Post fire restoration of *Pinus nigra* Arn. forests on Mount Parnon (Greece) through a structured approach

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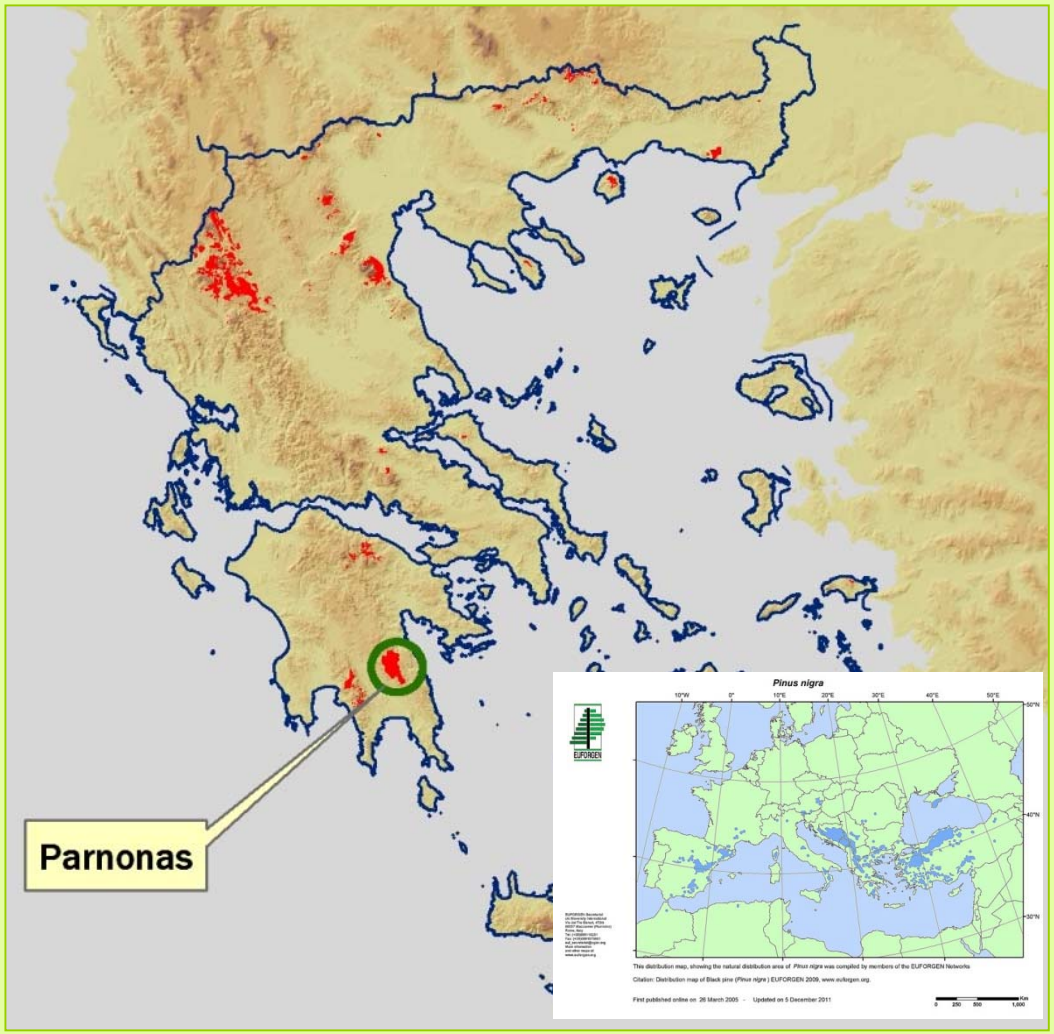
GENERAL DIRECTORATE FOR DEVELOPMENT AND PROTECTION OF FORESTS AND NATURAL ENVIRONMENT

Mediterranean pine forests with endemic black pine (*9530) in Greece and Parnonas

- *Pinus nigra* subsp. *nigra* var. *caramanica*
- In Greece it covers more than 200,000 ha of which 80,000 in Natura 2000 sites representing 30% of its surface in Natura 2000 sites in Europe



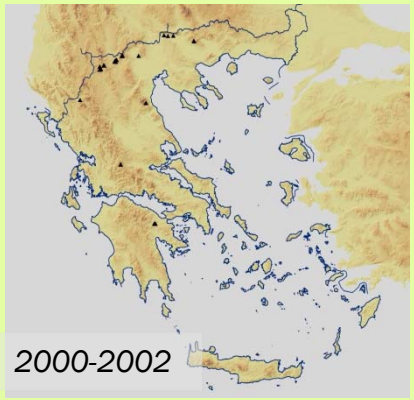
Why *Pinus nigra* needs a special approach;

