARRY RESTORATION



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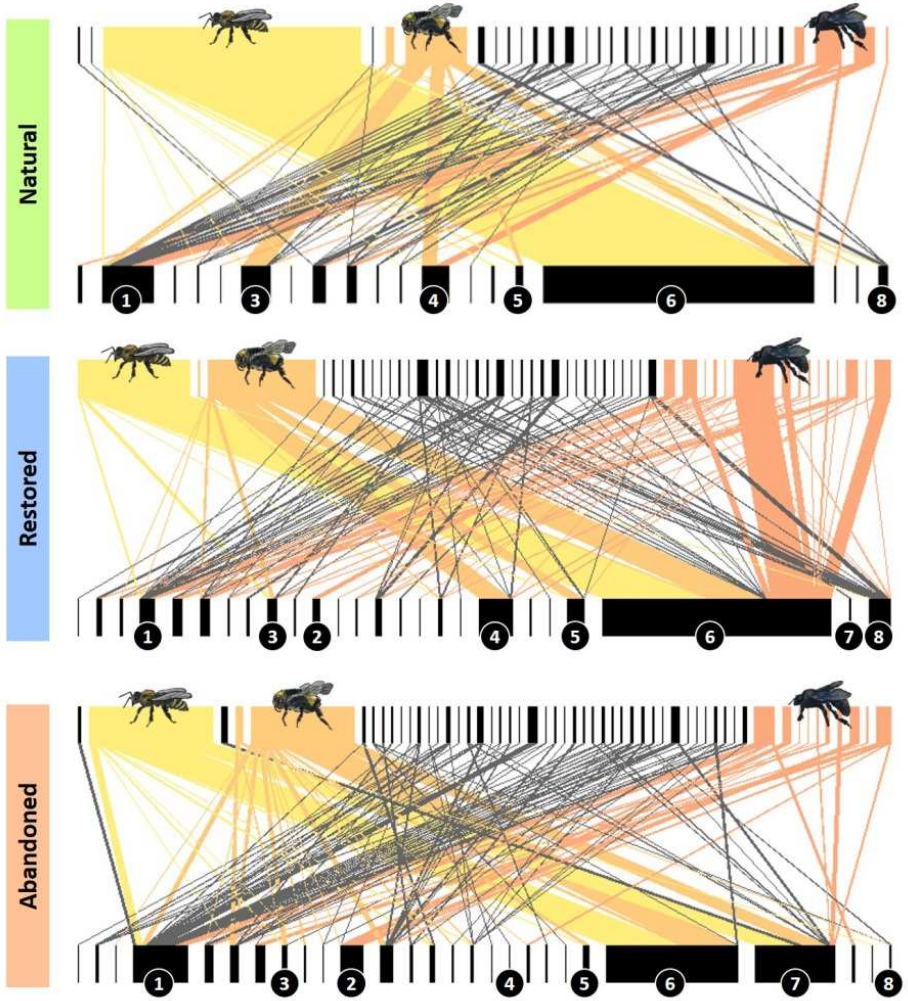
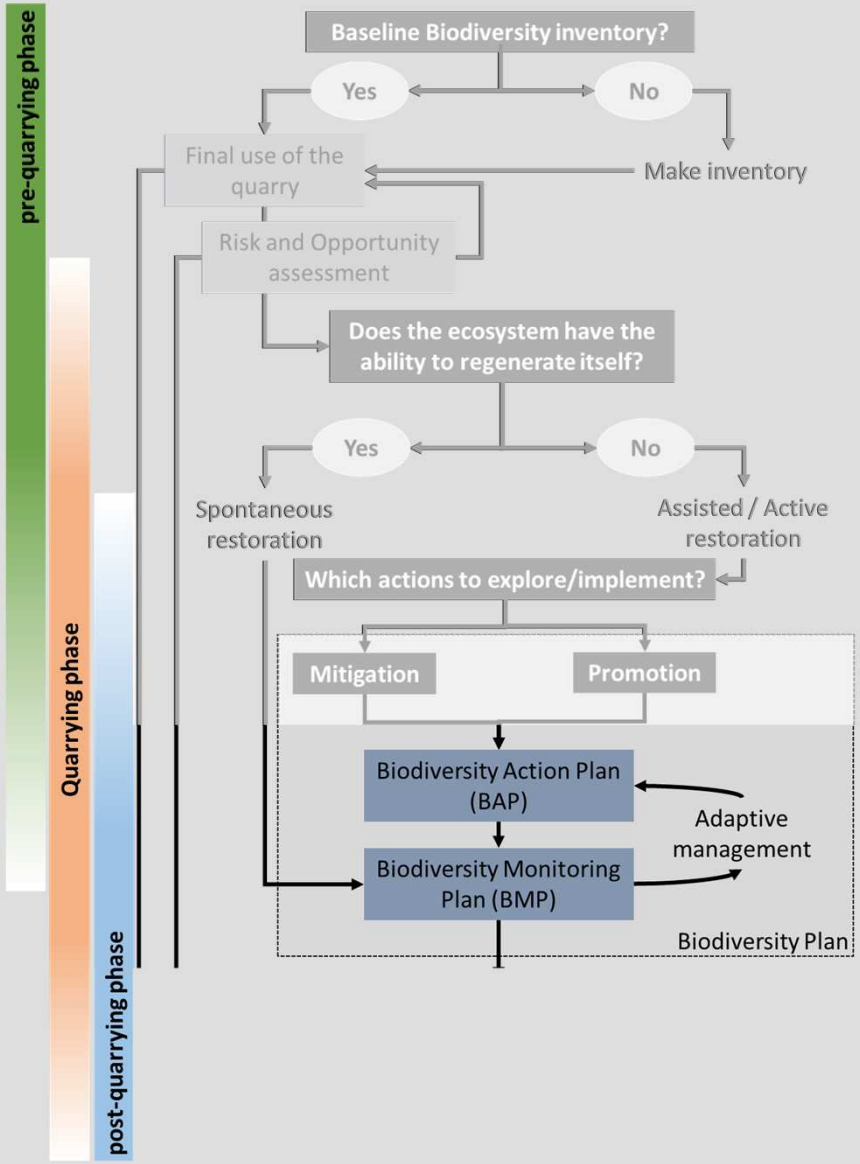
➢ INCREASE ECOSYSTEM SERVICES



