Past, present and future in an old-growth forest in Ordesa y Monte Perdido National Park: structure, dynamics and biodiversity

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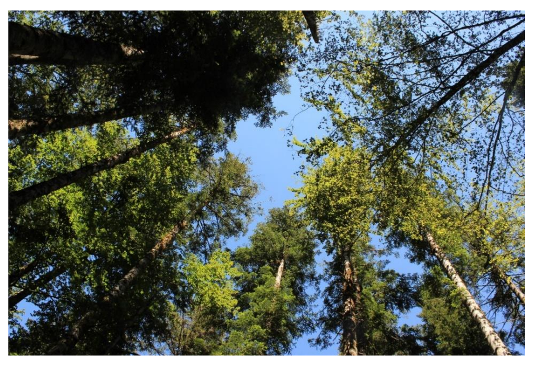
SPECIFIC OBJECTIVES :

1. Take information about the structure and dynamics in a mixed forest (*Abies alba – Fagus sylvatica – Pinus sylvestris*).
2. Set a reference system to monitor changes due to climatic & biotic interactions in the future. Monitoring should be repeated every 5 years.
3. Study how these changes could affect the biodiversity in the stand.
4. Test new technologies to improve the characterization of stands, forest plots and individual trees.

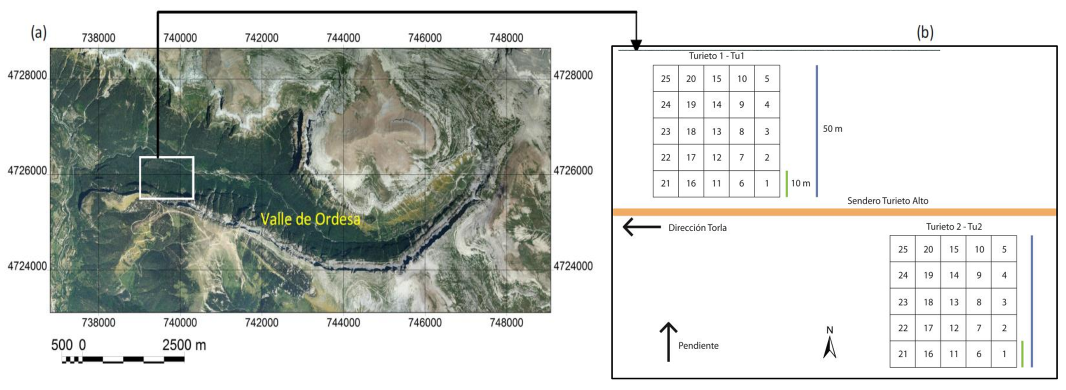


SITUATION :

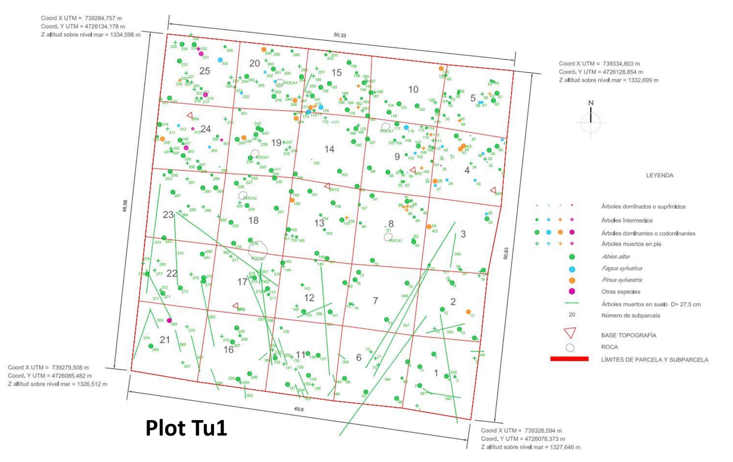
Located in Turieto stand, northern slope of the Ordesa Valley, at the **"Ordesa y Monte Perdido" National Park**, in the Spanish Pyrenees.

