Blue and green corridors: implementation of TSG 3 EUSAIR flagships, with Interreg IPA ADRION

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EU Strategy for the Adriatic and Ionian Region
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HELLENIC AGRICULTURAL ORGANIZATION - DEMETER

Preserve and monitor genetic diversity and biodiversity in green corridors

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THE EUROPEAN GREEN DEAL

- Biodiversity loss: key threats for humanity
- Almost half of global GDP is linked to nature
- Connections between biodiversity loss, climate change and pandemics
- Restoring biodiversity core part of recovery
- NATURA 2000: protect 30% of landscapes

EU Biodiversity STR by 2030:

- at least 30% of the EU's land area and 30% of the EU's marine area should be protected;
- at least one third of protected areas - that is 10% of the EU's land area and 10% of the EU's marine area -should be strictly protected;
- provisions on effective management and restoration.

GREEN AND BLUE CORRIDORS

Green and Blue Corridors are environmental spatial links of Green Infrastructure areas that maintain or improve biodiversity and/or supply of ecosystem services.

Features of Green and Blue Corridors:

Their basic feature is connectivity.

Green and Blue Corridors make part of the green infrastructure network.

Safety and security regarding climate changes and environmental degradation

They are recognised on all three levels: micro, mezzo, macro

A pilot study for green corridors has begun in Greece…

- Now in Greece WWF Hellas, the Forestry Institute and Department of Geography of University of Aegean are implementing a pilot study entitled: Identification and mapping of ecological corridors.
- The main objective of the pilot study is to identify and map the ecological corridors connecting the mainland protected areas and some areas of Crete, as well as the ecological corridors for the red deer and the wild goat, at a specific spatial scale, using modern satellite methods.
- Macroscopic - For large mammals,
- Microscopic - For the red deer and the wild goat.
- Covered Area: Macroscopic - Protected areas of mainland Greece and Crete, Microscopic - mountains Parnitha to Kithaironas, Gerania Mountains, Vardousia, Giona, Agrafa.
- Upon completion, results will be used to formulate a policy proposal aimed at institutional protection of the ecological corridors and initiating an extended process for their delineation and protection.

WWF

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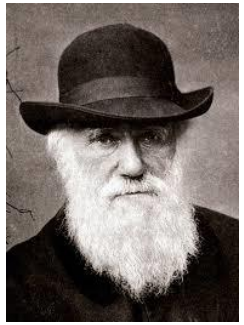
Going a step forward…

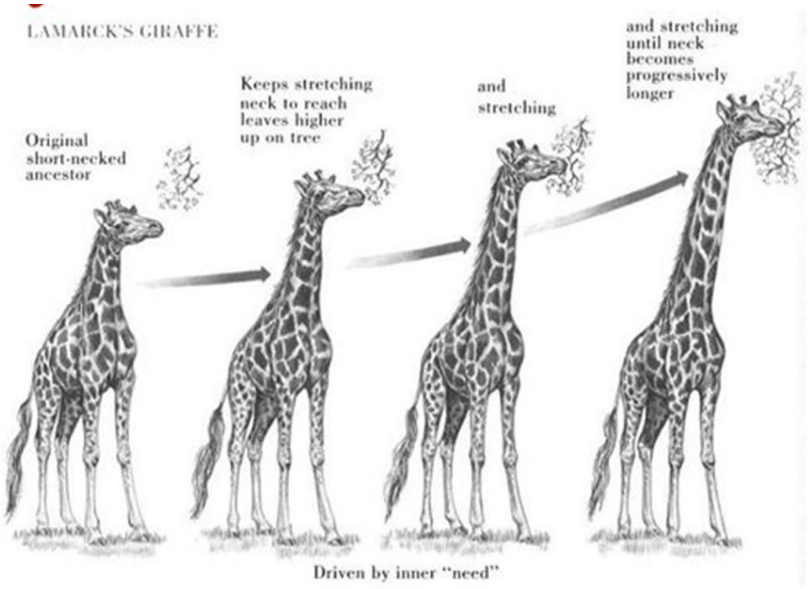
- Establishment of Green corridors aim to conserve and restore important ecosystems, protect endangered species, preserve genetic diversity, and maintain ecological processes essential for the region's natural heritage.
- Green corridors serve as pathways that enable the movement of plants, animals, and other organisms across fragmented landscapes and across different countries because nature does not have border.
- After the establishment and mapping of green corridors, the preservation of biodiversity and genetic diversity in relation to natural environment should also began.
- Preservation of natural environment of green corridors should start at the genes level for key species of the habitat.
- Organize discussion about specific environmental monitoring and investigation needs at regional and sub-regional level, having a transboundary component and agree on joint actions (e.g. joint monitoring programs for marine litter, coordinated studies on climate change adaptation, etc.).