Carvalho et al., subbmited

ROADMAP TO QUARRY RESTORATION



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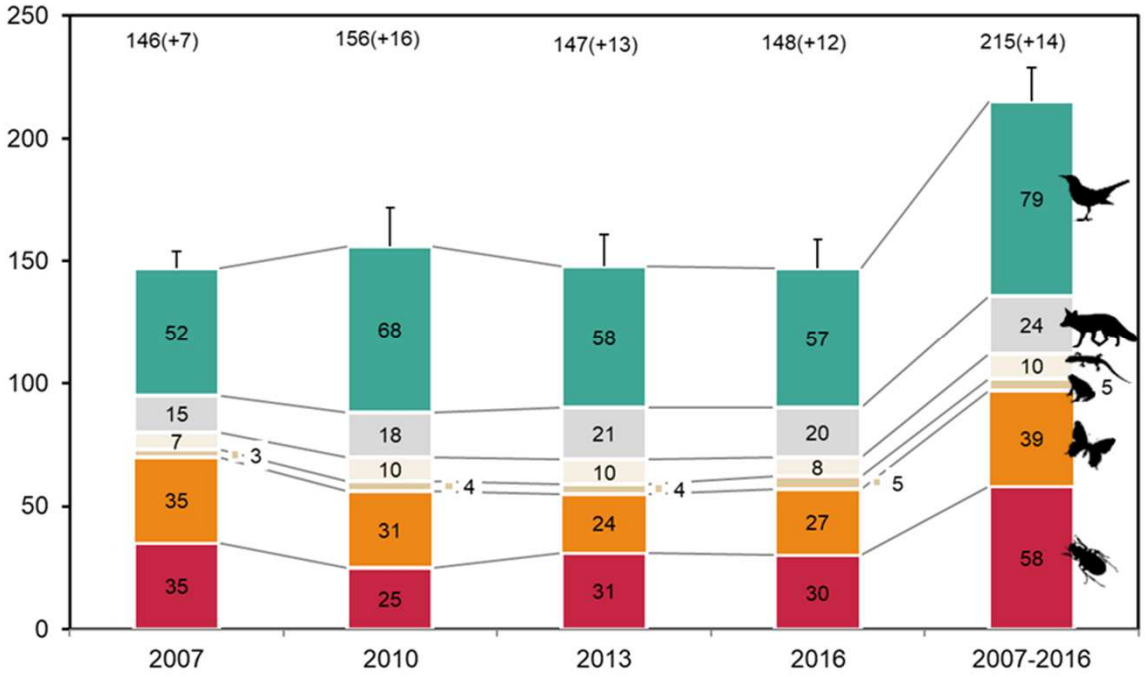
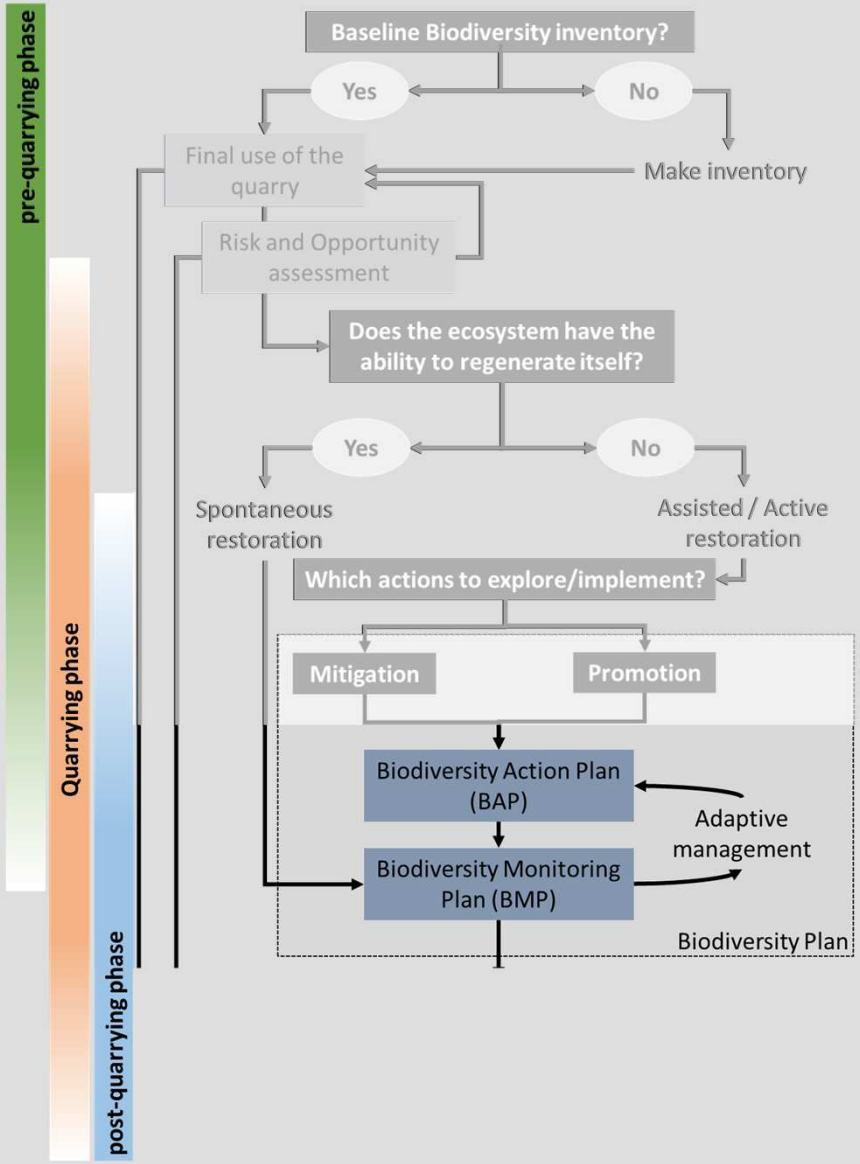
➢ LONG-TERM MONITORING