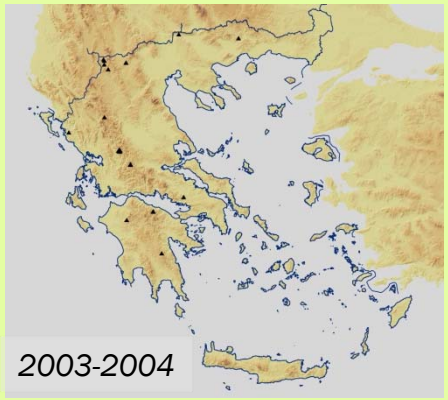
Pinus nigra and forest fires

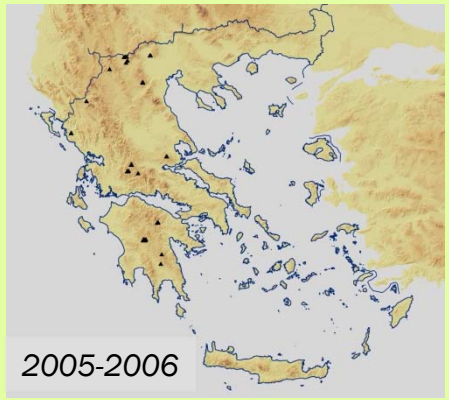
1. Tolerant in maturity to ground fires due to thick bark
2. Does not hold dormant cones after crown fire

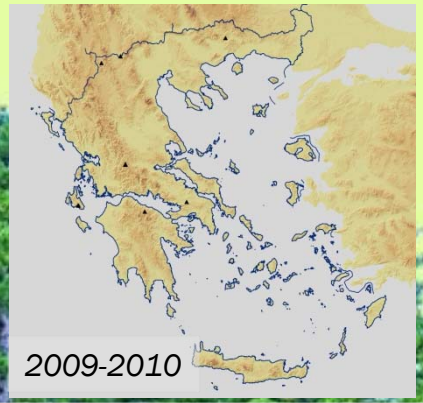
Wildfires in *Pinus nigra* forests are increasing

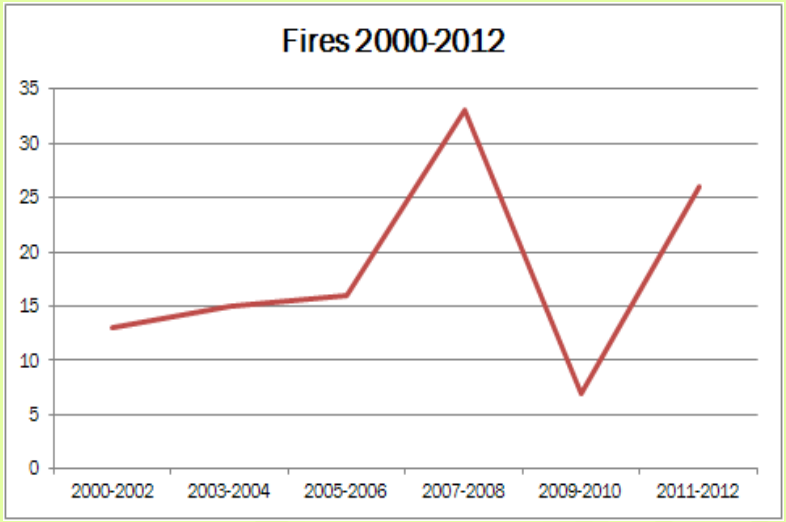
From 1992 onwards fire incidents above 1000 m where *Pinus nigra* appears are increasing