Altitude: 1300 – 1400 m.a.s.l. Orientation: North.
Climate: montane (in average 8,7ºC and 1255 mm/year)
Geology & edaphology: limestone, forest brown soils.

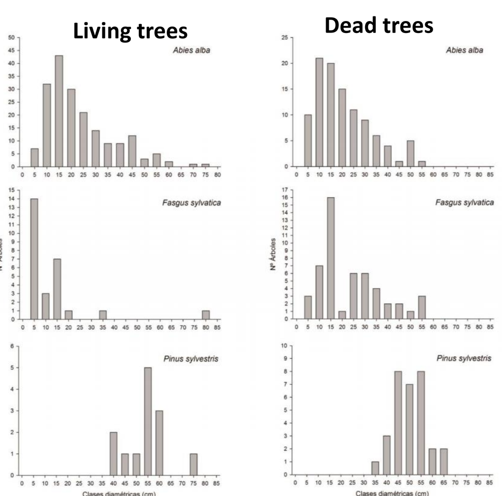
FOREST STRUCTURE



Two plots of 50 x 50 m were established, where we determined in a permanent way the position and characteristics from all living and dead trees. Each plot was subdivided into 25 subplots of 10 x 10 meter.

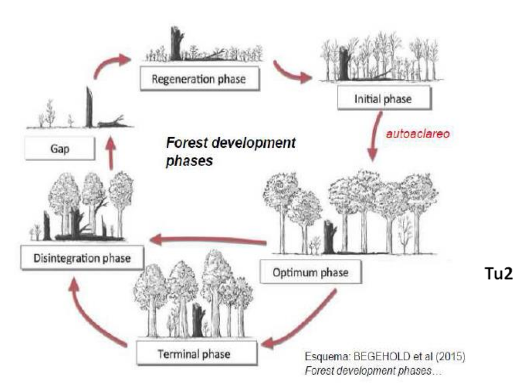


The analysis of the structure shows a global irregular curve and high volumes of living wood (650 m^3/ha) and dead wood, standing and falling (175 m^3/ha). Maximum DBH = 81 cm. Data for Tu1.



Number of trees for each diametric class, in plot Tu1 (0,25 ha).

DYNAMICS



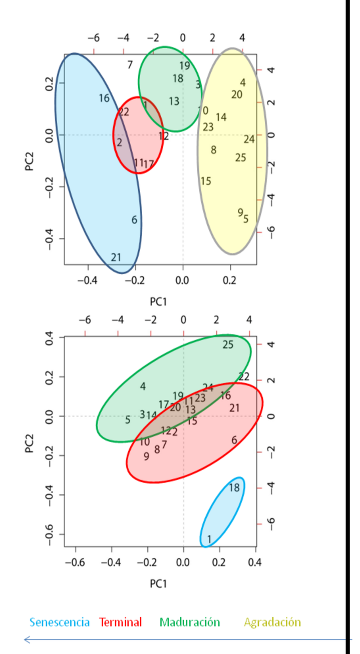
We study the sylvogenetical cycle, according to Begehold (2015).
For each subplot we determined which is the dominant development phase (regeneration, initial or agradation (A), optimum or maturation(M), terminal (T) and disintegration or senescence(S).