ROADMAP TO QUARRY RESTORATION



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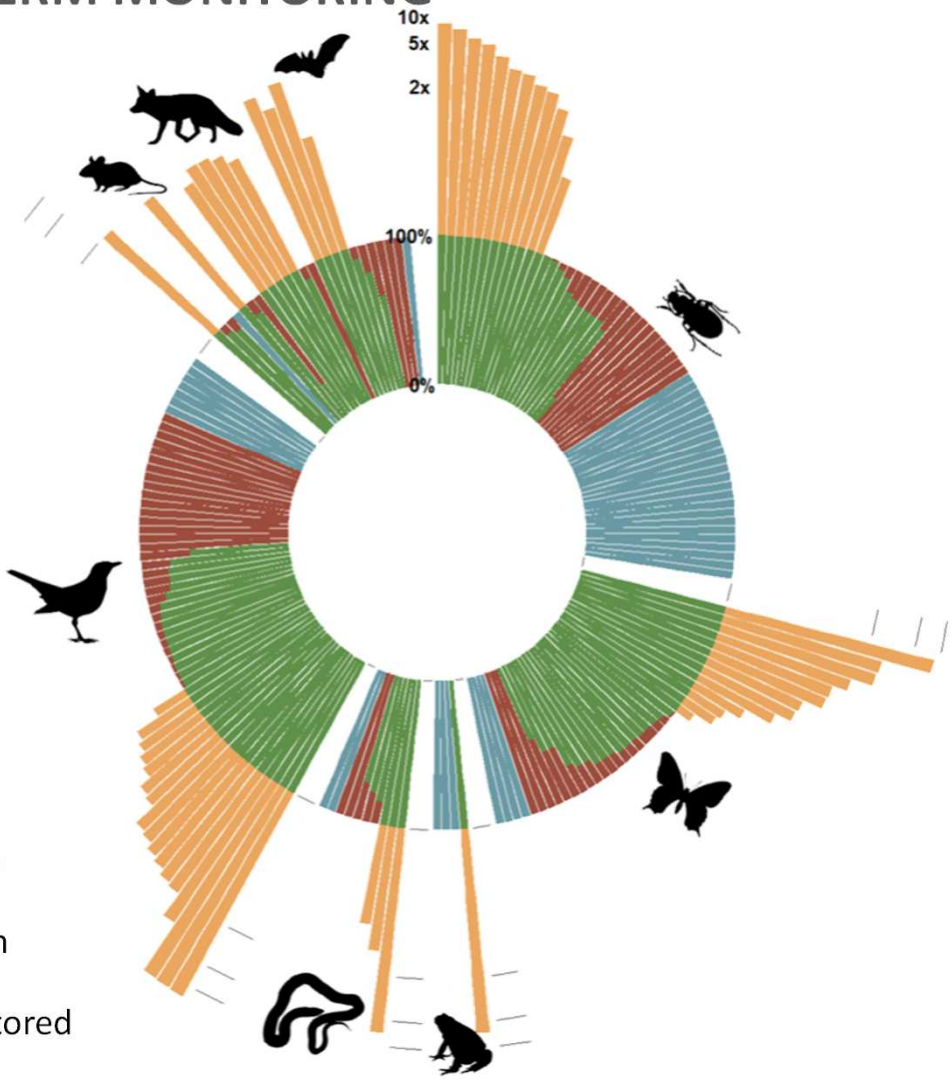
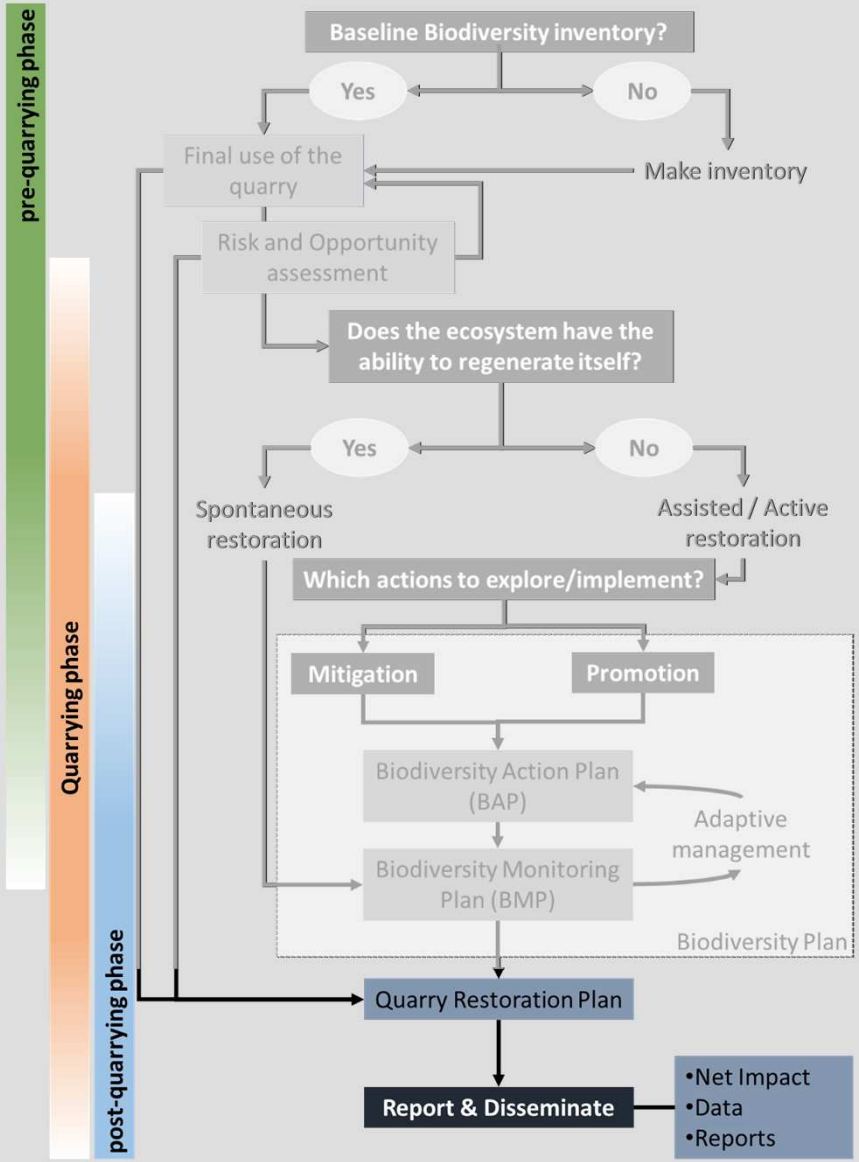
➢ LONG-TERM MONITORING