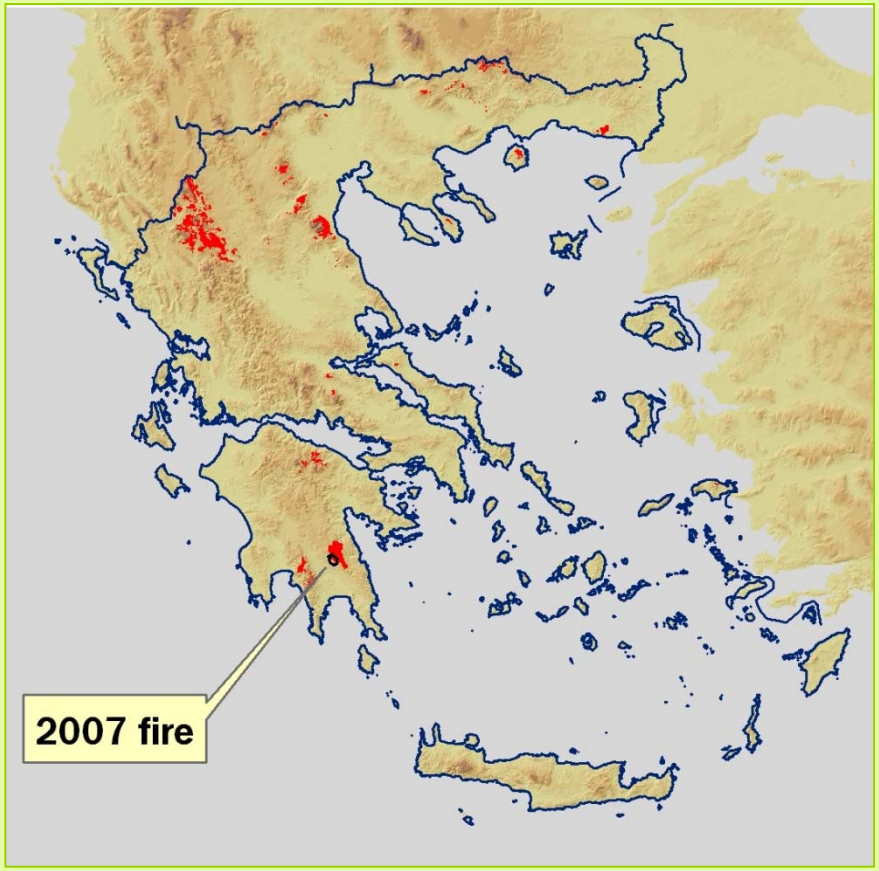




Source:Fire Information for Resource Management System (FIRMS) http://earthdata.nasa.gov/data/nrt-data/firms/active-fire-data

The fire of August 23, 2007

- *Pinus nigra* in Parnonas cover 3,845 ha representing 6,9% of the total area of the habitat type in Greece
- The site is one of the southernmost for Greece and Europe
- The fire burnt some of the southern *Pinus nigra* stands in the area



The structured approach: a step by step process

Aim: Optimisation of the restoration efforts of burnt *Pinus nigra* forests with an increased resilience to future disturbances

Description

The approach has five steps:

1. Specification of exclusion and ranking criteria of patches prospective for restoration
2. Implementation of the criteria
3. Preliminary selection of the patches for artificial restoration
4. Verification of the preliminary selection
5. Selection of restoration measures

Step 1. Selecting criteria

The criteria are exclusion and ranking

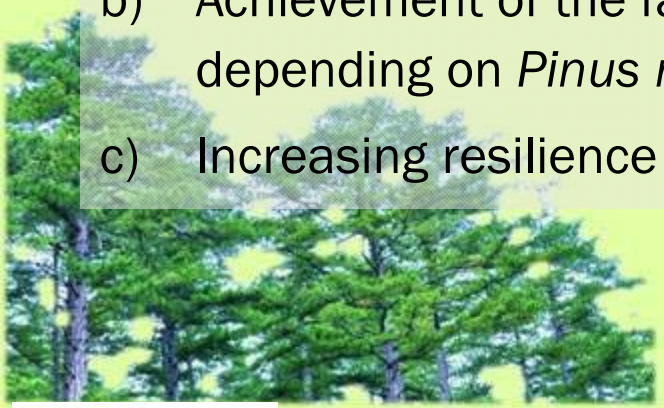
Exclusion aims to the prevention of disturbance of natural regeneration and to the exclusion of patches with severe disadvantages for artificial restoration (e.g. harsh climatic conditions).

Ranking aims to attribute priority for restoration to patches with the best opportunities for:

a) Successful re-establishment of the *Pinus nigra* trees

b) Achievement of the favorable conservation status of the species depending on *Pinus nigra* forests and

c) Increasing resilience of the future *Pinus nigra* forest



Step 1. The criteria

Exclusion criteria

A. Abundance of natural regeneration (1 plant/sq m the first year after fire)

B. Altitude

Ranking criteria (in order of importance)

C. Representativity of the habitat type typical vegetation

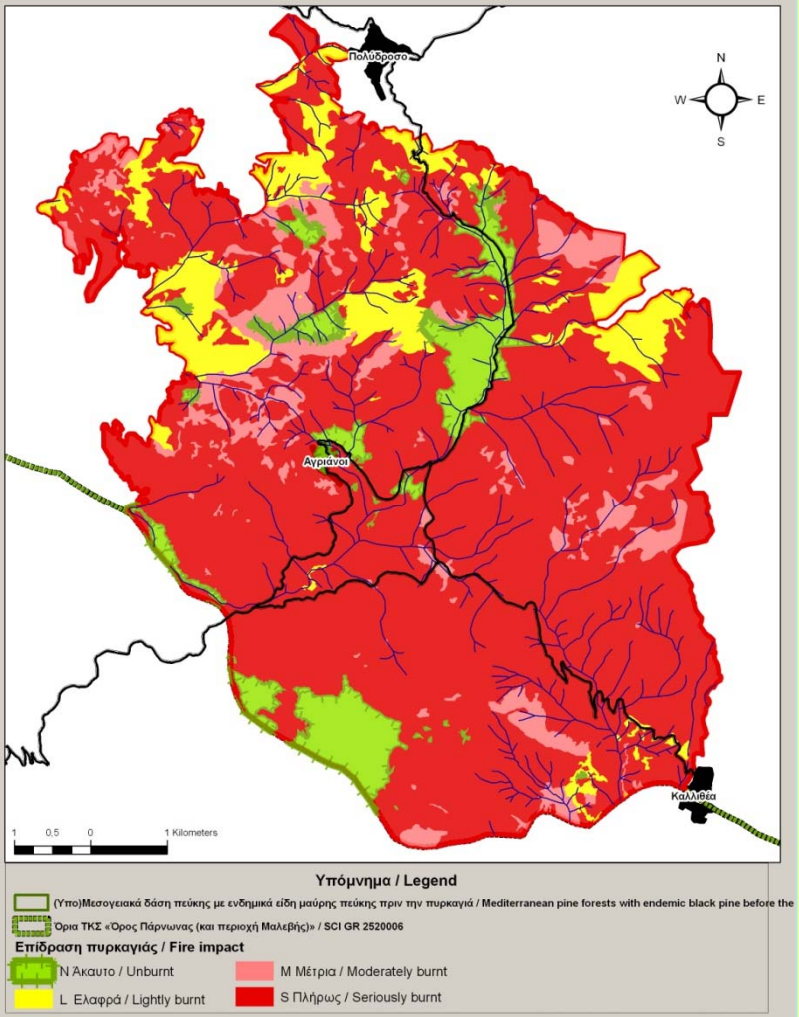
D. Inclusion of a patch in a Natura 2000 site or a protected area

