Adaptive Silviculture & Applied Forest Ecology
ASAFE Lab

Adaptive Forest Management Experimental sites

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mncn
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Presentation outline

Adaptive Silviculture & Applied Forest Ecology
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- Context
- Forest transition(s)
- Increasing forest stand complexity
- Experimental sites

Context

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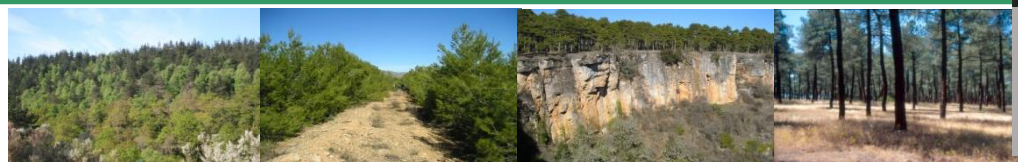
Europe's forests history is a story of deforestation….

- Intensive management (mining, firewood)
- Naval industry (*Floating forests*)
- Wars (to avoid an *ambush*)
- Liberal economic reforms (land seizures)

Wieringen, C. C. v. (2020, May 25). The Spanish Armada of 1588 CE By van Wieringen. *World History Encyclopedia*. Retrieved from https://www.worldhistory.org/image/12302/the-spanish-armada-of-1588-ce-by-van-wieringen/

Snayers, P. (2022, August 11). Battle of White Mountain 1620. *World History Encyclopedia*. Retrieved from https://www.worldhistory.org/image/16251/battle-of-white-mountain-1620/



Context

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…but also of afforestation and reforestation…

- Monospecific
- Large Scale
- Production (Native & Non-native)
- Protection (Erosion & flood control)

Reforestation in Guadalajara (Spain) in 1946 (above) and 2018 (below*) to* control floods over Tendilla town (upper left in both photos).
Serrada et al. (2020) Rev. Foresta 70

Eucalyptus plantation in Galicia for pulp production (NW Spain)
Photo: Pedro Álvarez (Universidad de Oviedo)

Scots pine reforestation for timber production, León (Spain)
Photo: Andrés Bravo-Oviedo (MNCN, CSIC)

Context

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…and a “Green Deal” towards less intensive management

- Climate-Smart Forestry
- Close-to-nature
- Continuous Cover Forestry
- Integrated Forest Management
- Complex Adaptive Systems
- Ecological forestry
- ….

EUROPEAN COMMISSION

Brussels, 27.7.2023
SWD(2023) 284 final

COMMISSION STAFF WORKING DOCUMENT

Guidelines on Closer-to-Nature Forest Management

Context

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quo vadis, silviculture?

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Climate-Smart Forestry: the missing link

P.J. Verkerk[a,*], R. Costanza[b], L. Hetemäki[a], I. Kubiszewski[b], P. Leskinen[a], G.J. Nabuurs[c], J. Potočnik[d], M. Palahí[a]

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

What is Climate-Smart Forestry? A definition from a multinational collaborative process focused on mountain regions of Europe

Euan Bowditch[a], Giovanni Santopuoli[b,c,*], Franz Binder[d], Miren del Río[e,f], Nicola La Porta[g,h], Tatiana Kluvankova[i], Jerzy Lesinski[j], Renzo Motta[k], Maciej Pach[l], Pietro Panzacchi[c,m], Hans Pretzsch[n], Christian Temperli[o], Giustino Tonon[m], Melanie Smith[a], Violeta Velikova[p], Andrew Weatherall[q], Roberto Tognetti[b,c,h]

PLOS CLIMATE

Forestry An International Journal of Forest Research

Institute of Chartered Foresters

Forestry 2016; **89**, 1–6, doi:10.1093/forestry/cpv043
Advance Access publication 18 November 2015

What is close-to-nature silviculture in a changing world?

Kevin L. O'Hara*

College of Natural Resources, University of California, Berkeley, CA 94720-3114, USA

REVIEW

Climate-Smart Forestry: Promise and risks for forests, society, and climate

Lauren Cooper[1]*, David MacFarlane[2]

1 Department of Forestry, Forest Carbon and Climate Program, Michigan State University, East Lansing, Michigan, United States of America, 2 Department of Forestry, Michigan State University, East Lansing, Michigan, United States of America

Forest Transitions

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Forests and Forestry are not facing a single transition but multiple pathways..