ROADMAP TO QUARRY RESTORATION



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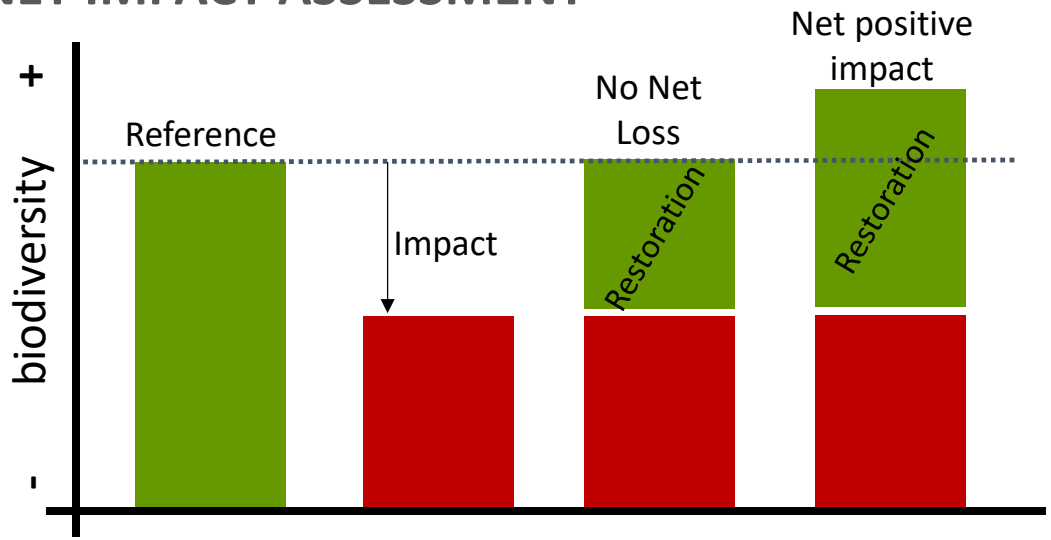
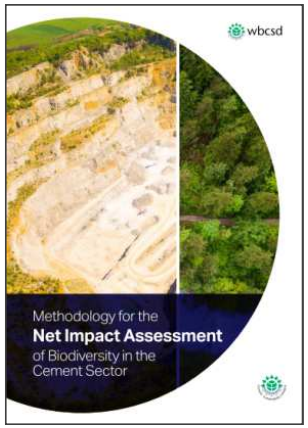
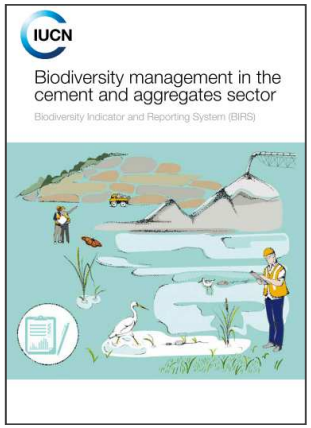
➢ NET IMPACT ASSESSMENT