E. Contribution to the conservation of important species

F. Contribution to forest connectivity

G. Abiotic features (soil depth, aspect)

Step 2. Fire area and severity assessment

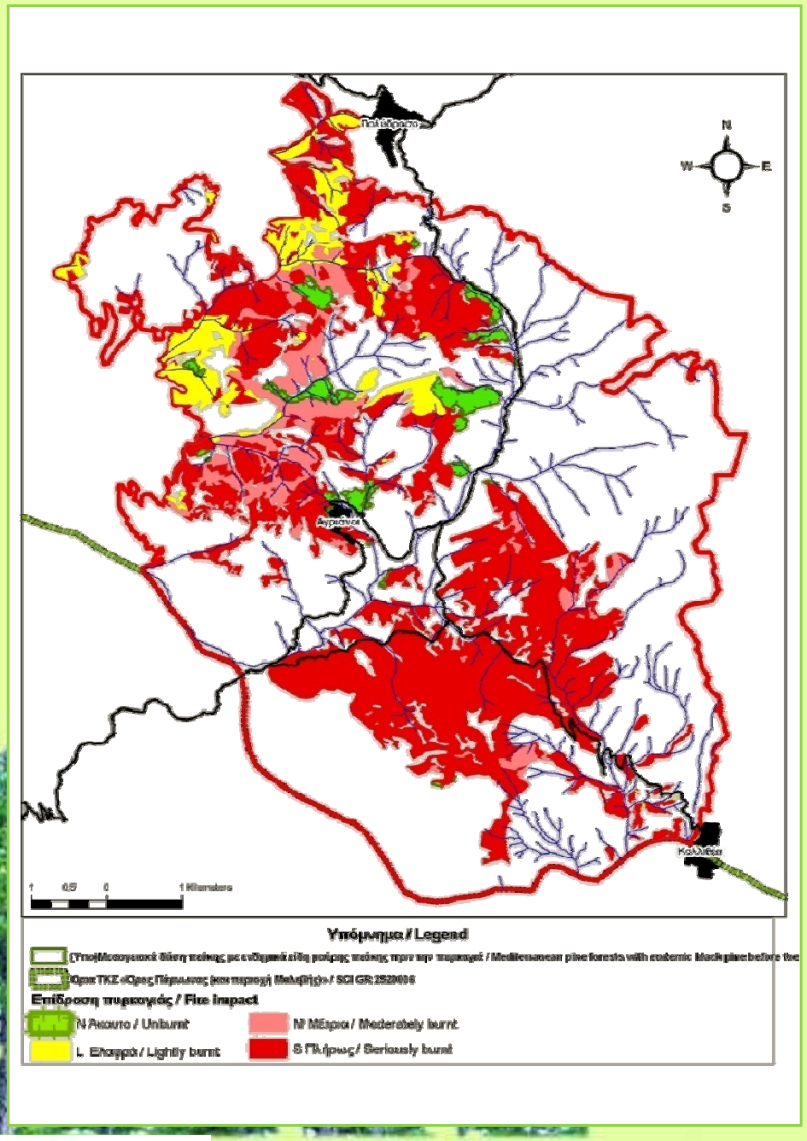


Burnt area within the SCI GR2520006 "Oros Parnonas (kai periochi Malevis)" was 5788 ha (9,6% of the total area)

Fire severity assessment within the burnt area for all habitat types:

- Completely burnt: 4309 ha (74,45 %)
- Moderately burnt: 523,7ha (9.05%)
- Slightly burnt: 540,6 ha (9.34)
- Intact: 414,8 ha (7.17%)

