Development of the Inventory of the virgin forest in the Carpathians

UPDATING AND ENRICHING THE INVENTORY

Marco Trombetti, Emanuele Mancosu, Dania Abdul Malak, Ana Marín (University of Malaga, ETC/DI)
Annemarie Bastrup-Birk (EEA)
The “protocol for sustainable forest management”, signed by the Carpathian Convention Parties is formalising the need to preserve the richness and ensure sustainable use of the Carpathian forests.

Article 10 of the Carpathian Convention calls for the identification and protection of natural, especially virgin forests of the Carpathians. Objective 6.1 of the Strategic Action Plan for the Implementation of the Protocol on Sustainable Forest Management foresees as expected result the development of an inventory data of virgin forests based on the format approved by the Parties included in Carpathian Convention joint information system.
European Topic Centres (ETCs) are consortia of organisations with expertise in specific areas, contracted by the EEA to support the implementation of the EEA work programmes. ETCs are centres of EEA to carry out specific tasks identified in the EEA Multiannual Work Programme and the annual work programmes.
The process

EEA signed a partnership agreement with the Carpathian Convention Secretariat in July 2012 and included a work plan that is being implemented by one of its European Topic Centres (actually ETC/DI) represented by the University of Malaga (UMA)

Since 2014, EEA and ETC/DI (previously ETC/ULS) support the Forest WG of the Carpathian Convention in setting the basis to locate, monitor, and prioritise virgin and HNV forest areas:

- Support in the virgin forest inventory for better conservation
- Develop an Integrated Data platform to host data
- Developing Carpathian-wide indicators supporting sustainable management efforts
EEA and SCC signed a cooperation agreement (WG on Forest for the implementation of the protocol on sustainable forest management)

Definition and delimitation of a study area (KEO), collection of available datasets to populate a virgin forest inventory

Gathering relevant available datasets, indicators from the Parties to support the identification of virgin forests

Development of regional indicators based on the EEA HNV forest indicator

Creation and publication of a first Inventory of Carpathians Virgin Forest (Member Parties data)

Virgin Forest inventory improvement, Forest typology harmonization (EUNIS), Integrated data platform

Finalization of the Virgin Forest Inventory

Publication of the Virgin Forest inventory (v1)

National consultation

support the CC to regularly update the Inventory of the virgin forest inventory

Explore the extension of the inventory also considering other degrees of naturalness.
Criteria for the selection of Virgin Forest in the Carpathians

**A1 Criterion: Naturalness**

**A1.1. Species composition**
Forests formed of native/autochthonous tree species according to potential natural forest types.

**A1.2 Structure**
Cyclic ecosystems with complex structures, which include all stages of small development circles in a mosaic structure (horizontal) and vertically layered, according to the natural type of forest.

**A1.3 Deadwood**
Presence of deadwood (lying and standing) at all stages of degradation and all over the forest surface.

**A1.4 Human activities which influenced the development, structure and dynamic of the ecosystem**
1) Infrastructure, 2) Felling, 3) litter removal, 4) Grazing and 5) Recreation /education infrastructure