- semantic
- from Deforestation to afforestation/reforestation
- from Production to Multiple use
- from Monospecific regular stands to complex forest structures

Forest transitions

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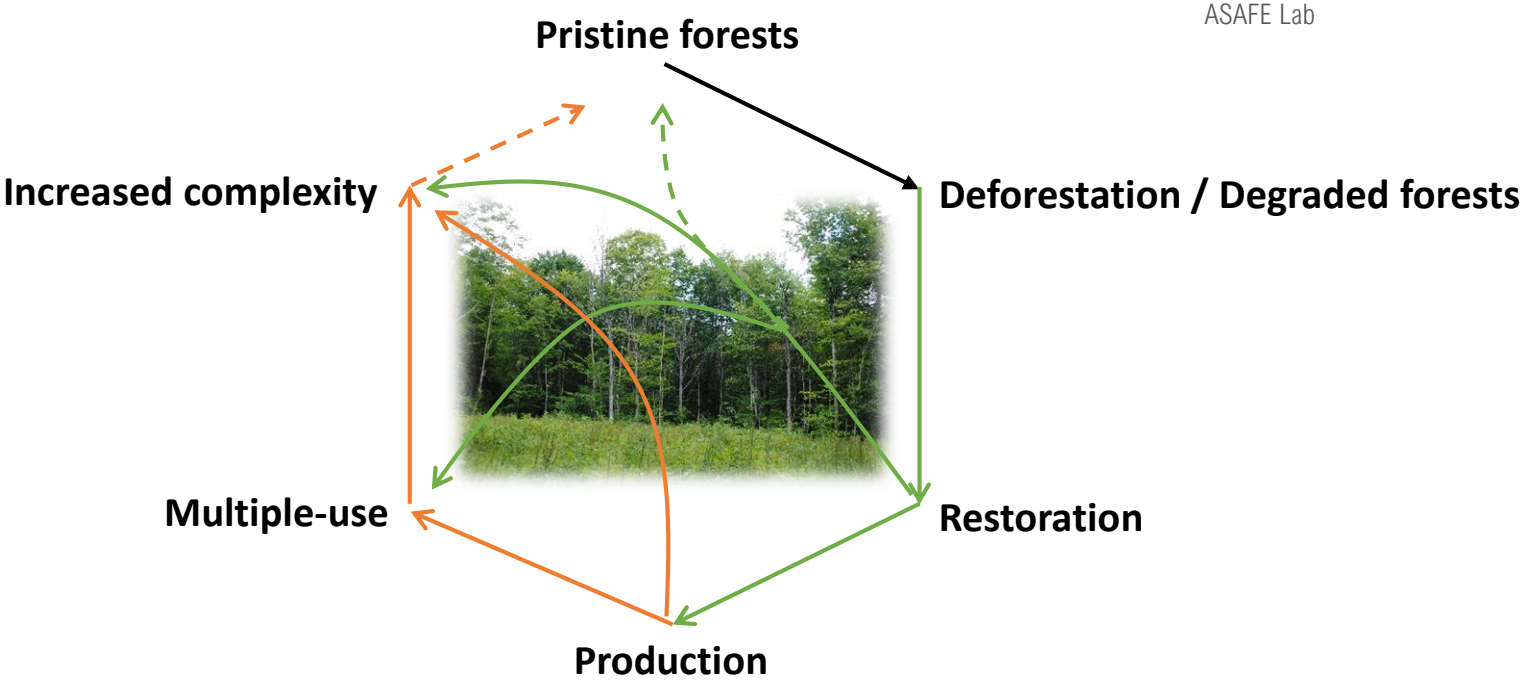

Figure inspired by Gamborg and Larson (2003)

Forest transitions

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The need of complex forests in a changing world

- Resilient forests
- Ecosystem services
- Social acceptability

Forest transitions

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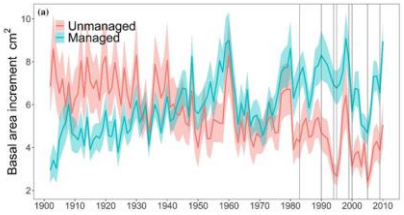
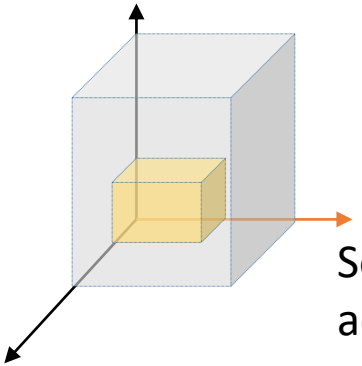
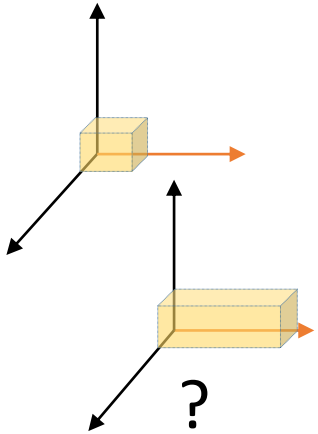
The need of complex forests in a changing world. Always?