Step 2. Impact to *Pinus nigra* forest



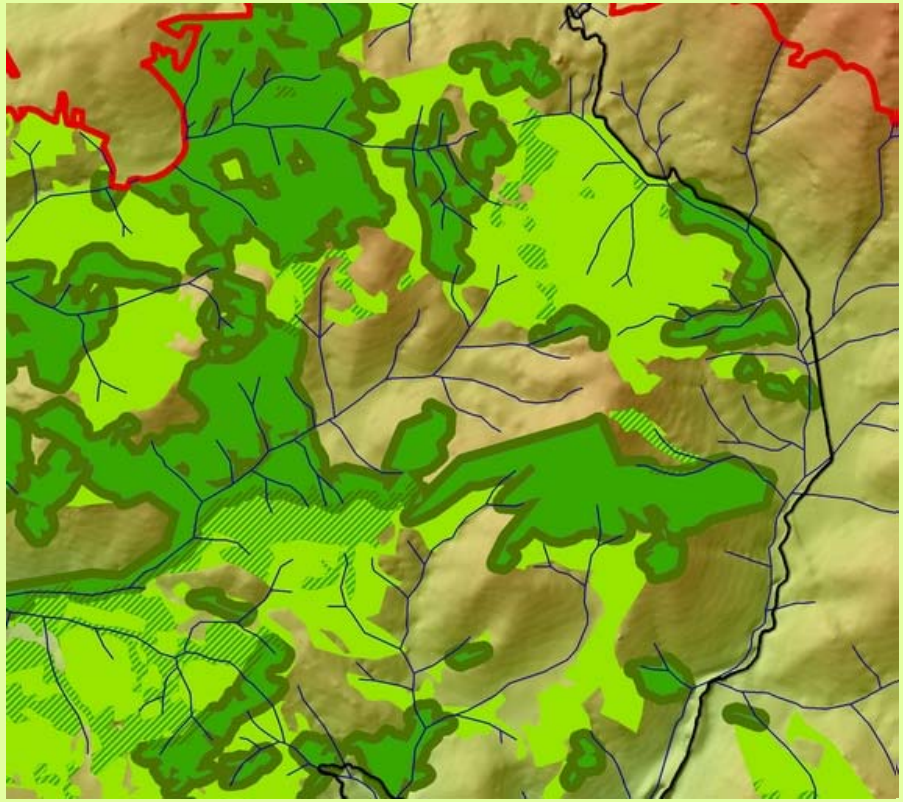
Total burnt area: 1921 ha (35.91% of its cover in the SCI)

Severity:

- Completely burnt: 1452 ha (76%)
- Moderately burnt: 256 ha (13%)
- Slightly burnt: 212 ha (11%)
- Intact: 65 ha

Step 2. Unburnt patches and scattered live trees

Natural regeneration was expected to appear in a zone 50 m around the unburnt patches and in areas with scattered live trees summing to 490 ha



Green islands with their 50 m buffer zone and areas with isolated *Pinus nigra* trees and the remaining areas for restoration

Step 2. Unburnt patches and scattered live trees

Unburnt islands:

- act as natural regeneration nuclei
- provide structural diversity
- act as refugees for other plants and animals

Step 2. Ranking

Criteria and values

C. Representativity of the habitat type typical vegetation (A: excellent – D: non-significant presence)

D. Inclusion of a patch in a Natura 2000 sites or a protected area (Yes/No)

E. Contribution to the conservation of important species (A: Very important to E: not significant)

F. Re-establishing of forest connectivity (2: node, 1: connection, 0: no connection)

G. Abiotic features:

Soil depth (best to worst) Deep, Deep and shallow, Deep and rock, Shallow and deep, Shallow, Shallow and rock

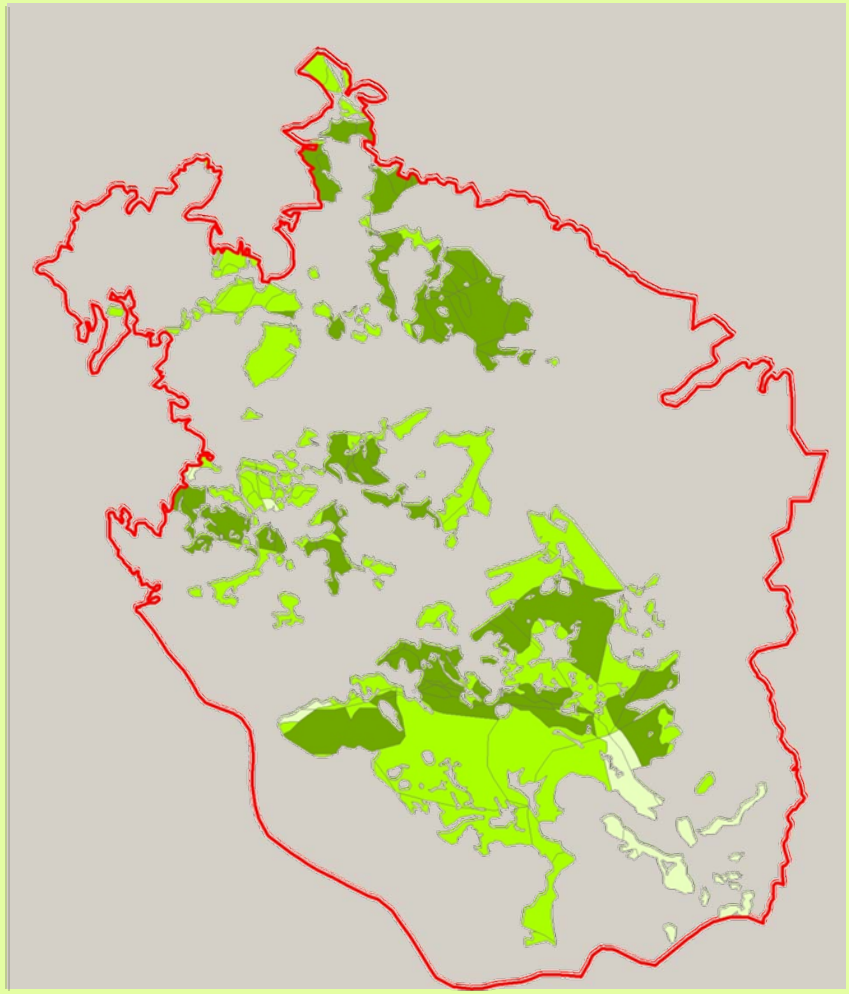
Aspect (best to worst) N,NE,NW,E,W,SA,SW,S