Tu1

A	A	A	A	A
A	M	A	A	A
A	M	M	A	T
T	T	A	M	M
S	S	S	S	T

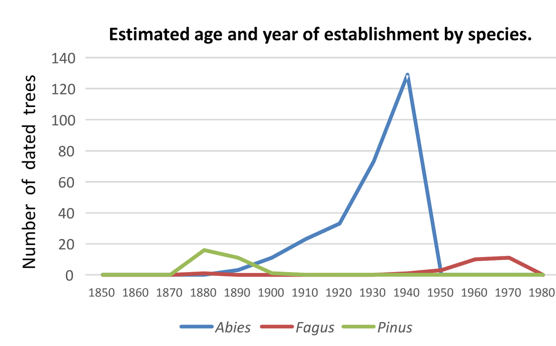
Tu2

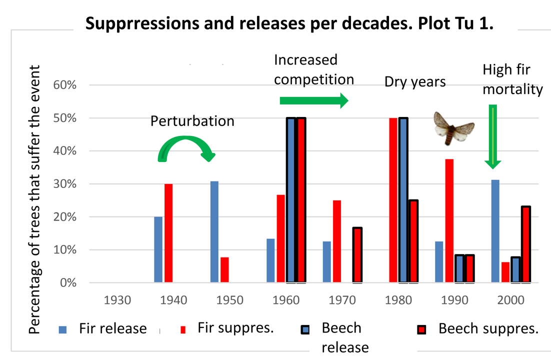
M	M	M	M	M
T	T	M	M	M
T	S	T	T	M
T	M	M	M	T
M	M	T	T	S



Through a principal component analysis we determined the consistency of the model.

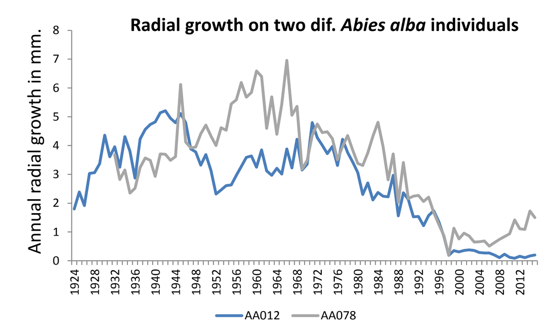
DENDROCHRONOLOGY



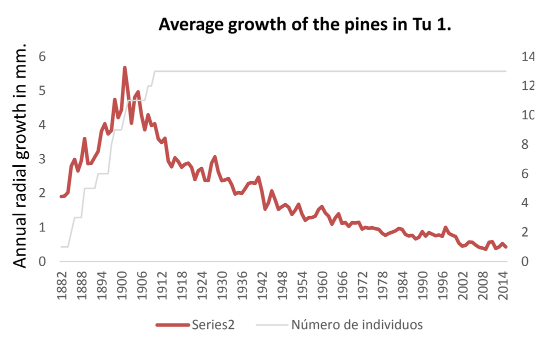


We also studied the forest dynamics using the tree-ring info from woody species. From that, we can observe the succession in the tree commnunity in the last 150 years, with an important change around 100 years ago since the end of land uses at establishment of the National Park (1917). From an open pine forest (*Pinus sylvestris*) it becames in a fir (*Abies* alba) dominated closed forest.

Also some important events can be studied through suppressions and releases, as the last timber extractions in the 50's & 60's, and some extreme climatological events with a strong influence on the health status of *Abies alba* trees.



This graphic shows different responses of two different fir individuals in radial growth to stress events.



The radial growth in average for pines is decreasing with time, showing a general decline for the species.

BIODIVERSITY

Tritomaria exsectiformis an epixilic specialist.

We made samplings of specific elements of the ecosystem: Coleoptera, birds, bats, vascular plants, lichens and mosses....