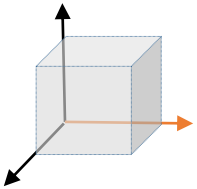


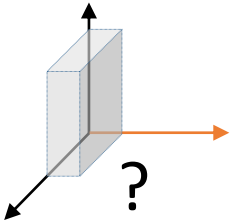
+ Resilient



Socially acceptable/ adoptable







+ Ecosystem services

Increasing complexity in SUDOE

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- Southwest Europe (SUDOE)

Interreg Sudoe COMFOR
European Regional Development Fund

EUROPEAN UNION

Increasing complexity in SUDOE

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- Reforestation (*Pinus pinaster* Ait.) in SUDOE

  - Landes (~ 900,000 ha)
  - Portugal (~ 500,000 ha)
  - Spain (~ 912,000 ha, 1940-2013)

Increasing complexity in SUDOE

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- Lack of resilience

Windthrows (Klaus Cyclone, 2009)
Photo: Hervé Jactel (INRAE)

Severe Forest Fire

Drought-induced mortality
Photo: A. Bravo-Oviedo

Run-off and soil erosion
Photo: M.E. Lucas-Borja (Universidad de Castilla-La Mancha)

Increasing complexity in SUDOE

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How to increase forest stand complexity in Mediterranean conditions?

- Underplanting?
- Uneven-aged silviculture (transformation)
- Mixed species plantations instead of 1 species plantation?
- Gap in literature?

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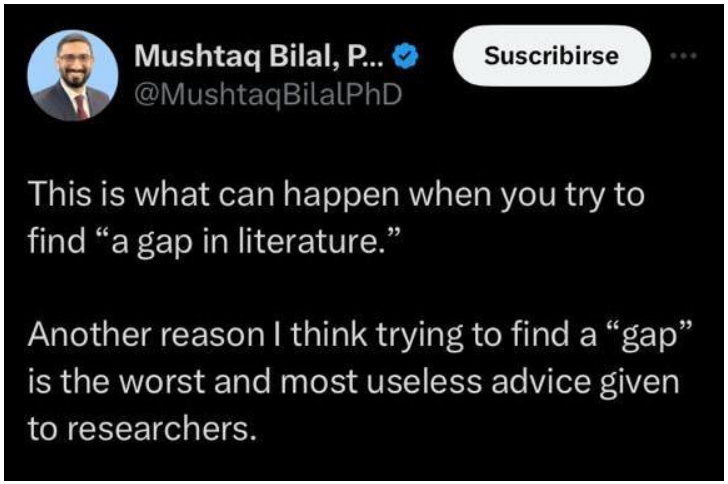

SILVICULTURAL SYSTEMS

BY

R. S. TROUP, C.I.E., D.Sc. (Oxon.,) F.R.S.
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PROFESSOR OF FORESTRY IN THE UNIVERSITY
DIRECTOR OF THE IMPERIAL FORESTRY INSTITUTE
FORMERLY OF THE INDIAN FOREST SERVICE

THE IRREGULAR SHELTER-WOOD SYSTEM

1. TERMINOLOGY

This system, commonly known as the Swiss or Baden *Femelschlag*, may be defined as a system of successive regeneration fellings with a long and indefinite regeneration period, the chief object of which is to secure light increment for selected stems of the overwood and to produce young crops of a somewhat uneven-aged type for protective reasons.

