

COAL MINING WASTES IN NORTHERN SPAIN: PLANT COLONIZATION AND SUCCESSION

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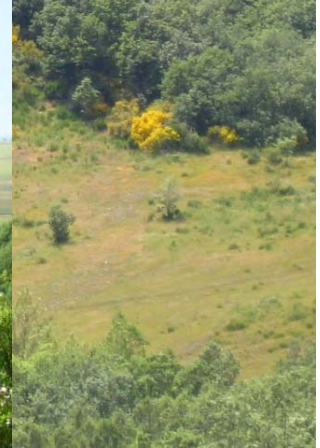
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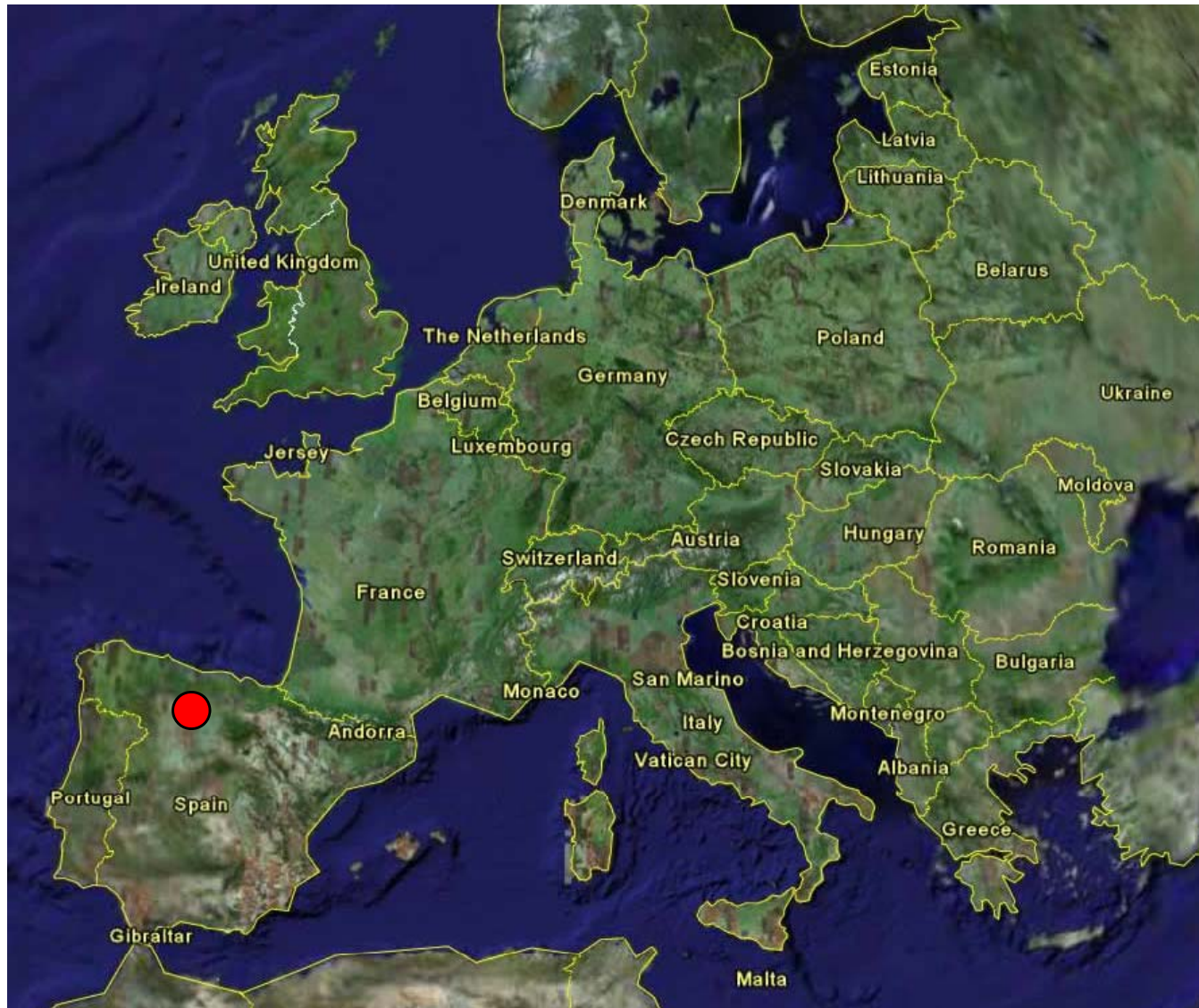
The environmental impact of coal mining