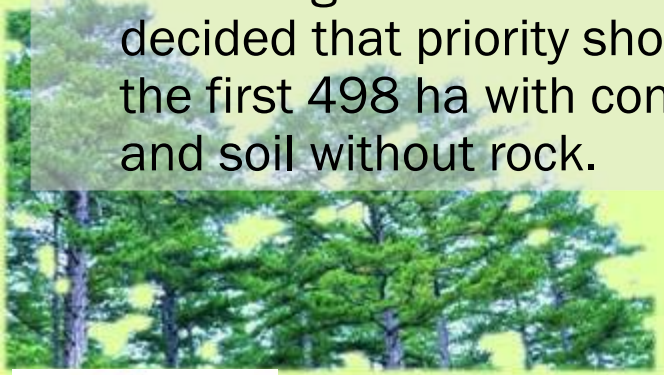
Step 2: Ranking

Ranking was applied to the patches resulted by the combination of different layers of information for each of the criteria in the GIS and was performed within the GIS.

After exluding all patches that were expected to regenerate naturally and those with altitude lower of 850 m 1144 ha remained for ranking.

After ranking the set of 1144 ha it was decided that priority should be given to the first 498 ha with connectivity >0 and soil without rock.



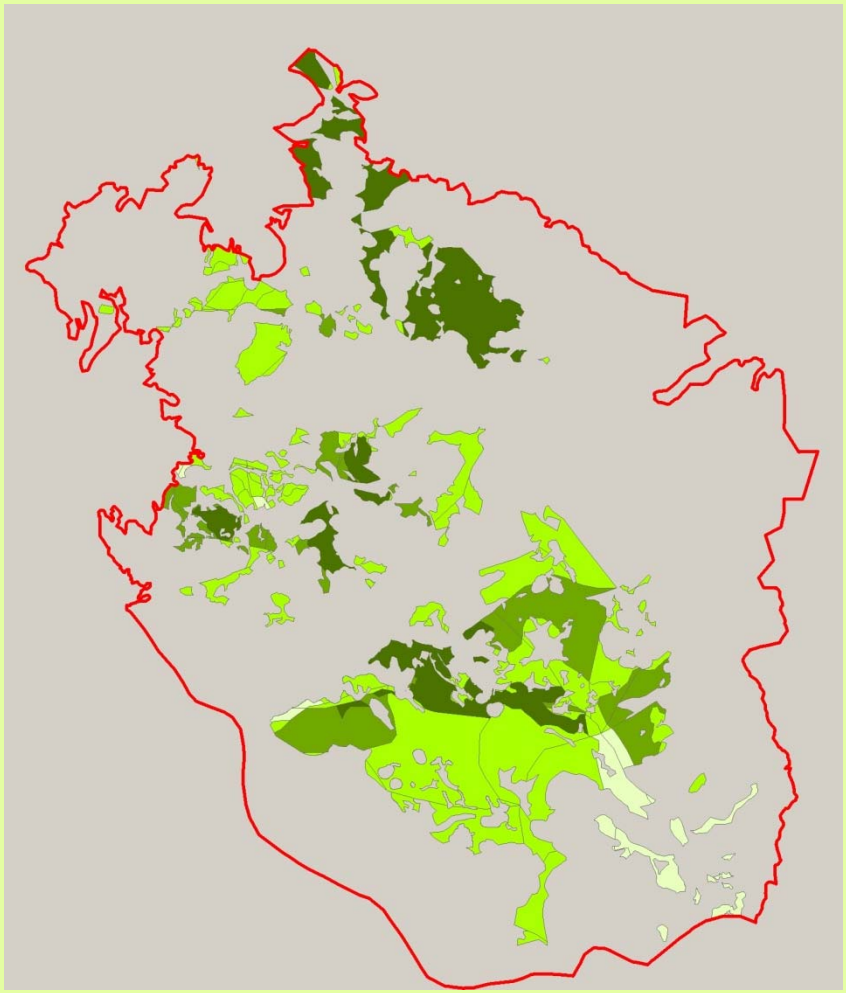


Steps 3 & 4: Preliminary selection and verification

From the top ranked patches were selected for restoration through LIFE those that were more adjacent to each other and had easy access from the existing road network, summing up to 291,3 ha.