GENES AND EPIGENES

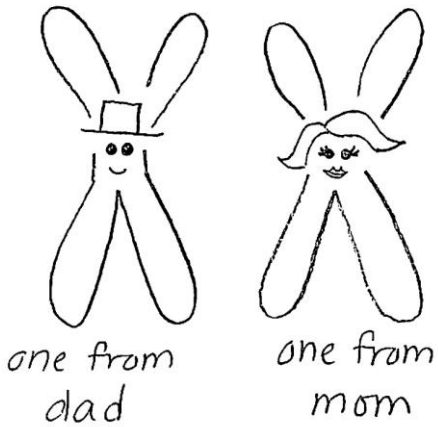
The Neo-Darwinian theory of evolution is a synthesis of genetic and Darwinian theories, based on natural selection, genetic recombination, and random mutations. Darwin (1809-1882), in formulating the theory of evolution, wrote: "This preservation of the favorable variations and the rejection of injurious variations, I call Natural Selection" - Charles Darwin

However, according to Lamarck (1744-1829), the environment can have a direct impact on the phenotype, and this influence can be inherited.





Genes and EPIGenes!!!

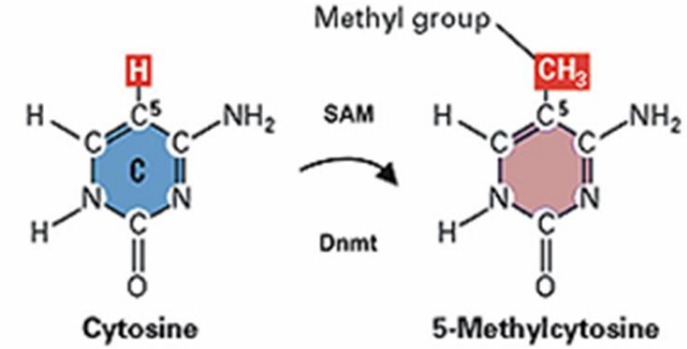


Genes define what we inherited from our parents

Epigenetics is defined as mechanisms that regulate gene expression without base sequence alteration.

Main epigenetic mechanisms:

- DNA methylation (addition of a CH3 in a cytosine)
- Modification of histones (phosphorylation, acetylation)
- mRNAs

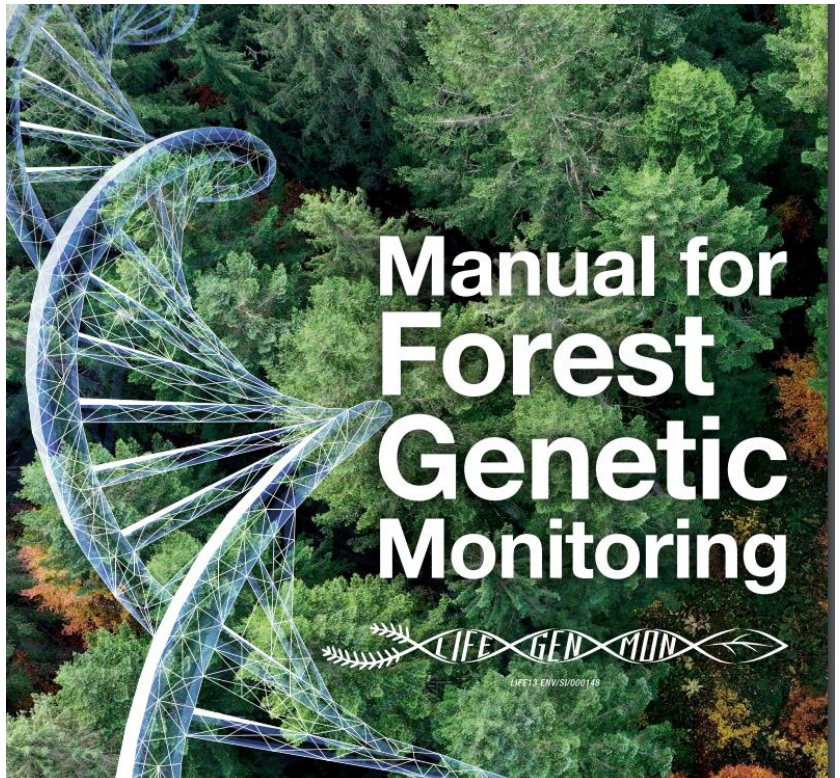


Forest Genetic Monitoring (FGM) Long-term adaptability of forest ecosystems

Starts at the lowest, namely the gene level.