The environmental impact of coal mining



LOCATION OF THE STUDY AREA



DESCRIPTION OF THE STUDY AREA

○ Climate

- Sub-humid Mediterranean
- Mean anual Temperature between 10.4 °C & 11.4°C
- Rainfall 995 mm.yr-1
- Intense sumer drought

○ Vegetation

- *Quercus pyrenaica*
- *Rosa canina*, *Cytisus scoparius*,
Genista florida, *Crataegus monogyna*
- *Bromus mollis*, *Arenaria montana*,
Plantago alpina



FOUR MAIN OBJECTIVES OR PARTS

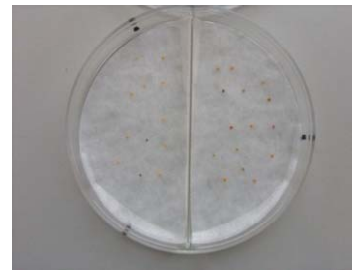
1.- Short-term revegetation dynamics



2.- Long-term vegetation succession



3.- Soil seed bank formation



4.- Seed rain processes



1.- SHORT TERM REVEGETATION DYNAMICS

○ Objective:

- Influence of abiotic factors (aspect, dry periods, soil properties)
- Describe the behaviour of sown and native species

“Pozo sell” 10 ha restored open pit



1.- SHORT TERM REVEGETATION DYNAMICS

VEGETATION SAMPLING

10 ha area restored in 2003

9 permanent plots 4x5 m²

3 North
3 South } 25° slope
3 Flat

8 quadrats of 0,25 m² per plot

Sampled every two months, during the first three years

% of soil without vegetation
% of cover of each species

Every Spring for 5 years 2004–2009

3 permanent plots in the reference community also, every Spring

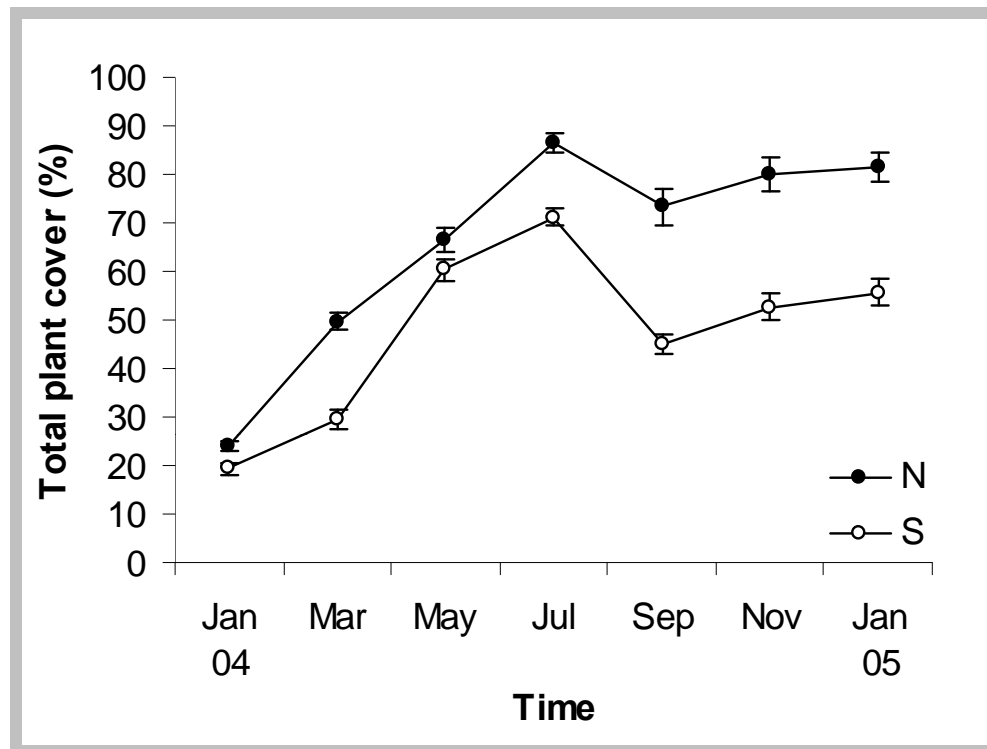
SOIL SAMPLING

8 samples (Ø 8 cm; 10 cm ↓)
per plot

Physical-Chemical properties



1.- SHORT TERM REVEGETATION DYNAMICS



Hypothesis:

Aspect → dynamics of herbaceous species

By means of microclimatic differences (Solar radiation)



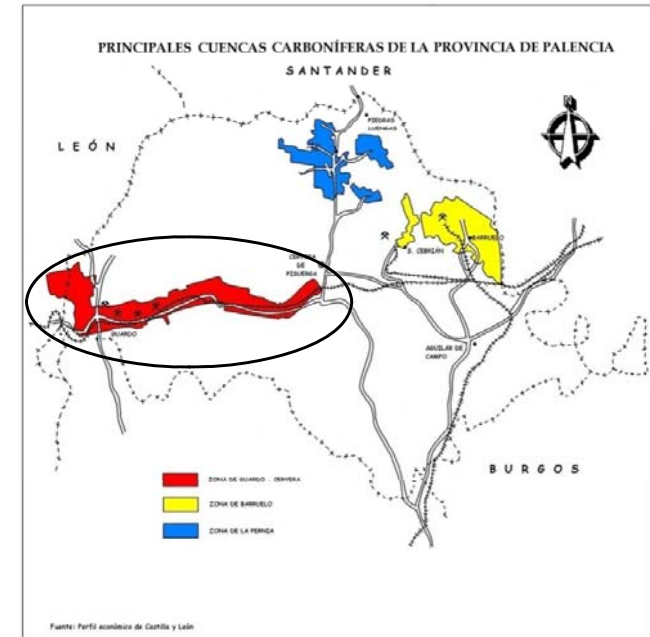
2.- LONG-TERM VEGETATION SUCCESSION

○ Objective:

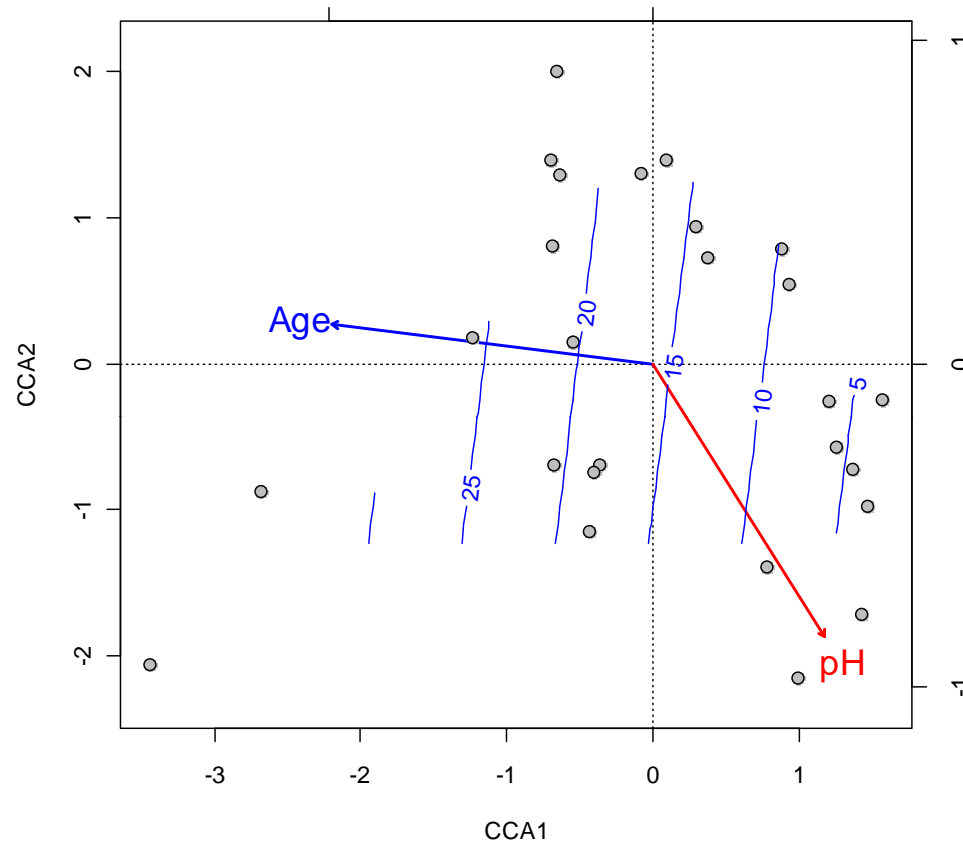
- Characterize the local successional dynamics
- Identify the most influence local soil and landscape factors
- Influence of restoration process

○ Sampling:

- 31 different mines with dissimilar age since were closed (1-40 years)
- 3 restoration process were used at these sites
 - Topsoil addition followed by hydroseeding (n=16)
 - Only topsoil addition (n=10)
 - Natural restoration occurred (n=5)



2.- LONG-TERM VEGETATION SUCCESSION



Hypothesis:

Main influential local factors

Topsoiled → age and pH



3.-SOIL SEED BANK FORMATION

○ Objective:

- Size and composition of the soil seed bank
- Site specific variables influence

○ Sampling:

10 ha area restored in 2003 in 2 periods

- before hydroseeding (84 soil cores randomly)
- 2.5 years after hydroseeding (4 zones > 3 strip > 94 cores)

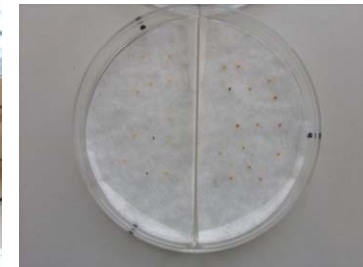


Methods used for seed bank analysis

Emergence method



Sieving/flotation technique



3.-SOIL SEED BANK FORMATION

- Seed bank of the amended soil (before hydroseeding)
 - 15 viable seeds per m²
 - *T. campestre*; *T. glomeratum*; *Vicia* sp.; *Daucus carota*
- Seed bank increased to 1824 seed per m² (after hydroseeding)
 - Hydroseeded species were an important part of seed bank
 - Native species density increased in areas close to natural communities



Huge component of native species in vegetation composition

Where do natives species come from?