OXFORD
AT THE CLARENDON PRESS
1928

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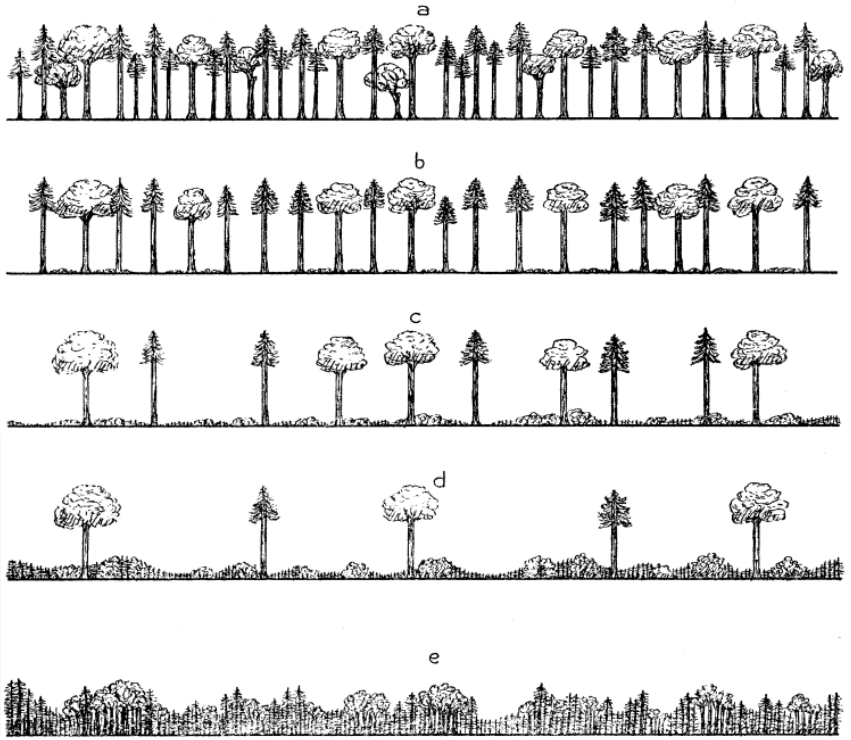
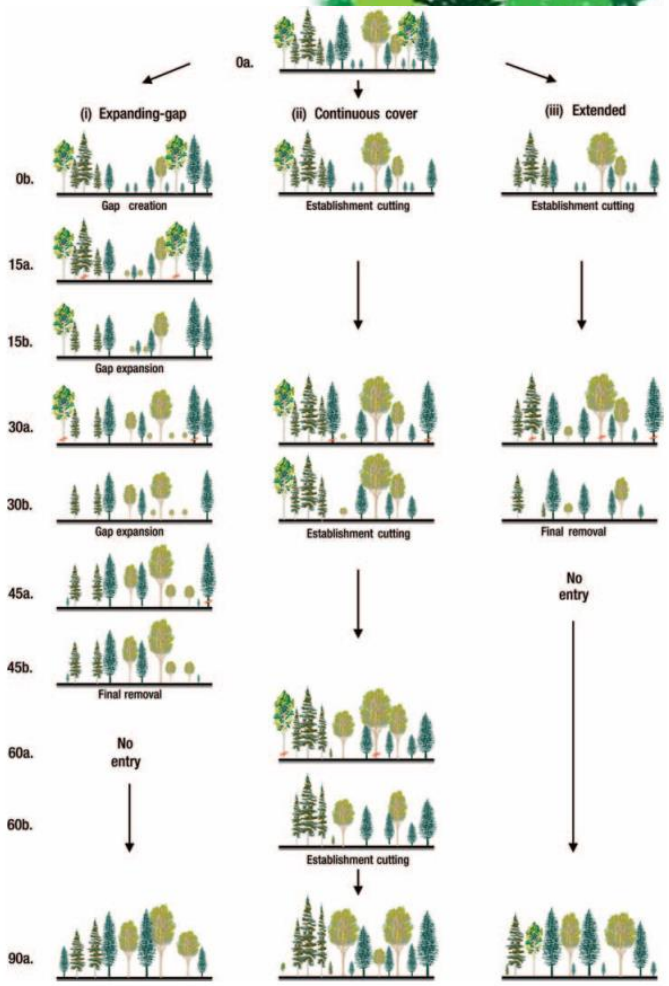


FIG. 32. Swiss *Femelschlag*, showing successive stages of regeneration in mixed forest of spruce, silver fir, and beech. *a*, mixed crop 40–80 years old (average 60 years), ready for regeneration to begin ; *b*, beech regeneration appearing as the result of a seeding felling ; *c*, regeneration of beech and silver fir establishing itself, and spruce appearing in gaps ; *d*, young crop with selected trees of the old wood retained for increment purposes ; *e*, young crop up to 50 years of age, after the final felling, showing irregular appearance.

Increasing complexity in SUDOE

Irregular shelterwood



The Irregular Shelterwood System: Review, Classification, and Potential Application to Forests Affected by Partial Disturbances

Patricia Raymond, Steve Bédard, Vincent Roy, Catherine Larouche, and Stéphane Tremblay

2009 Journal of Forestry 107 (8)405–413
https://doi.org/10.1093/jof/107.8.405

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The COMFOR and FORMIX networks