A new era of monitor potentially harmful changes of forest adaptability before they are seen on higher levels is achieved through Forest genetic monitoring (FGM).

Objective: Access the current status of genetic resources and quantify relevant changes at a temporal scale to preserve long term adaptive evolutionary potential.

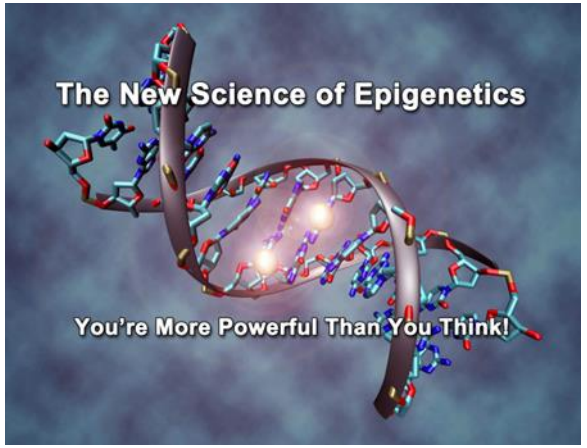


In the era of epigenetics monitoring

- Knowledge of the regulatory mechanisms involved in adaptive epigenetic responses may help to guide management of genetic resources and plant breeding especially in long lived forest trees species where changes in allele frequencies are expected to occur very slowly.
- At the interface between genotype and environment the overall rate of epimutation is much higher than that of genetic mutation. Studies have shown that if an environmental stress is maintained long enough epigenetic alterations can reach equilibrium frequencies and transmitted in next generations.

What can we monitor in epigenetics and how?

- Monitor sudden changes after drought events, fires and biotic and abiotic threats.
- In Norway spruce (*Picea abies*) a temperature dependent epigenetic memory from the time of embryo development, which thereafter influences the timing of bud phenology and gene expression has been discovered (Skrøppa and Johnsen 2000, Johnsen et al 2005; Yakovlev et al. 2010).



Studying epigenetics in forest trees in Greece

- Total methylation presented a mean of 28.2%, which was higher than the midparent value
- Maternal inheritance was higher (5.65%) than paternal (3.01%)
- Faithfull Mendelian inheritance was low (4.29%), whereas *de novo* methylation in the progeny was high (19.65%).

forests

MDPI

Article

Studying the Genetic and the Epigenetic Diversity of the Endangered Species *Juniperus drupacea* Labill. towards Safeguarding Its Conservation in Greece

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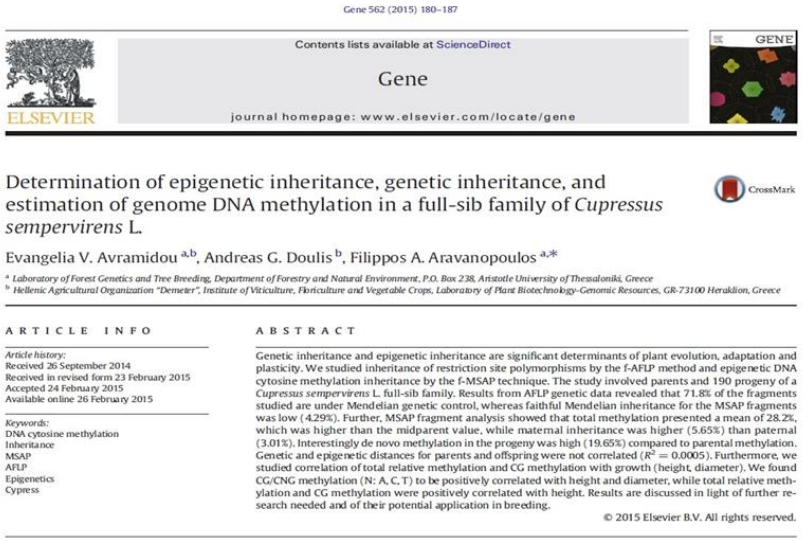
Abstract: *Juniperus drupacea* Labill is a unique representative tree which, nowadays, has limited geographical range. In Greece, it exists only in the southeastern part of the Peloponnese, and it is labeled as endangered according to the IUCN in Europe. In the light of climatic changes, a conservation plan which will secure its adaptation and resilience is important. Knowledge of the genetic and the epigenetic diversity of *J. drupacea* in Greece can establish a pledge for sustainability. In this study, genetic diversity with amplified fragment length polymorphism (AFLP) markers and epigenetic diversity assessed with methylation-sensitive amplification polymorphism (MSAP) were used for eleven subpopulations of the species. Simultaneously, first assessment between midday water potential (Ψmd) and epigenetic diversity was calculated in order to determine drought