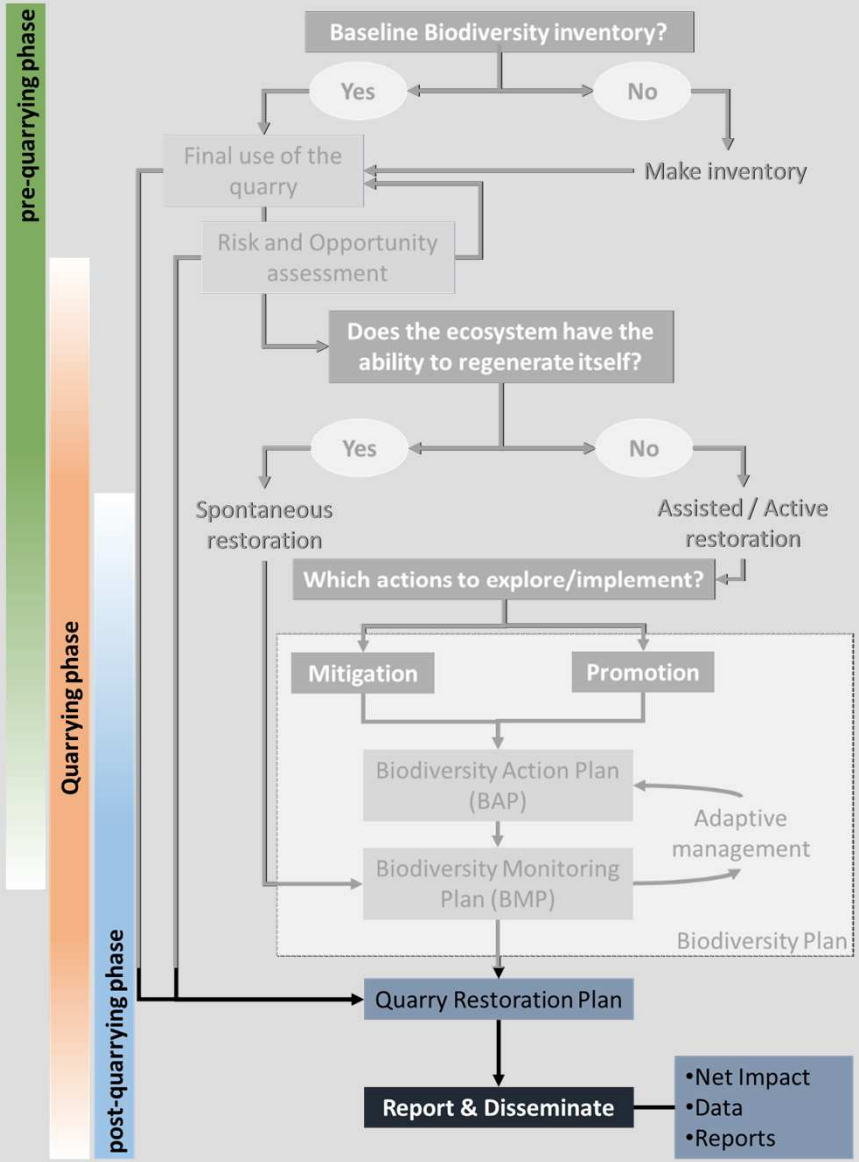


NIA - WBCSD



BIRS - IUCN

ROADMAP TO QUARRY RESTORATION



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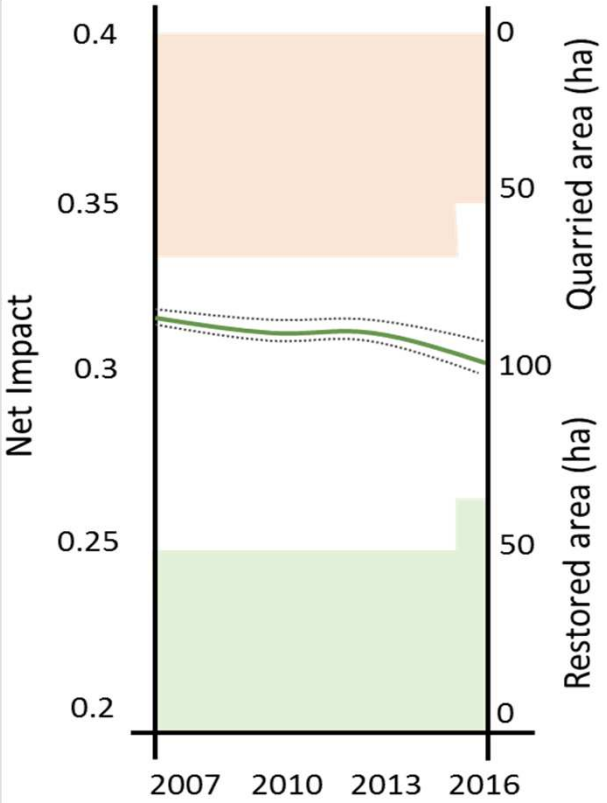
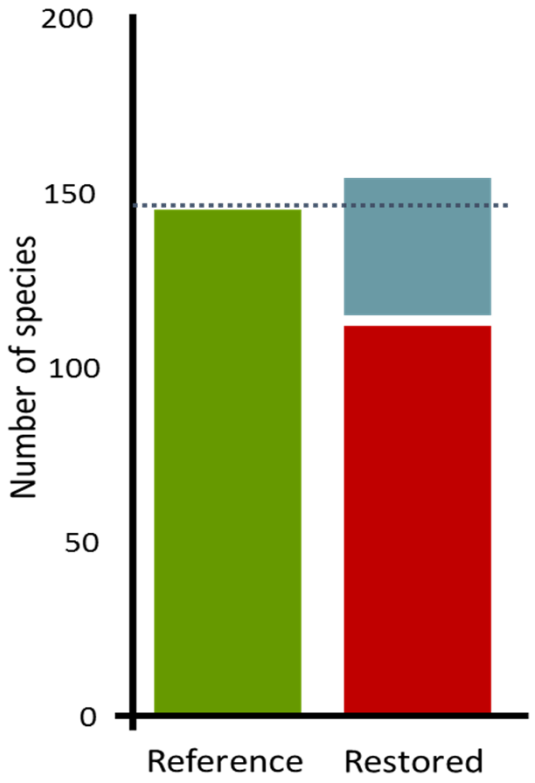
➢ NET IMPACT ASSESSMENT