COMFOR

FORMIX NETWORK

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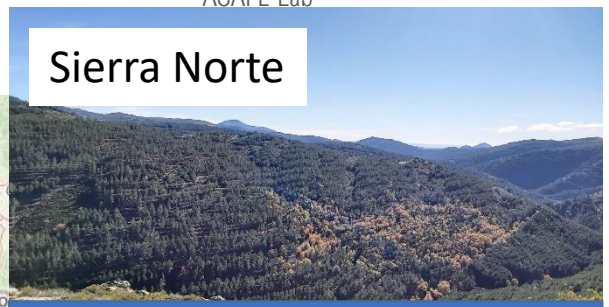
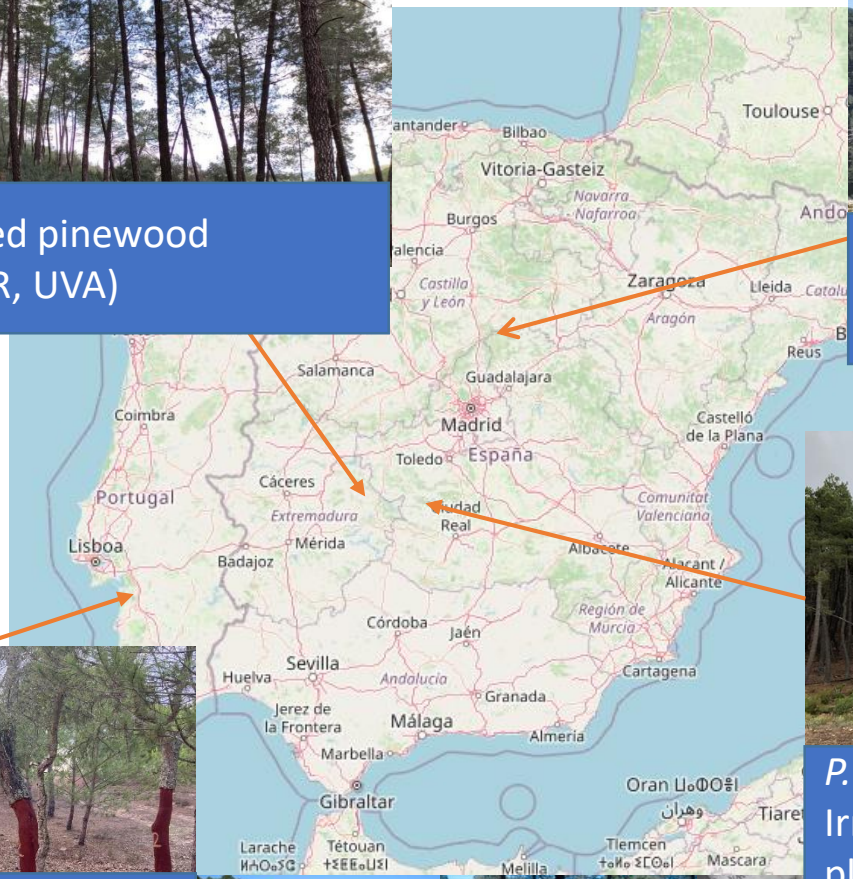
La Siberia

P. pinaster to Mixed pinewood
Irreg. Shelt. (iuFOR, UVA)



Sierra Norte

P. sylvestris to Mixed stand
"Rectangular Gaps" + planting



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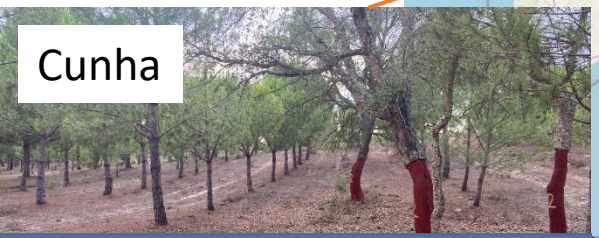
Cabañeros

P. pinaster to Med. Mixed forest
Irreg. Shelt. (expanding gaps + planting)



Cunha

Cork oak to mixed oak-*P. pinea*
Thinning (ISA)

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Key decisions

- Gap size
- Number of gaps
- Planting in gaps
- Reserved trees

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Applications of Irr. Shelterwood in Mediterranean forests

Increasing complexity in SUDOE

Cabañeros site

- *Pinus pinaster* reforestation (50 years)
- Very small gaps (0.5 Ho)
- Small gaps + thinning (1 Ho)
- Planting *Q. suber, Q. faginea, Q. ilex* (all combinations)
- Control
- Follow-up regeneration, plantation performance

Increasing complexity in SUDOE

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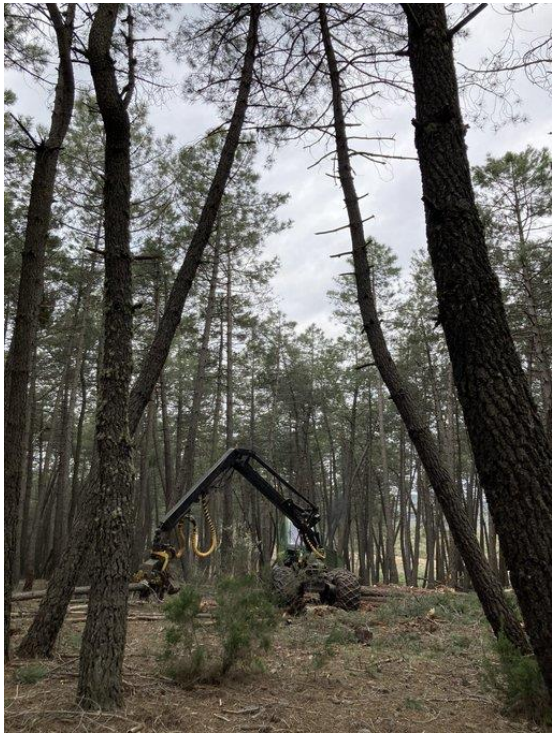
Cabañeros site