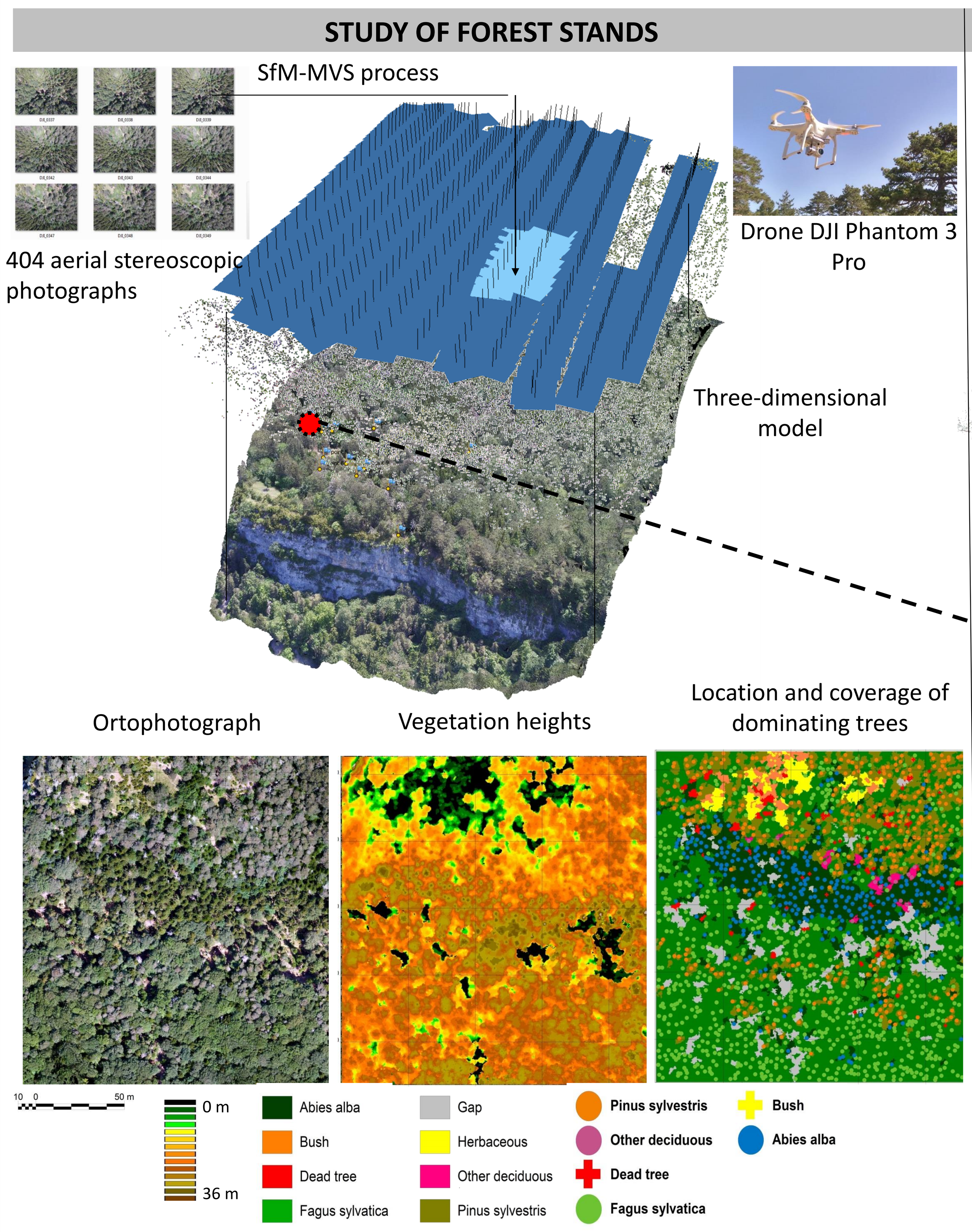
On cryptogams, some interesting old-growth forest indicators are present, caused by the abundance of dead wood (snags and logs) and ancient trees.