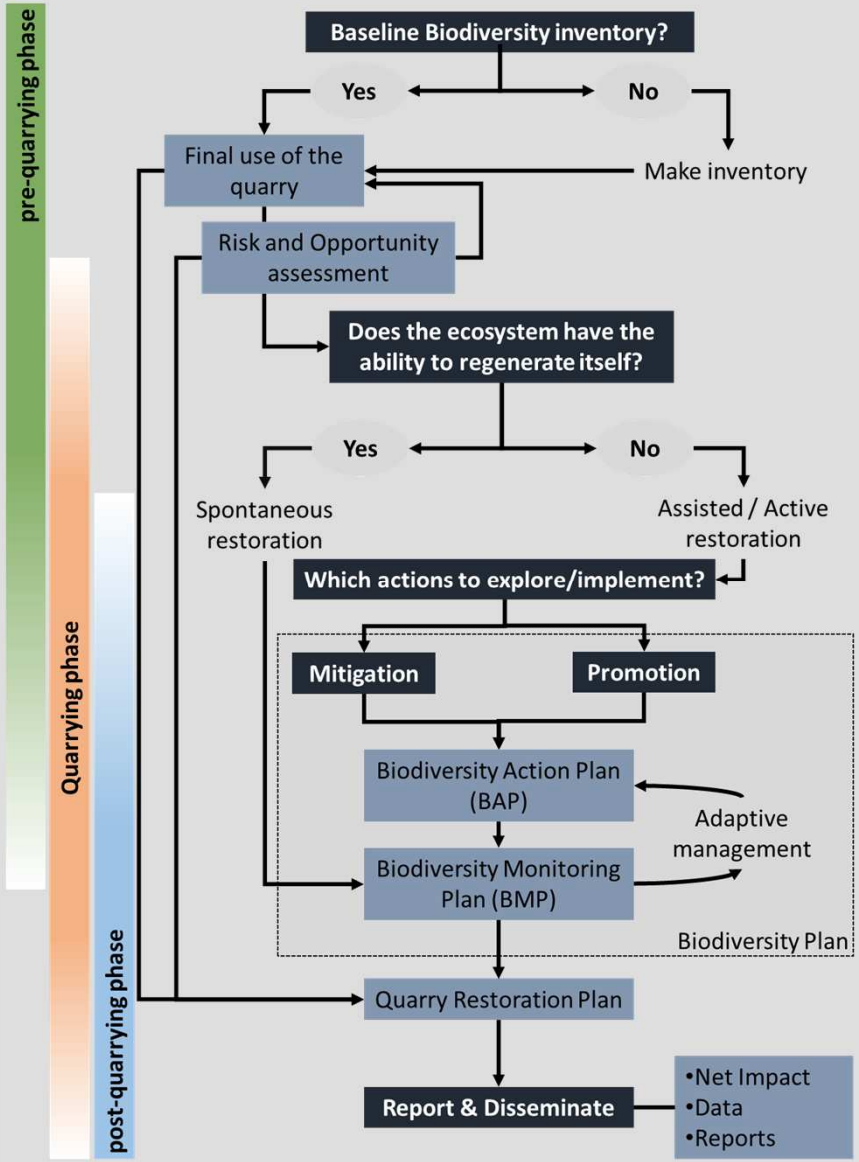


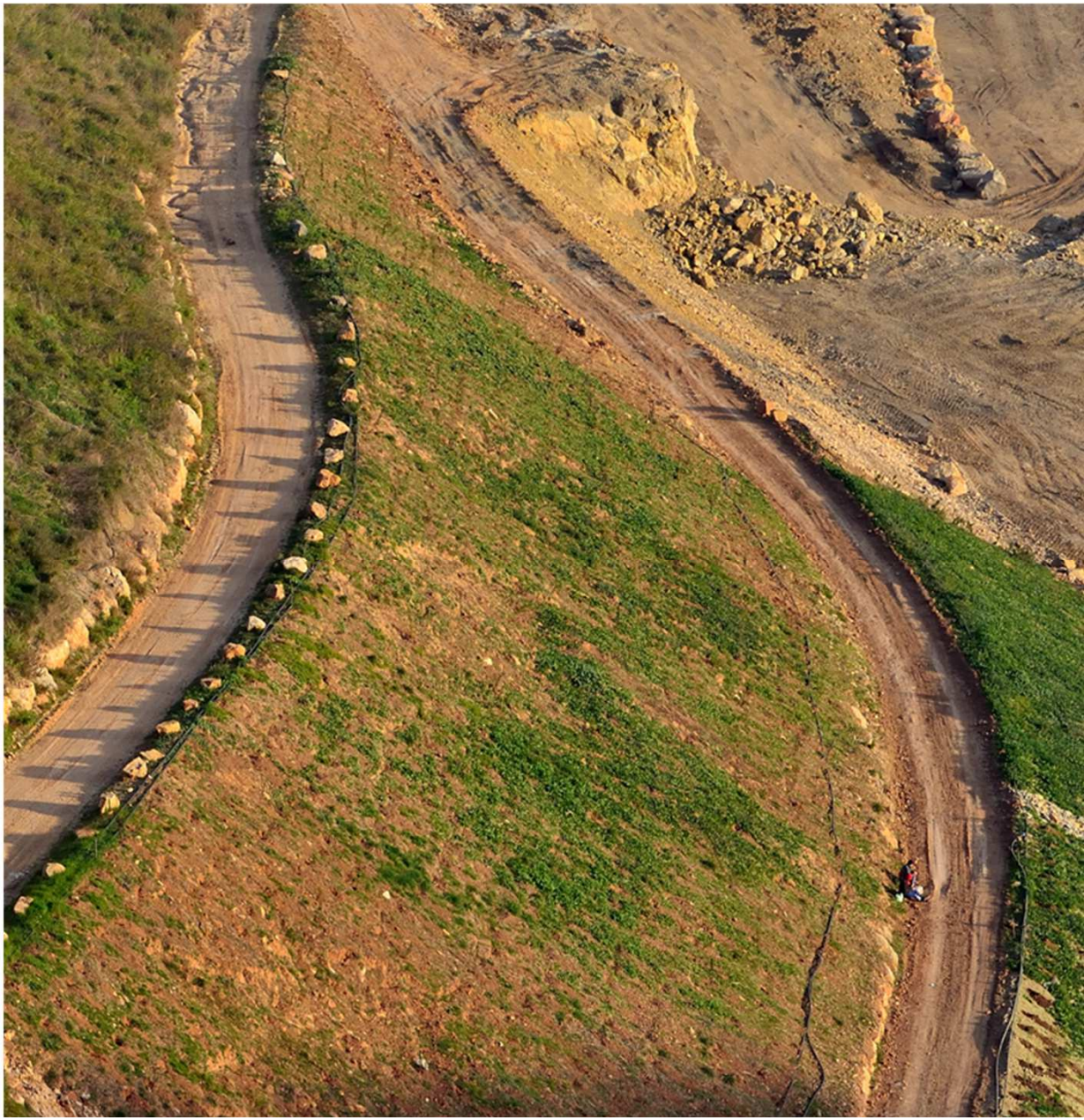


The impact exists, but:

- How can 'new' biodiversity be added as a value to NIA?
- Is species composition and richness enough?

ROADMAP TO QUARRY RESTORATION





How **Business integrates** the scientific studies in quarry restoration?

INTEGRATING APPLIED SCIENCE INTO BUSINESS

SCIENCE

Effects of hydrophilic gel soil amendment varies with substrate type; not very useful in marl-type substrates

Addition of municipal solid waste to substrate promotes "opportunistic" species, and not natives adapted to nutrient poor soils

Long-term abundant irrigation promotes high herbaceous cover of seeded species, limiting the establishment of some native species propagules from surroundings

Non-native Aleppo pine trees impair understory development and alter animal communities

BUSINESS

Cessation of the use of hydrophilic gel in plantations

No substrate amendments with municipal solid waste

Irrigation only in critical periods (e.g. immediately after plantations and during summer drought)

Removal of Aleppo pine from the list of planted species, increase of broadleaf oaks

INTEGRATING APPLIED SCIENCE INTO BUSINESS

SCIENCE

Quarry restoration operations should prevent from disturbing species in specific seasons