**A2 Criterion: Area & Delimitation**

**A2.1 Area of forest plot**
Minimum 20 ha

**A2.2 Shape of forest plot**
Minimum distance between any two opposite boundary points does not decrease below 200 m.

Source: SCC webpage
<table>
<thead>
<tr>
<th>No.</th>
<th>Name of the virgin forest</th>
<th>Forest management plan, edition (year)</th>
<th>Study, edition</th>
<th>Type of property</th>
<th>Latitude N</th>
<th>Longitude E</th>
<th>Altitude</th>
<th>County</th>
<th>Owner, administrator</th>
<th>Production Unit</th>
<th>Basic forest unit (compartment)</th>
<th>Type of forest: Czech site classification (Vičnegh et al. 2003) / Habitat directive classification</th>
<th>Area (ha)</th>
<th>of which surfaces that do not meet the criterion of naturalness (fully protected, in progress, not protected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>244</td>
<td>Mionší</td>
<td>archive documents, field survey naturalness assessment</td>
<td>state 49.533275N 18.6615444E</td>
<td>720 950</td>
<td>Frydek-Místek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5B6 / 9130</td>
<td></td>
<td>National Nature Reserve</td>
<td>131.01</td>
<td></td>
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<tr>
<td>2107</td>
<td>Travný</td>
<td>archive documents, field survey naturalness assessment</td>
<td>state 49.5598211N 18.4927431E</td>
<td>530 1203</td>
<td>Frydek-Místek</td>
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<td></td>
<td></td>
<td></td>
<td>5B6, 6F1, 5F1 / 9130</td>
<td>Nature Reserve</td>
<td>32.10</td>
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<tr>
<td>238</td>
<td>Mazák</td>
<td>archive documents, field survey naturalness assessment</td>
<td>state 49.5252717N 18.4079039E</td>
<td>715 1315</td>
<td>Frydek-Místek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6F1, 7S1 / 9130, 9410</td>
<td>National Nature Reserve</td>
<td>61.46</td>
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<td></td>
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<tr>
<td>237</td>
<td>Muzicky Grunik</td>
<td>archive documents, field survey naturalness assessment</td>
<td>state 49.5299775N 18.4324972E</td>
<td>540 940</td>
<td>Frydek-Místek</td>
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<td></td>
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<td></td>
<td>5F1, 5B6 / 9130</td>
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<td>Nature Reserve</td>
<td>38.96</td>
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<tr>
<td>1883</td>
<td>Smrk</td>
<td>archive documents, field survey naturalness assessment</td>
<td>state 49.5010147N 18.5646803E</td>
<td>900 1276</td>
<td>Frydek-Místek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7K2, 7S1, 7Z4, 6F1, 6S1 / 9410, 9130</td>
<td>Nature Reserve</td>
<td>81.14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Physical features
- **Name:** Mionší, Travný, Mazák, Muzicky Grunik, Smrk
- **Geolocation:**
  - Mionší: 49.5333275N 18.6615444E
  - Travný: 49.5598211N 18.4927431E
  - Mazák: 49.5252717N 18.4079039E
  - Muzicky Grunik: 49.5299775N 18.4324972E
  - Smrk: 49.5010147N 18.5646803E

### Management features
- **Year of management plan:**
- **Type of property:**
- **Ownership:**
- **Level of protection:**
- **Area:**
- **Basic forest unit:**

### Vegetation features
- **Forest type:**

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**Official Virgin Forest Inventory**

**Altitude:**
- Minimum: 32.10
- Maximum: 950

**Area (ha):**
- Minimum: 32.10
- Maximum: 950

**County:**
- Frydek-Místek

**Owner, administrator:**
- Frydek-Místek

**Type of forest: Czech site classification (Vičnegh et al. 2003) / Habitat directive classification:**
- National Nature Reserve

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**Study, edition:**
- Archive documents, field survey

**CZ:**
- State Forest Service of the Czech Republic

**HU:**
- Czech Forestry Industry

**SK:**
- Ministry of Agriculture of the Czech Republic

---

**Director:**
- Milos Ruzek

---

**Department:**
- Forest Conservation

---

**Institution:**
- Forests of the Czech Republic

---

**Address:**
- Rytířská 3, 501 01 Praha 5

---

**Telephone:**
- +420 233 128 840

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**Email:**
- info@kmp.cz

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**Website:**
- www.kmp.cz

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**Naturalness assessment:**
- Natural

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**Management of the forests:**
- Fully protected

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**Forest type:**
- Mixed coniferous forest

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**Habitat:**
- Europe 2090

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**Habitat Directive:**
- 92/43/EC

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**Reference site:**
- Nature Reserve

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**Protected site:**
- National Nature Reserve
Carpathian-wide Virgin Forest Inventory: Need for Harmonization

Incomplete thematic data

Local Forest Type classification schemes

Different data format (Tabular, Spatial)

Missing or heterogenous information about ownership or protection status

Description of forest types according to local schemes, classifications, languages

Mixture of spatial and tabular data, different reference systems

Harmonized Dataset

Point shaped features

Consistent thematic information

Validation with independent vegetation plot data

EUNIS classification
The EUNIS habitat classification is a comprehensive European system to facilitate the harmonised description and collection of data across Europe through the use of criteria for habitat identification. It is hierarchical and covers all types of habitat from natural to artificial, from terrestrial to freshwater and marine.
Data sharing / publication
Harmonisation of forest typologies

Integration of the **crosswalk between national forest types and EUNIS habitats** classification for Ukraine plots