*The amount of sporophytes of **Buxbaumia viridis** is highly remarkable*

THE USE OF NEW TECHNOLOGIES IN THE CHARACTERIZATION OF OLD-GROWTH FORESTS

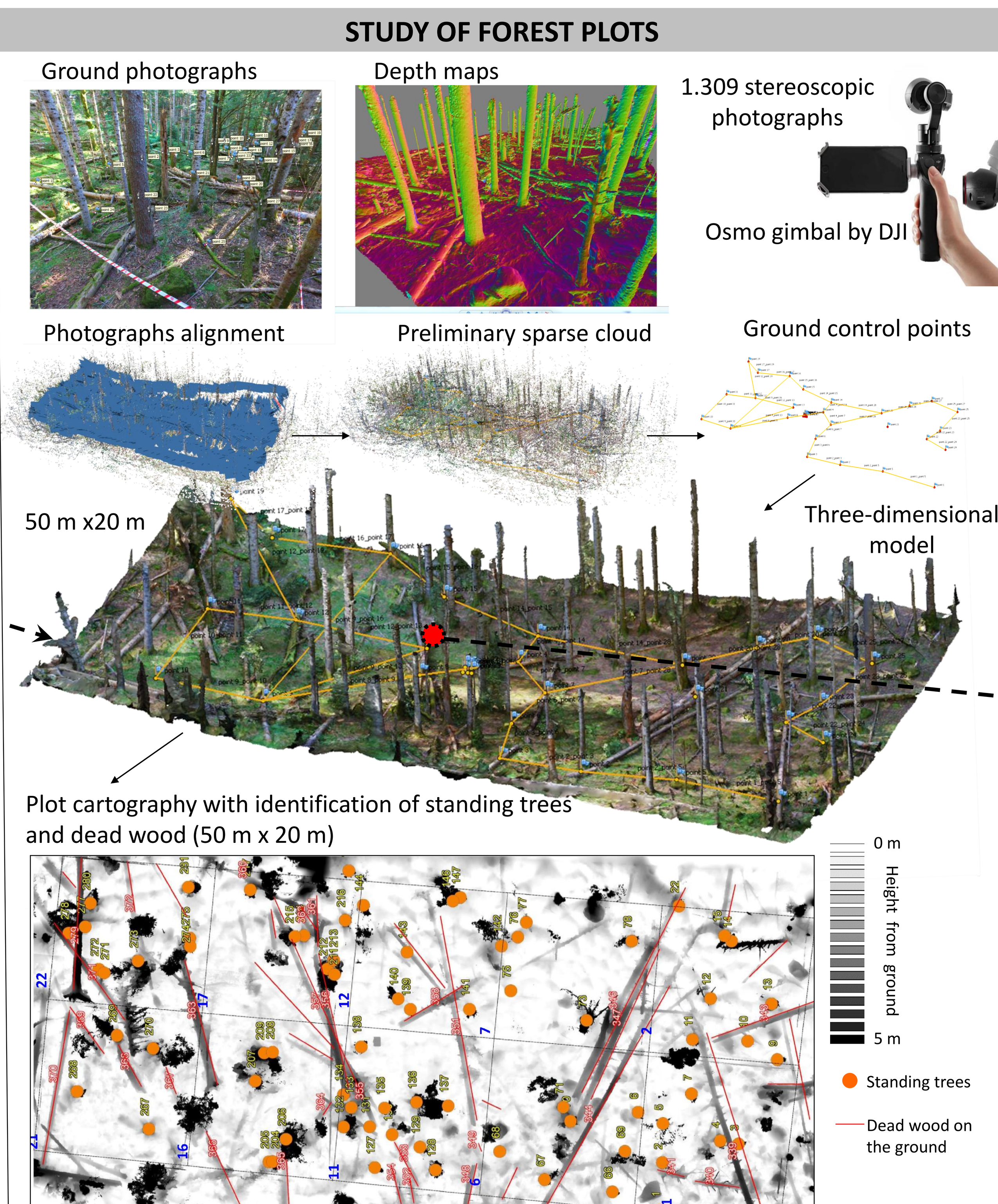
A workflow is developed to obtain topographic information of high resolution and density as a basis for evaluating the forest structure at different working scales (STAND, FOREST PLOT and INDIVIDUAL TREE). It combines the use of aerial platforms (Phantom 3 Professional UAV by DJI) and ground platforms (Osmo gimbal by DJI) to acquire stereoscopic photographs. These photographs have been post-processed using Structure from Motion-Multi View Stereo (SfM- MVS), Remote Sensing and Geographic Information Systems (GIS) techniques. With the information obtained, different forest parameters are calculated in relation to the physiognomy, structure and processes of forest mass at a STAND level, and structure and dendrometry at PLOT and TREE INDIVIDUAL levels. All the material prepared has been integrated into a Miramon GIS database and in a free access online platform (https://sketchfab.com/Gob.Aragon-D.G.Sostenibilidad)