Fruit-bearing plants are valuable resources to attract fauna, which in turn favors natural restoration

Water is a limiting factor, its availability attracts animals to restored areas

BUSINESS

Operations involving soil, vegetation, or water, are avoided during nesting (birds) or nursing (amphibians) seasons

The number of fruit-bearing plants planted in field has increased

One pond was built, several temporary ponds in quarries are now flagged for amphibians

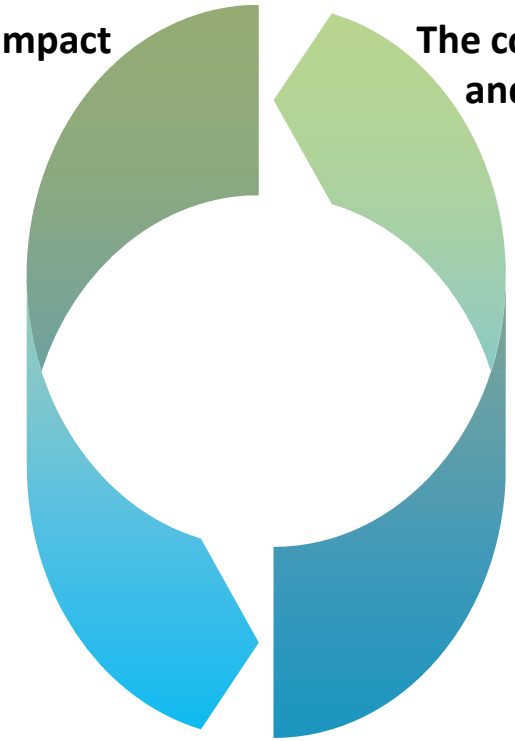
INTEGRATING APPLIED SCIENCE INTO BUSINESS

SCIENCE

Restoration practices should evolve from impact mitigation and landscape aesthetics to an ecological restoration perspective

Test and apply the Net Impact Assessment in Outão as a case-study

Explore and select specific, measurable, realistic and time-bound indicators for minimizing and reversing impacts on biodiversity



BUSINESS

The company has integrated biodiversity assessment and ecological processes in their strategy to achieve No-Net-Loss or Net-Positive-Impact

Expand the methodology to the entire SECIL-Group

Define and apply a Strategic Plan to integrate Biodiversity management into Secil-Group


Q
A

Integrating biodiversity value in quarry restoration: Linking business and applied science