All selected patches were verified with field visit.

The remained area was restored with a subsequent project.



Step 5: Restoration measures

Restoration measures for *Pinus nigra* forests are:

- Seeding
- Planting
- Auxiliary measures such as watering, fencing etc

Restoration measures should be selected considering:

- Availability of funding and reproductive material
- Experience from past restoration efforts

Restoration measures in Parnonas

- Soil protection measures
- Seed collection (2007-2009)
- Logging
- Planting of almost 600,000 seedlings
- Protection from fires

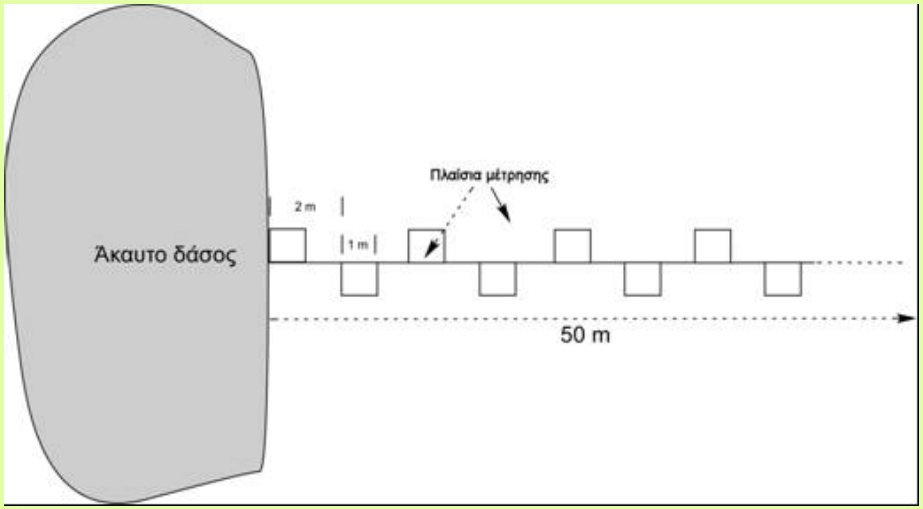


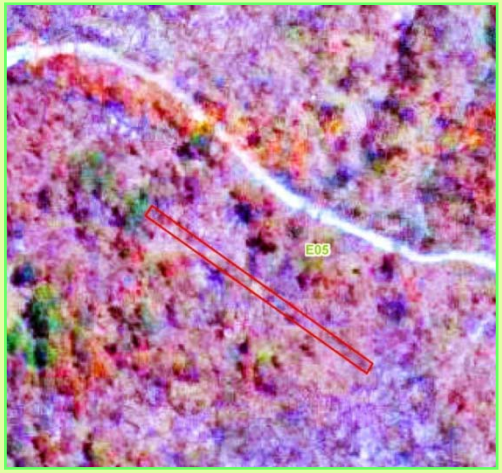




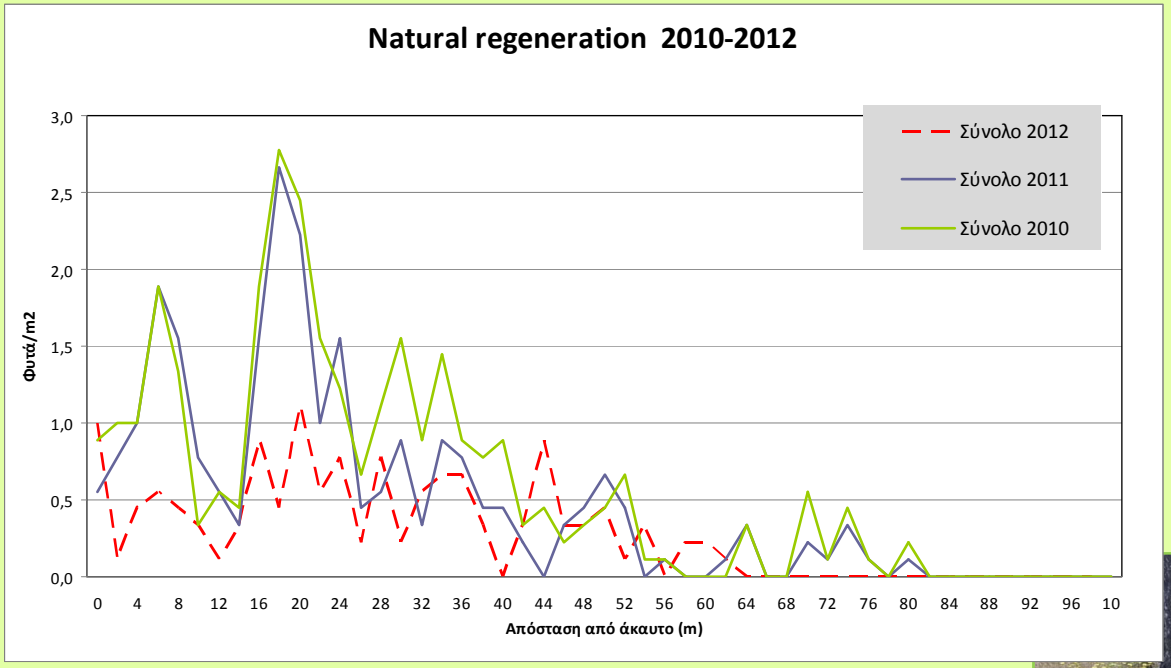
Monitoring of natural regeneration

13 permanent monitoring transects from the unburnt part to the burnt for natural regeneration





Natural regeneration results



Monitoring of restoration

20 permanent monitoring plots for artificial restoration

Restoration results

Planting success:

- Increased with altitute

Survival (1st year)		
Altitude	Average	SD
850-1000	13,08%	9,16%
1001-1150	40,11%	29,59%