STUDY OF FOREST STANDS



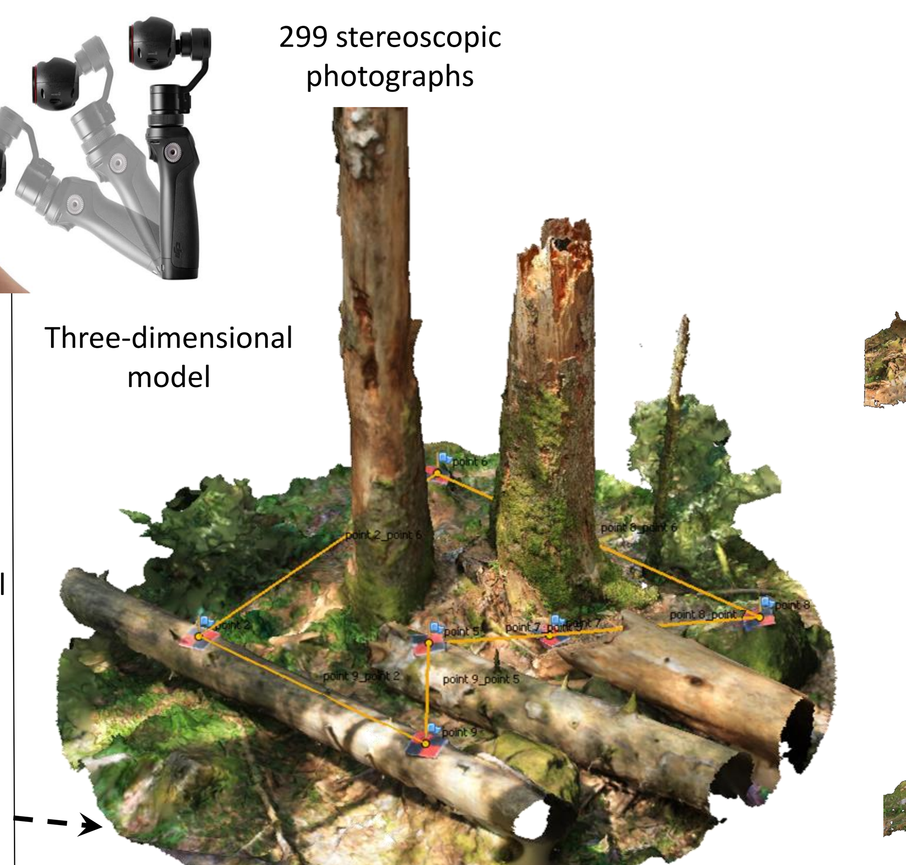
The objective is to obtain continuous variables to evaluate structural parameters of the mature forest at STAND scale (5 ha). Patterns of distribution of dominant tree species (coverage and position), vegetation heights and the existence of gaps within the forest (size and morphology) are calculated.