19 March 2021

14:00 – 16:00 CET

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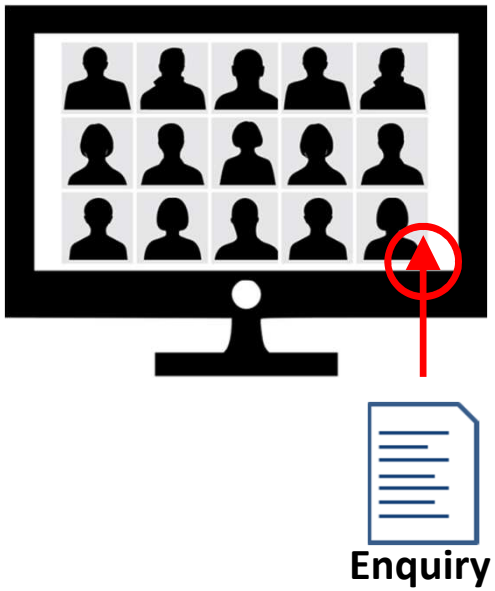
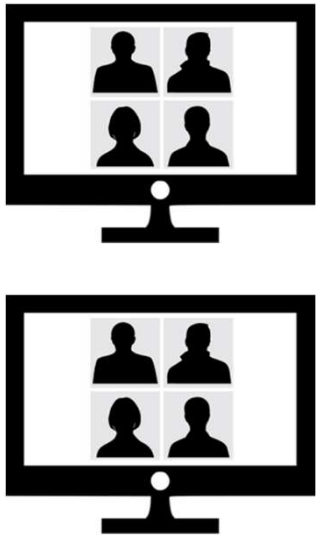
INTERACTIVE DISCUSSION

Main room



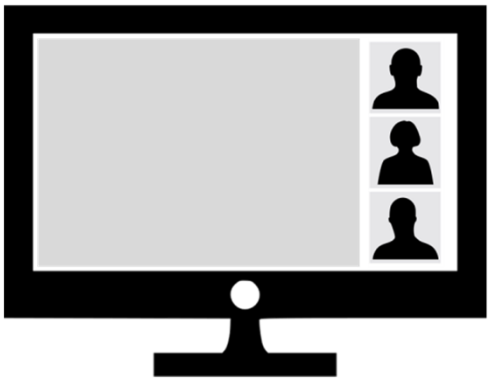
Enquiry

Break-out rooms

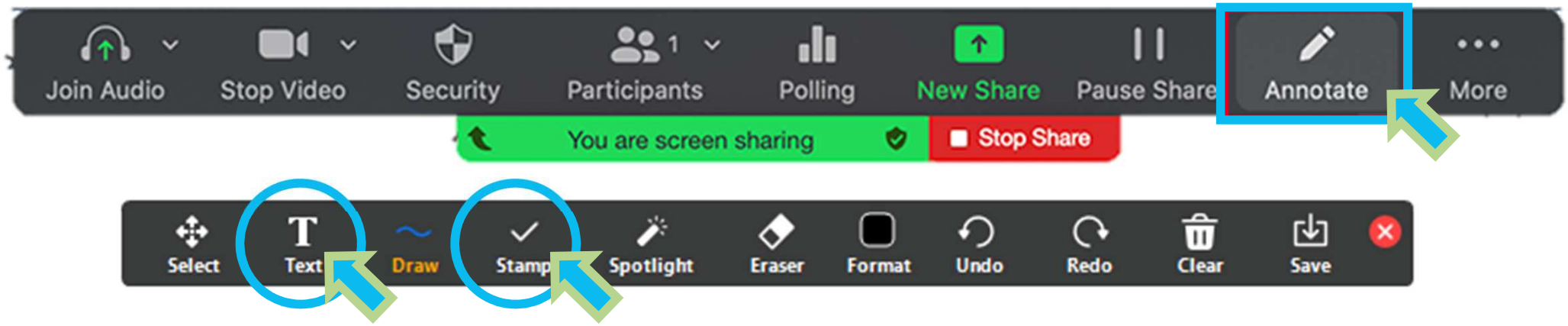


1) Select a spokesman
2) Discuss the questions

Main room
(General discussion)



1) Spokesman writes main findings
2) Everyone votes / discuss


Join Audio
Stop Video
Security
Participants
1
Polling
New Share
Pause Share
Annotate
More
You are screen sharing
Stop Share
Select
Text
Draw
Stamp
Spotlight
Eraser
Format
Undo
Redo
Clear
Save

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1 – Which arguments (economic, biodiversity/carbon credits, international or society recognition, …) could be most persuasive to engage companies in adopting biodiversity and ecosystem's restoration in their policies?

Room 1	**Room 2**	**Room 3**
Room 4	**Room 5**	**Room 6**

2 – Which criteria should be accounted to determine restoration targets? (economic constraints, social and cultural context, high biodiversity values, ecosystem services…)

Room 1	**Room 2**	**Room 3**
Room 4	**Room 5**	**Room 6**

3 – What are the current gaps and future directions in involving biodiversity and ecosystem's restoration in the extractive and similar industries?

Room 1	**Room 2**	**Room 3**
Room 4	**Room 5**	**Room 6**

Integrating biodiversity value in quarry restoration: Linking business and applied science

19 March 2021

14:00 – 16:00 CET

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Part of the WE VALUE NATURE 10-DAY CHALLENGE


Q
A

FINAL REMARKS

- Presentations will be shared
- Disclosure of main findings / issues discussed during the event: **Workshop Report** will be shared within a few days
- Leave your **feedback** on this session and We Value Nature initiative at: https://wevaluenature.eu/Feedback

WE VALUE NATURE

Supporting

CAPITALS COALITION

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821303

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Thank you!

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