With dispersal mechanisms adapted to long-distances

Anemochory

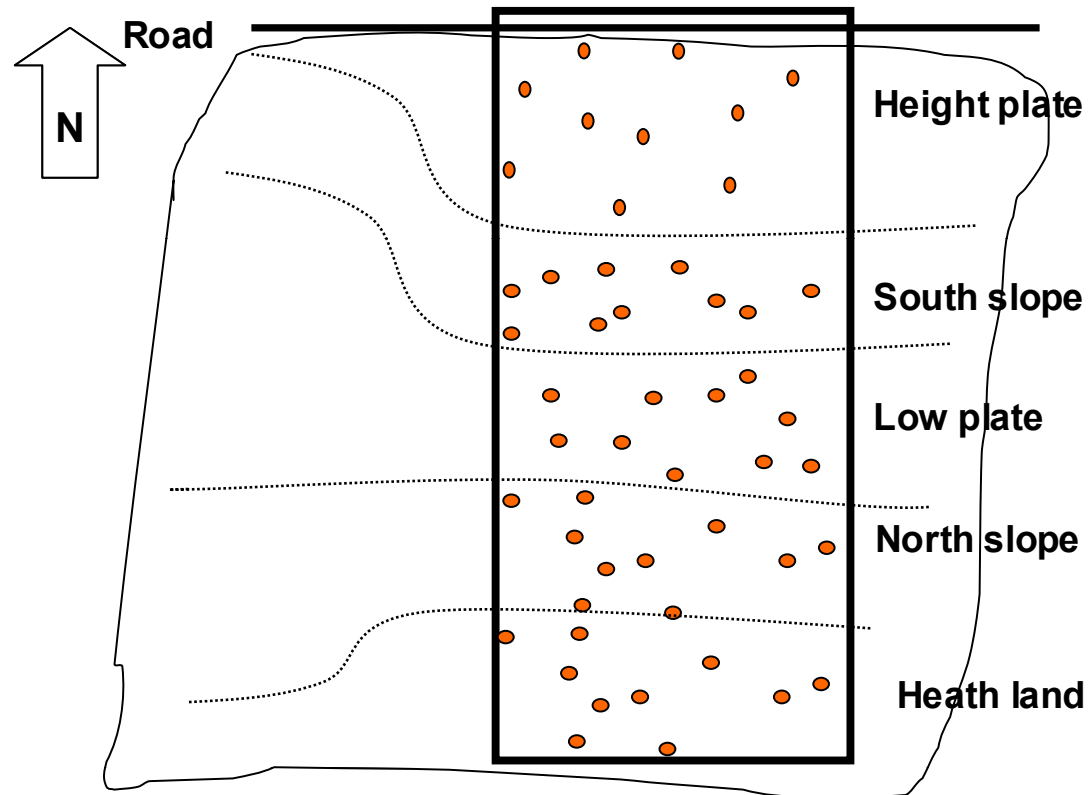


Zoochory



4.- SEED RAIN (future perspectives)

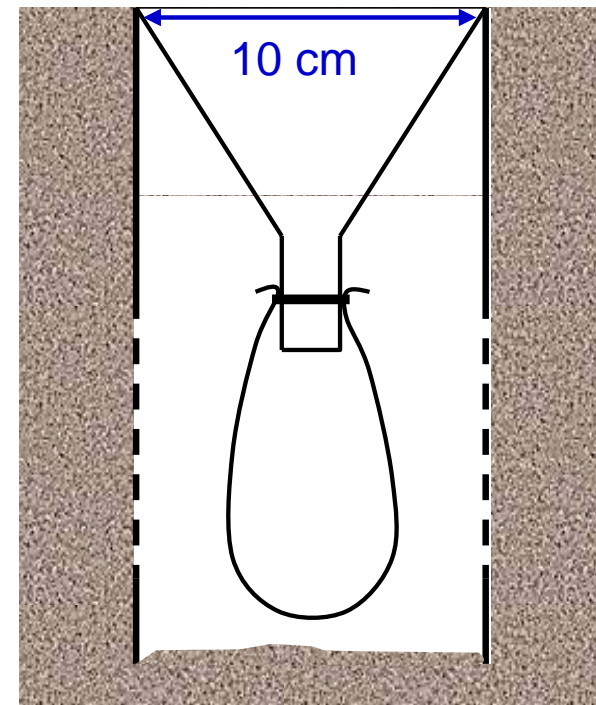
WHICH PLANT SPECIES CAN ARRIVE?



April – Nov. 2008

every 15 days

30 funnels per strip



150 funnels
(Chabrerie & Alard 2005)



4.- SEED RAIN (future perspectives)

WHICH PLANT SPECIES COME FROM THE CLOSE ENVIRONMENT?



THANKS FOR YOUR ATTENTION!!!