<table>
<thead>
<tr>
<th>N</th>
<th>EU-NIS</th>
<th>Ukrainian forestry types in English</th>
<th>Ukrainian forestry types in Ukrainian</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F2.46 Carpathian [Pinus mugo] scrub</td>
<td>Damp Mountain Pine woodland/scrub on oligotrophic soils (B3 - C2), Rare and fragmented: Damp Mountain Pine woodland/scrub on oligotrophic soils (A3 - C2)</td>
<td>Волохові горілково-вільсінні субер (Б3 - С2), Рідко та фрагментарно: Волохові горілково-вільсінні низ</td>
</tr>
</tbody>
</table>
Upgrading the official dataset (toward version 2)

version 1, 2019

Virgin forest: 820 plots
Quasi-virgin forest: 1504 plots

version 2, 2022 (under consultation)

Virgin forest: 960 plots (refinement of the locations of 8 plots)
Quasi-virgin forest: 3823 plots

Access to Carpathian Viewer
Other documented primary and old-growth forests

To complement and enlarge the wide database on well conserved forest in the Carpathian Mountains from trusted entities/organization to create a “non-official data” on well conserved forest (OGF) in the Carpathians,

Data sources explored

- European primary forest database v2.0 (Sabatini et al. 2021)
- WWF UA datasets (virgin, quasi-virgin and natural forests in Ukraine)
- Greenpeace Potential Primary Forests Map of Romania

Analysis

- European primary forest inventory (Sabitini et al. 2021) → based on local-to-national datasets, literature review and survey → Baseline
- WWF - Identified old-growth forests of Ukrainian Carpathians and Polissia map → already included in EU Primary forest inventory
- Greenpeace Potential Primary Forests Map in Romania → modelled location (non-validated) → no ground truthing done and not used
Based on European primary forest database v2.0 (Sabatini et al. 2021)

The dataset includes “primary forest” defined as “naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities, and the ecological processes are not significantly disturbed”.

This follows the definition proposed by Buchwald (2005), where ‘primary forest’ is used as an umbrella term to include forests with different levels of naturalness, such as primeval, virgin, near-virgin, old-growth and long-untouched forests.

https://www.nature.com/articles/s41597-021-00988-7
Other documented primary and old-growth forests database

Summary statistics of European primary forest database v2.0 in KEO region

<table>
<thead>
<tr>
<th>Degree of naturalness</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No info</td>
<td>65,925</td>
</tr>
<tr>
<td>Long untouched forest</td>
<td>3,384</td>
</tr>
<tr>
<td>Old-growth forest</td>
<td>38,720</td>
</tr>
<tr>
<td>Near-virgin forest</td>
<td>68,906</td>
</tr>
</tbody>
</table>

https://www.nature.com/articles/s41597-021-00988-7
Update process of the Virgin Forest Inventory of the Carpathians - National consultation (lead by SCC)

**OFFICIAL (v2) REGION-WIDE DATABASE ON VIRGIN, QUASI-VIRGIN FOREST**

- National consultation & validation process

**DOCUMENTED DATABASE ON OTHER OLD GROWTH FOREST IN THE CARPATHIANS**

- Sub-sets (shapefiles) and consultation/validation form were sent to NFP
  - July – September 2022

- Consolidated, validated and updated Virgin Forest Inventory (v2)
- Get updated information, if any, and get the shapefile of the extent instead of dots (if exist)
- Comments to the other documented primary and old-growth forests datasets

**Comments from all Carpathian Parties**
Czech Republic confirmed and validated the VF datasets
Hungary confirmed and validated the VF datasets
Poland was asked to contribute to the VF inventory.

Poland provided the next list of Polish virgin forests in the Carpathians (no geolocation and CC format)

1. Gorczański National Park – 183,87 ha of virgin forests
   - Gorc Troszacki: forest compartment 96 - 22,69 ha
   - Kamienica Valley: forest compartment 101, 102 - 48,14 ha
   - Turbacz Nature Reserve: stream Turbacz valley, forest compartment 60, 61 - 42,84 ha
   - Stream Olszowy valley, forest compartment 67, 68, 69 - 70,20 ha

2. Babiogórski National Park – 330,36 ha of virgin forests
   - sub-compartment 16a – 55,34 ha
   - sub-compartment 23a – 36,20 ha
   - sub-compartment 22a – 20,92 ha
   - sub-compartment 19a,20a,21b – 101,01 ha
   - sub-compartment 6d,7a – 33,27 ha
   - sub-compartment 18b,18c,18d – 23,47 ha
   - sub-compartment 25c – 21,31 ha
   - sub-compartment 28j – 38,84 ha