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Determination of epigenetic inheritance, genetic inheritance, and estimation of genome DNA methylation in a full-sib family of *Cupressus sempervirens* L.

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ABSTRACT

Genetic inheritance and epigenetic inheritance are significant determinants of plant evolution, adaptation and plasticity. We studied inheritance of restriction site polymorphisms by the f-AFLP method and epigenetic DNA cytosine methylation inheritance by the f-MSAP technique. The study involved parents and 190 progeny of a *Cupressus sempervirens* L. full-sib family. Results from AFLP genetic data revealed that 71.8% of the fragments studied are under Mendelian genetic control, whereas faithful Mendelian inheritance for the MSAP fragments was low (4.29%). Further, MSAP fragment analysis showed that total methylation presented a mean of 28.2%, which was higher than the midparent value, while maternal inheritance was higher (5.65%) than paternal (3.01%). Interestingly de novo methylation in the progeny was high (19.65%) compared to parental methylation. Genetic and epigenetic distances for parents and offspring were not correlated ($R^2 = 0.0005$). Furthermore, we studied correlation of total relative methylation and CG methylation with growth (height, diameter). We found CG/CNG methylation (N: A, C, T) to be positively correlated with height and diameter, while total relative methylation and CG methylation were positively correlated with height. Results are discussed in light of further research needed and of their potential application in breeding.

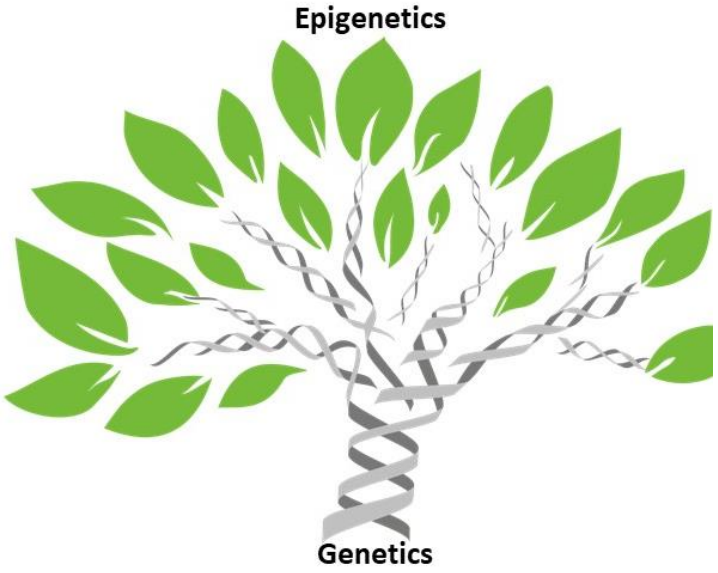
- A significant negative correlation between epigenetic Shannon index and midday water potential (Ymd) was found.
- Results showed that genetic diversity was higher than epigenetic diversity and no subpopulation differentiation was observed. No significant correlations were found between geographic, epigenetic, and genetic diversity, indicating that the genetic diversity is uncoupled from epigenetic diversity.

NEXT STEPS: A holistic approach for monitoring green corridors

- Combining genetics and epigenetics on forest monitoring will add a holistic approach for long term adaptation and sustainability of green corridors.

Proposed approach:

- In the beginning we can determine key species to monitor for green corridors with the standard level of FGM monitoring approach and basic for epigenetics analysis.



THANK YOU FOR YOUR ATTENTION!!!!