The last Maramureș old-growth fir-beech forests: a long-term and global study for their better understanding, conservation and management

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The last Maramureș old-growth fir-beech forests: a long-term and global study for their better understanding, conservation and management
A French experience in Romania (Eastern Carpathians)
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A French experience in Romania
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Județ Maramureș
A specific rural landscape: the « subnatural forest »
The ecological movie: « Mononoko Princess »

Forêt de Yakushima
What is a "subnatural" or "old-growth forest"?

« vieille forêt » in French, « foresta vetusta » in Italian
What is a "subnatural" or "old-growth forest"?

« vieille forêt » in French, « vecchia foresta » in Italian

- Never or very little exploited

Cateau et al. 2015 C.R. Biologies 338
What is a "subnatural" or "old-growth forest"?

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- A long period without anthropogenic disturbance
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- Never or very little exploited
- A long period without anthropogenic disturbance
  -> an ancientness of several centuries
What is a "subnatural" or "old-growth forest"?

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- Never or very little exploited
- A long period without anthropogenic disturbance
- **A high maturity**
  - many large living trees
  - old living trees
  - many types of TreMs (Tree related microhabitats)
  - high volume of dead wood (different states of decomposition)

Cateau et al. 2015 C.R. Biologies 338
TreMs examples

Nest of vertebrate © L. Larrieu

Black woodpecker feeding cavities © L. Larrieu

Larrieu et al. 2018 Ecological indicator 84
What is a "subnatural" or "old-growth forest"?

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- Stands dominated by *dryades*

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- A high maturity
- A high biodiversity
- Stands dominated by dryades
- Heterogeneity of the vertical structure
Old-growth forest (OGF)

- A concept defined by ecologists
- A definition excluding human uses/practices

The natural cycle of fir-beech forest

L. Fouédjeu in Py-Saragaglia et al. in press
OGF: a key role facing global change

- Carbon storage
OGF: a key role facing global change

- Carbon storage
- CO₂ fixing
OGF: a key role facing global change

- Carbon storage
- CO₂ fixing
- Species and intraspecific genetic diversity
OGF: a key role facing global change

- Carbon storage
- CO$_2$ fixing
- Species and intraspecific genetic diversity
- Reservoir of biodiversity
OGF: a key role facing global change

- Carbon storage
- CO2 fixing
- Species and intraspecific genetic diversity
- Reservoir of biodiversity

!! But underestimated ecosystem goods and services !!
OGF: less than 1% of European forest

Sabatini et al. 2018 Diversity and distribution
OGF: less than 1% of European forest

Forests
Top-ranking 5%
Remaining 90-95%

Romanian Carpathians

Sabatini et al. 2018 Diversity and distribution
OGF: a relict and vulnerable landscape

2 millions ha in the 19th c. -> less than 200 000 ha today

Knorn et al. 2013 Environmental conservation
Industrial forestry exploitation and illegal logging

Knorn et al. 2013 Environmental conservation
Industrial forestry exploitation and illegal logging

Knorn et al. 2013 Environmental conservation
Industrial forestry exploitation and illegal logging

https://www.dailymotion.com/video/x59qar9
Maramureș County: an “archaic ethnographic zone”

Rey et al. 2002

Agroforestry landscape © S. Guillerme

Wooden architecture © S. Guillerme
Maramureș County: an important mining district
PbS, Fe, ZnS, Cu, Ag, Au etc.
Maramureș County: an important mining district

Băiuț mining area © V. Py

Ruined industrial building © V. Py
Maramureș County: an important mining district

Băiuț mining area – mine waste heaps © V. Py
Maramureș County has the last primeval beech forest!

Unesco World Heritage from July 2017: « The area is made entirely out of beech forests and represents one of the most unique primeval forests of the Romanian Eastern Carpathians »
Is it possible to have a “primeval forest” at the heart of a mining area?

Mines recorded from 14th c.; exploited until 2006-2007; definitely closed in 2009-2011
Is it possible to have a “primeval forest” at the heart of a mining area?

Primeval forest: large forest area constituted from the last deglaciation and never exploited or disturbed by human
Is it possible to have a “primeval forest” at the heart of a mining area?

✓ If so, why and how is it possible?

✓ If no, what is Strambu Băiuț?
Is it possible to have a “primeval forest” at the heart of a mining area?

✓ If so, why and how is it possible?

✓ If no, what is Strambu Băiuț? What is its degree of maturity, diversity, ancientness, long-term dynamic, resilience capacity?
Is it possible to have a “primeval forest” at the heart of a mining area?

- If so, why and how is it possible?
- If no, what is Strambu Băiuț?
- If no, what are and were human practices and uses?
Is it possible to have a “primeval forest” at the heart of a mining area?