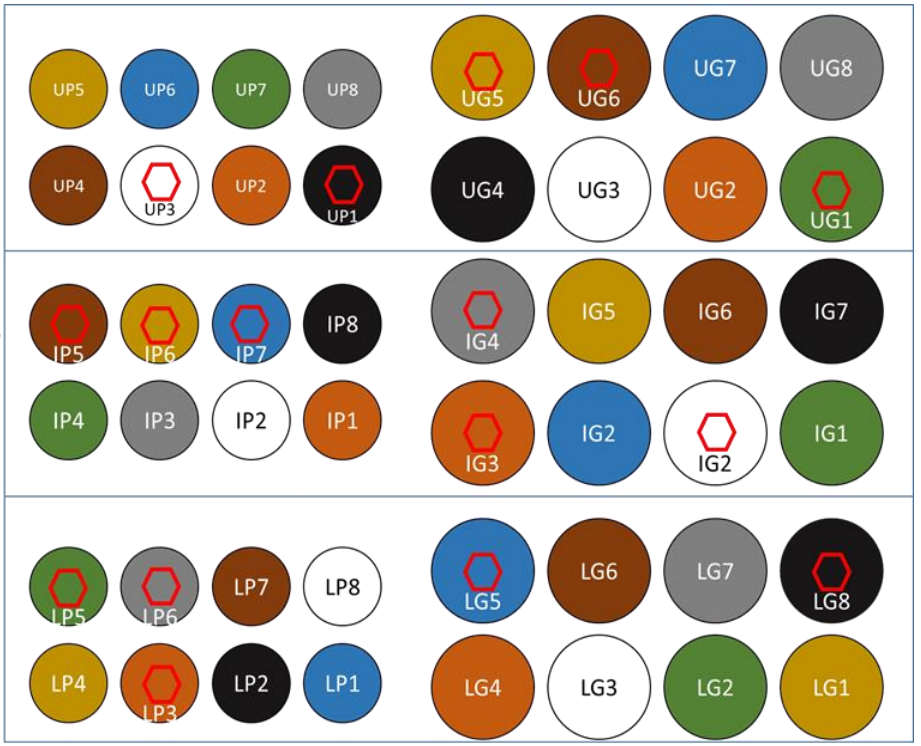


- *Quejigo*
- *Alcornoque*
- *Encina*
- *Alcornoque + Quejigo*
- *Encina + Alcornoque*
- *Encina + Quejigo*
- *Encina + Alcornoque + Quejigo*
- *SIN PLANTAS*

Cerramiento parcial en el interior del bosquete

Parte alta de la ladera

Parte baja de la ladera



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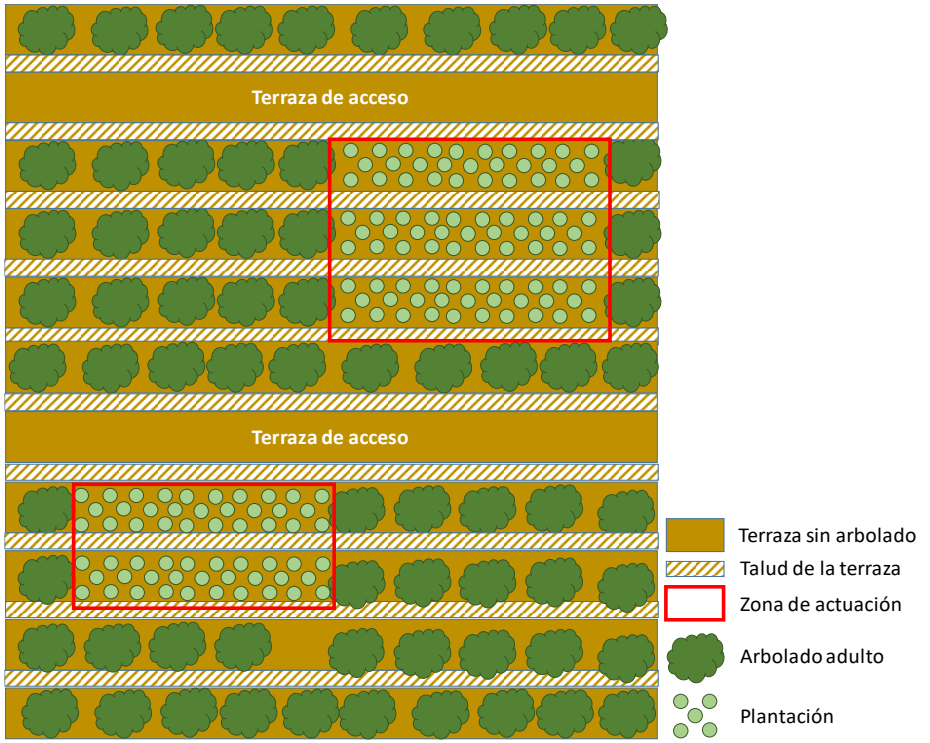
Sierra Norte site