3. Tatrański National Park – 105,00 ha of virgin forests
   - 2 sites in Roztoka valley:
     - Orla Ściana – 78 ha
     - Wołoszyńskie Szczoty – 27 ha

4. Bieszczadzki National Park – 2204,04 ha of virgin forests
   - Hylaty Valley
   - Terebowiec Valley
   - Wołosatka Valley – E
   - Wołosatka Valley – N
   - Wołosatka Valley – W
   - Zakopaniec Valley
   - Bieszczady Forest on the San River
   - Rabia Skała
   - “U źródeł Solinki” and “Wetlina”
   - Wielka Rawka
   - Wielka Rawka – Semenowa
   - Zdegowa
Romania confirmed the VF and QvF datasets and locations; sharing the polygons

Romania has updated its catalogue and shared it (30 August 2022)
Serbia confirmed and validated the VF datasets
Slovakia validated and confirmed the VF plots' locations.

Additionally, they shared the shapefile of Slovakia Nature Reserve approved by the Government of the Slovak Republic on November 3, 2021. This includes mapped stands of primeval forests and remnants of primeval forests, but it also includes neighboring forest stands.
They shared data on virgin forests and quasi-virgin forests, which are available in the forests of the Ukrainian Carpathians under the State Forestry Agency.

By now, not possible to obtain spatially explicit information that defines the surface extent of the virgin forest plots (polygons).
National consultation – Other documented primary and old-growth forests database

There was not clear validation of this layer.
Comparing databases

Slovakia

Romania

Legend
- KEO_EU_PrimaryForest_Sabatini_et_al
- vrska_PR_Presny_Slovenska
- EU_PrimaryForest_Sabatini_et_al
- Country boundaries

Source: Bird, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USGS, IMA, and the GIS User Community

European Environment Agency
European Topic Centre
Data integration and digitalisation
Comparing databases

Ukraine

The overall comments were:

1) predisposition to extent the inventory upon the virgin forest

2) the need to have common definition of quasi-virgin forest and old-growth forest, define protocol for their definition and give official status to the criteria and indicators for determining them
Next steps

• About Inventory of Virgin Forests of the Carpathians:
  – Integrate the countries’ comments and update the EEA sdi

• Regarding the extension of the inventory also considering other degrees of naturalness:
  – Further discussion about the definition, criteria etc is needed

## Notions of primary forest and old-growth forest definitions

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAO - Forest Resource Assessment (FAO 2018)</td>
<td><strong>Primary forest:</strong> “Naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed. Some key characteristics of primary forests are 1) They show natural forest dynamics, such as natural tree species composition, occurrence of dead wood, natural age structure and natural regeneration processes; 2) The area is large enough to maintain its natural ecological processes; and 3) There has been no known significant human intervention or the last significant human intervention was long enough ago to have allowed the natural species composition and processes to have become re-established.”</td>
</tr>
<tr>
<td>FOREST EUROPE (2015)</td>
<td><strong>Forest undisturbed by man:</strong> “Forest (or other wooded land) which shows natural forest dynamics, such as natural tree composition, occurrence of deadwood, natural age structure and natural regeneration processes, the area of which is large enough to maintain its natural characteristics and where there has been no known significant human intervention or where the last significant human intervention was long enough ago to have allowed the natural species composition and processes to have become re-established.”</td>
</tr>
<tr>
<td>Carpathian Convention (2014)</td>
<td><strong>Virgin forest:</strong> “natural forests which have not been influenced directly by human activities in their development and natural forest means forests composed of tree species indigenous to the area with most of the principal characteristics and key elements of native ecosystems, such as complexity, structure and diversity.”</td>
</tr>
<tr>
<td>European Commission (2015)</td>
<td><strong>Primary forest:</strong> Same as in FAO’s Forest Resource Assessment (see above).  <strong>Old-growth forest:</strong> “Old-growth forest stands are stands in primary or secondary forests that have developed the structures and species normally associated with old primary forest of that type.”</td>
</tr>
</tbody>
</table>

Extract from Barredo et al. 2021https://publications.jrc.ec.europa.eu/repository/handle/JRC124671
### Notions of primary forest and old-growth forest definitions