- If so, why and how is it possible?
- If no, what is Strambu Băiuț?
- If no, what are and were human practices and uses?
- If no, is there an antagonism between biological diversity, its conservation and human practices?
Retro-observation: historical & paleo-ecology

- Multiproxy study of peat bog
- Soil charcoal analysis
- Archaeology and LiDAR
- Charcoal kiln analysis
- Retro-observation: historical & paleo-ecology

- Multiproxy study of peat bog
- Soil charcoal analysis
- Archaeology and LiDAR
- Charcoal kiln analysis
- Texts and maps study
Observation: ecology & social geography

Forest ecology, dendrochronology, biogeochemistry, soil DNA analysis, social inquiries
Observation: high resolution satellite imagery and LiDAR

- Deforestation control
- Forest structure
- Structural components of biodiversity
Study area: 2 valleys Băiuț and Poiana Botizii
Peat bogs / 2 sites

<table>
<thead>
<tr>
<th>Name</th>
<th>XUTM35N</th>
<th>YUTM35N</th>
<th>Secrétaire</th>
<th>Mission</th>
<th>Commentaire</th>
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<tr>
<td>Petite tourbière</td>
<td>276144,121</td>
<td>5282961,57</td>
<td>Taul_Rosia</td>
<td>oct-17</td>
<td>sondage prélèvement core 1 TM (carotte 1)</td>
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<td>5282852,47</td>
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<td>oct-17</td>
<td>sondage core 2 TG (carotte 2)</td>
</tr>
</tbody>
</table>

PointsGPS_Tourbiere_TaulRosia_UTM35

Chemin de prospection
Vieilles forêts WWF

Fond de carte: photographie aérienne de 2012

S. Ladet 2018
Managed forest (MF)  OGF

- Tea protocol + XRF
- Charcoal kiln
- Soil pit sampling point
- 1 ha plot

OGF

- Species, dbh
- Dead wood, TreMs
- IBP, vertical structure
- DNA sampling
- Fungi
- Saproxylic beetles

Managed forest (MF)

Dendrochronology

Conception M. Saulnier 2017
Forests are considered in a broader land use system

About 40 interviews with local population and main stakeholders

© S. Guillerme
2 XRF Transects for measuring heavy metal pollution

3 measures per point
- alluvium
- soil horizon A within forest
All forest sites and types are/were managed and used until the 19-20th c.

Charcoal manufacturing in the modern times until the 19-20th c.
All forest sites and types are/were managed and used

Up to 16 charcoal kilns/ha

Charcoal manufacturing in the modern times until the 19-20th c.
All forest sites and types are/were managed and used.

Wastes of logging operations with different saproxilation stages.
All forest sites and types are/were managed and used

« Fitting notches »

- To test the quality of wood
- Selective timber extraction
A plurisecular exploitation?
XRF Băiuţ: environmental contamination by heavy metals
Not very old stands

Abies alba  
MF: 74 to 183  
OGF: 85 to 235

Fagus sylvatica  
MF: 104 to 224  
OGF: 73 to 227

M. Saulnier 2018
But many attributes of maturity

- **Dryades** – *Abies alba*, *Fagus sylvatica* (*Picea abies*)

- **Secondary species** – *Acer pseudoplatanus*, *Fraxinus excelsior*, *Betula pendula* etc.

- **Dead wood**

- **Very large trees** (*dbh* > 100 cm)

- **TreMs**
Very ancient wooded areas?

First pedoanthracological results:
- Continuity of forest ecosystem (from several millennia?)
- Continuity of fir-beech forest
- Anthracomass very low in OGF and very high in MF
- No significant differences between AM and OGF
  - Similar vertical structure
  - IBP similar score
  - No more lying dead wood
  - No more TreMs diversity
Fungi diversity slightly higher in Băiuț OGF and Poiana MF

Order \( q = 0 \)

+ indicator species of "subnatural forest":

- **Fomes fomentarius**
- **Phellinus hartigii**
- **Polyporus squamosus**
- **Sparassis nemecii**
- **Hericium flagellum**
- **Climacodon septentrionalis**
- **Fomitopsis pinicola**

© L. Larrieu
Saproxylic beetles diversity higher in Băiuț MF

- Rhysodes sulcatus
- Ceruchus chrysomelinus
- Peltis grossa
- Eurythyrea austriaca

4 high-value species inpn.mnhn.fr
What is Strambu Băiuț?

- It is not a primary forest
- It is not a “subnatural” forest
- It is a “secondary” managed forest but with OGF indicators
- It is a very ancient forest
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=> Towards a new definition of the “subnatural forest” concept
Is there an antagonism between biological diversity, its conservation and local human practices?

What are tolerable trajectories for biodiversity conservation?
BENDYS PROJECT
Thank you!