- *Pinus sylvestris* reforestation (50 years)
- Rectangular gaps (~ 20 x 7 & 20 x 15 m)
- Planting *F. sylvatica, Betula, Sorbus, Q. pyrenaica*
- Control
- Regeneration performance



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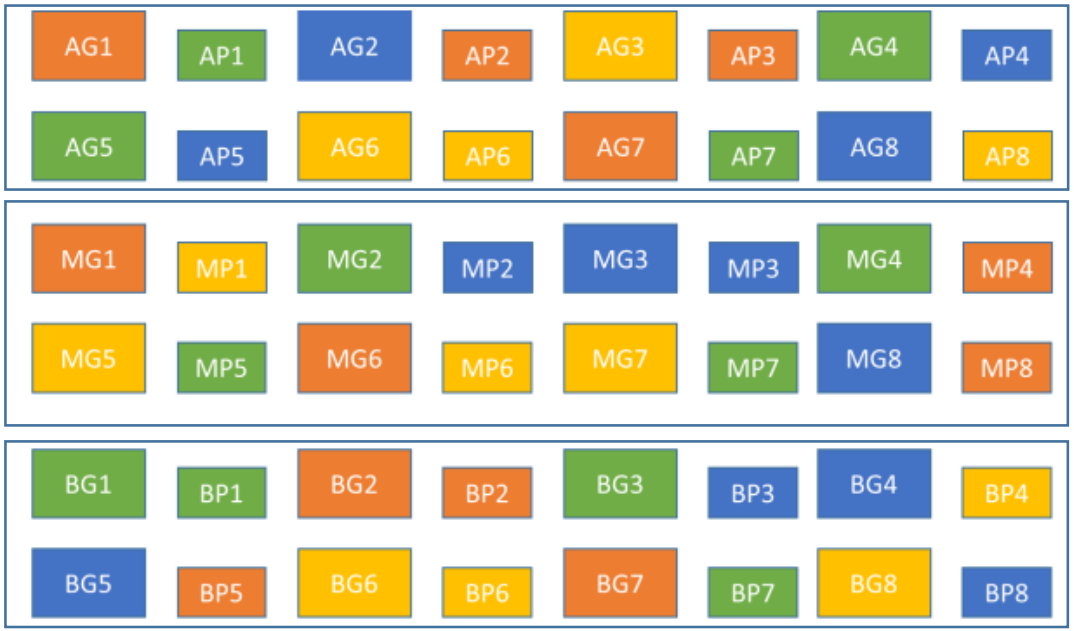
Sierra Norte site

F. sylvatica
Q. pyrenaica
F. sylvatica + Q. pyrenaica
F. sylvatica + Q. pyrenaica + S. aria



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Sierra Norte site

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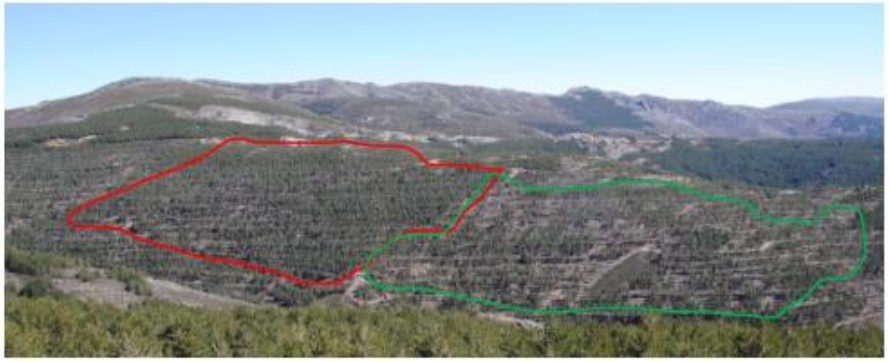
Sierra Norte site

Thinning

"rectangular" gaps



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https://formix.plantedforests.org/the-network/