1151-1300	13,95%	11,20%

- Early planting of seedlings of 1-2 years shows invreased success

Photographic monitoring

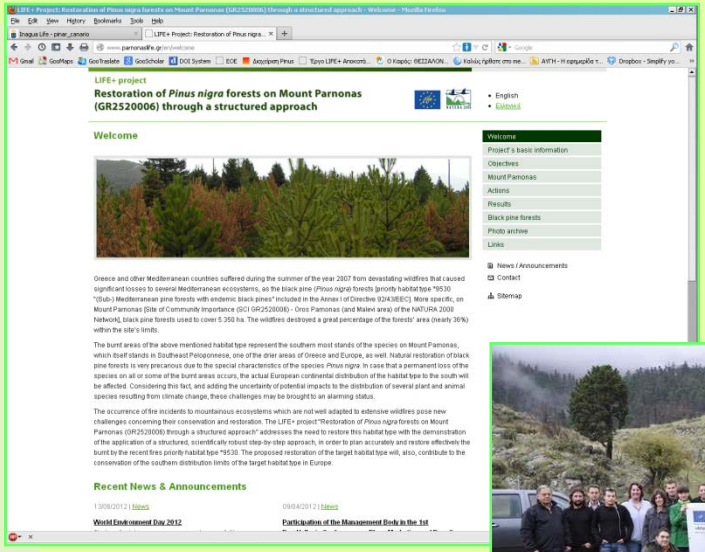
Conclusions from initial implementation

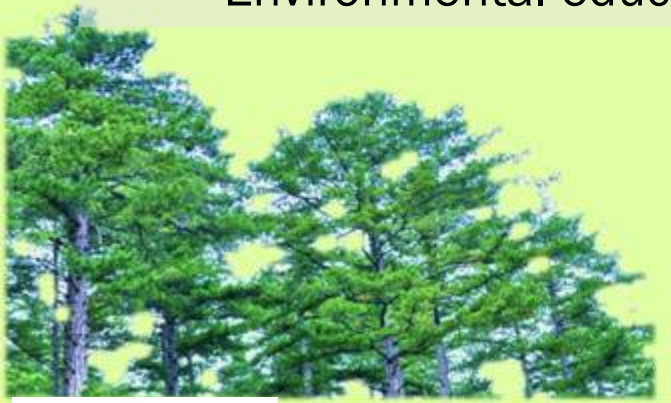
The structured approach:

- Succeeded in the selection of the more suitable patches with a reliable way
- Protected the natural regeneration
- Contributed to the planning of restoration in two phases allowing for easier fund-raising and better scheduling of seedling production
- Can be used with basic computing infrastructure even though remote sensing and modeling can advance its implementation

Communication

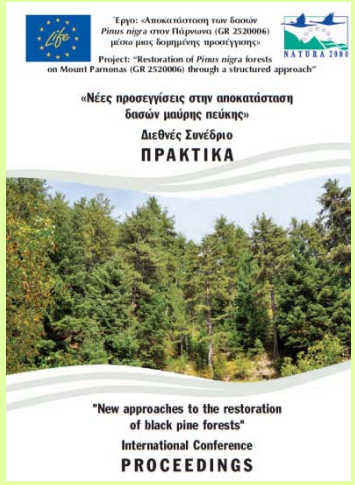
- Web site www.parnonaslife.gr
- Printed material
- Conference on post-fire management
- Film
- Environmental education





Conference on post-fire management

"New approaches for the restoration of black pine forests"
Sparti 15-16 October 2009



Film: The travelling seed

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www.parnonaslife.gr

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Thank you