<table>
<thead>
<tr>
<th>UNESCO Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe (Kirchmeir and Kovarovic 2016)</th>
<th><strong>Primeval forest</strong> (comprises virgin forests):</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Primeval or virgin forests</strong> means natural forests which have not been influenced directly by human activities in their development and ‘natural forest’ means forests composed of tree species indigenous to the area with most of the principal characteristics and key elements of native ecosystems, such as complexity, structure and diversity.”</td>
<td></td>
</tr>
<tr>
<td>- <strong>Ancient (beech) forest</strong>, considered synonymous with <strong>old-growth (beech) forest</strong>, describe “forest stands which have been directly influenced by human activities in the past, but the last significant impact is dated back several decades (or even centuries). Throughout the period of missing impact (mainly absence of logging), natural processes have taken place and structures similar to untouched virgin forests have developed. For beech forests, this includes trees that are significantly older than the usual period of logging rotation (100–120 years) and deadwood amounts of over 20 m³/ha are already in place.”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Convention on Biological Diversity (CBD)</th>
<th><strong>Primary forest:</strong> “is a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. It is referred to ‘direct human disturbance’ as the intentional clearing of forest by any means (including fire) to manage or alter them for human use. (...). In much of Europe, primary forest has a different connotation and refers to an area of forest land which has probably been continuously wooded at least throughout historical times (e.g., the last thousand years). It has not been completely cleared or converted to another land use for any period of time. However traditional human disturbances such as patch felling for shifting cultivation, coppicing, burning and also, more recently, selective/partial logging may have occurred, as well as natural disturbances. The present cover is normally relatively close to the natural composition and has arisen (predominantly) through natural regeneration, but planted stands can also be found. However, the suggested definition above would include other forests, such as secondary forests.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Old-growth forest:</strong> “Are stands in primary or secondary forests that have developed the structures and species normally associated with old primary forest of that type have sufficiently accumulated to act as a forest ecosystem distinct from any younger age class.”</td>
</tr>
</tbody>
</table>

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*Extract from Barredo et al. 2021 [https://publications.jrc.ec.europa.eu/repository/handle/JRC124671]*
Notions of primary forest and old-growth forest definitions

*Forest Naturalness – The hierarchy of definitions proposed by Buchwald (2005),*

<table>
<thead>
<tr>
<th>Level of naturalness</th>
<th>Proposed names for levels</th>
<th>Stand origin</th>
<th>Genesis</th>
<th>Tree species origin</th>
<th>Processes and structures</th>
<th>Management</th>
<th>Forestry activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>n10</td>
<td>Primeval forest</td>
<td>Natural forest</td>
<td></td>
<td>Native</td>
<td>Forest managed mainly for conservation</td>
<td></td>
<td>Minimum-intervention forest</td>
</tr>
<tr>
<td>n9</td>
<td>Virgin forest</td>
<td>Self-sown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n8</td>
<td>Frontier forest</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>n7</td>
<td>Near-virgin forest</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>n6</td>
<td>Old-growth forest</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>n5</td>
<td>Long untouched forest</td>
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<td></td>
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</tr>
<tr>
<td>n4</td>
<td>Newly untouched forest</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>n3</td>
<td>Specially managed forest</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>n2</td>
<td>Exploited natural forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n1</td>
<td>Plantation-like natural forest</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>p4</td>
<td>Partly natural plantation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>p3</td>
<td>Native plantation</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>p2</td>
<td>Exotic plantation</td>
<td></td>
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<tr>
<td>p1</td>
<td>Self-sown exotic forest</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Thank you for your attention!

Ana I. Marín - Guerrero (ETC/DI): aimarin@uma.es

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Relevant links
KEO: https://sdi.eea.europa.eu/catalogue/biodiversity/eng/catalog.search#metadata/3eb6231c-6cc3-4162-9b6f-3d3607480436
Virgin forest layer: https://sdi.eea.europa.eu/catalogue/idp/api/records/571259cc-97da-45a5-acbb-d4f95a164a2b
Integrated data platform https://maps.eea.europa.eu/EEAViewer/?appid=151024dc3c4d43848accc4cf7b5c63e0

CLIMAT-ADAPT: Adaptation in Carpathian Mountains — Climate-ADAPT (europa.eu)
FISE www.forest.eea.europa.eu
BISE www.biodiversity.europa.eu