FORMIX NETWORK

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INRAE la science pour la vie, l'humain, la terre

iuFOR Instituto Universitario de Investigación GESTIÓN FORESTAL SOSTENIBLE

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FORMIX NETWORK

M

One or several Main species **(M)** dedicated to provisioning service (raw materials).

e.g., *Pinus pinaster, Pinus taeda, Pseudotsuga menziesii, Larix eurolepsis, Eucalyptus globulus, ...*

S

One or several Secondary species **(S)** dedicated to e.g. biomass or non-timber forest products

e.g., *Betula pendula, Robinia pseudoacacia, Quercus rubra, Castanea sativa, Pinus pinea, Quercus suber, ...*

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FORMIX NETWORK

Initial plot densities

- d1= 1666 t/ha
- d2 = 1250 t/ha

Relative species category distributions

- p1 = 50% (M) / 50% (S)
- p2 = 66% (M) / 34% (S)
- p3 = 33% (M) / 33% (M) / 33% (S)

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https://formix.plantedforests.org/the-network/

FORMIX NETWORK

6 monocultures:

- M1_d1
- M1_d2
- M2_d1
- M2_d2
- S1_d1
- S1_d2

10 Two-species mixtures:

- (M1+S1)_d1_p1
- (M1+S1)_d1_p2
- (M1+S1)_d2_p1
- (M1+S1)_d2_p2
- (M2+S1)_d1_p1
- (M2+S1)_d1_p2
- (M2+S1)_d2_p1
- (M2+S1)_d2_p2
- (M1+M2)_d1_p1
- (M1+M2)_d2_p1

2 Three-species mixtures:

- (M1+M2+S1)_d1_p3
- (M1+M2+S1)_d2_p3

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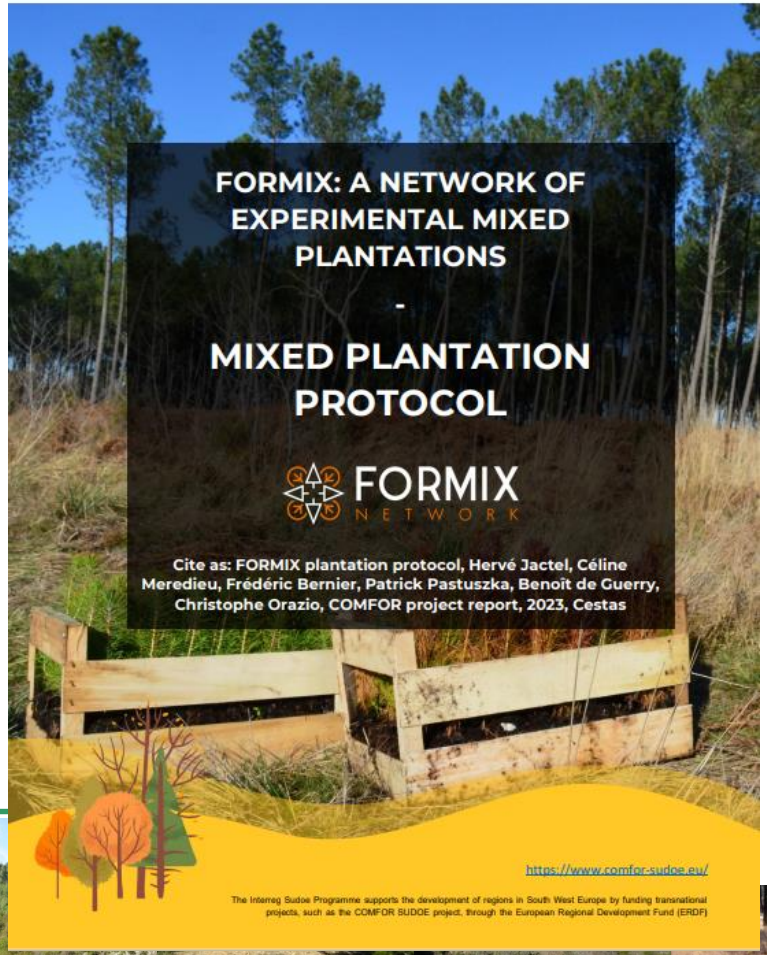

Increasing complexity

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Minimum requirements to build a network

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- The main objective of the experimental site is to increase complexity (species, structure or both)
- It must include a control (BAU, untransformed site)
- It must include replications of transformation and control.
- Participation / Co-creation

FORMIX NETWORK

- Biodiversity and forest ecosystem functioning relationships in the context of **climate change**
- Species relevant for owners and managers
- Same design and measurement protocol

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COMFOR

Thank you very much for your attention

FORMIX NETWORK

THE MIXTURE AWAKENS

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