STUDY OF FOREST PLOTS

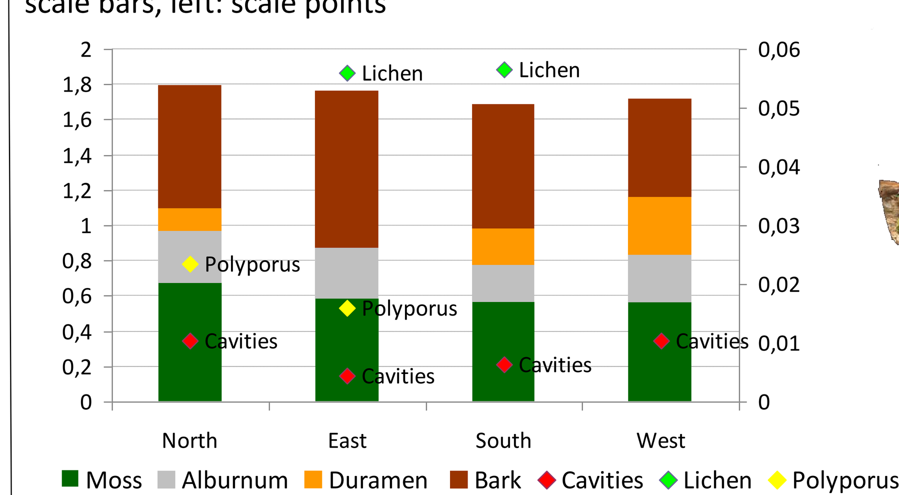


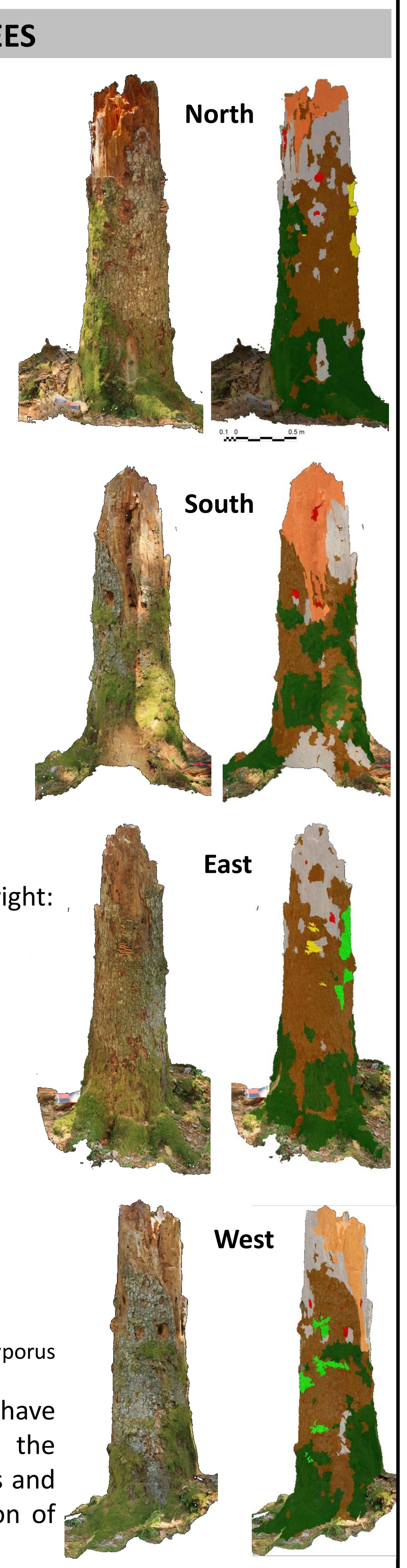
A 3D survey of two plots of mature forest (only Turieto 1 is shown in this poster) was carried out to represent (up to a height of 5 m) the distribution of standing trees, dead wood and soil morphology. The position and mean diameter of the trees and a high resolution map of the physiognomy of the plot was also calculated.

STUDY OF INDIVIDUAL TREES



Surface area (in m²) of each cover class by stem orientation (right: scale bars, left: scale points





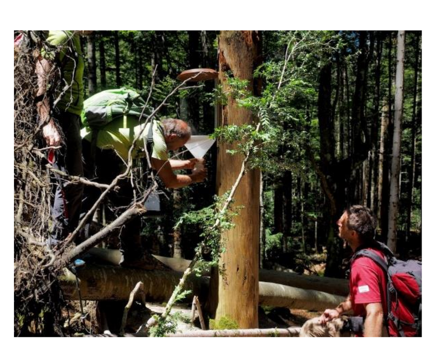
Four trees of special interest (up to a height of 5 meters) have been monitored to study their evolution in relation to the structure of the tree, the presence of microhabitats, lichens and fungi. Coverage class maps are created for each orientation of the stem.

SUMMARY:

- We studied a complex forest from different temporal windows (the past through dendrochronology, the present through structural analysis and the future will follow a periodic monitoring) and spatial windows (under landscape, plot and individual tree scales).
- In the past this forest has supported a strong anthropic influence, but after 100 years of protection it reaches a complex structure and intense natural dynamics driven by ecological processes, hosting a rich biodiversity.
- In global, it has a high conservation value.

CONCLUSIONS:

1. It is necessary to fix permanent plots in the high value ecosystems as a reference for long-term monitoring.
2. There is a great interest in trying new technologies and compare results and effectiveness.
3. A multi-scalar and multi-disciplinary approach allows to detect changes of different nature, escale and speed.

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