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

Vanessa Py, Marie-Claude Bal, Antoine Brin, Cécile Brun, Stina Burri, Sandrine Buscaino, Carine Calastrenc, Mihaela Danu, Sylvie Guillerme, Sylvie Ladet, et al.

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5T.ERA meeting - Genoa 23-24 May 2019



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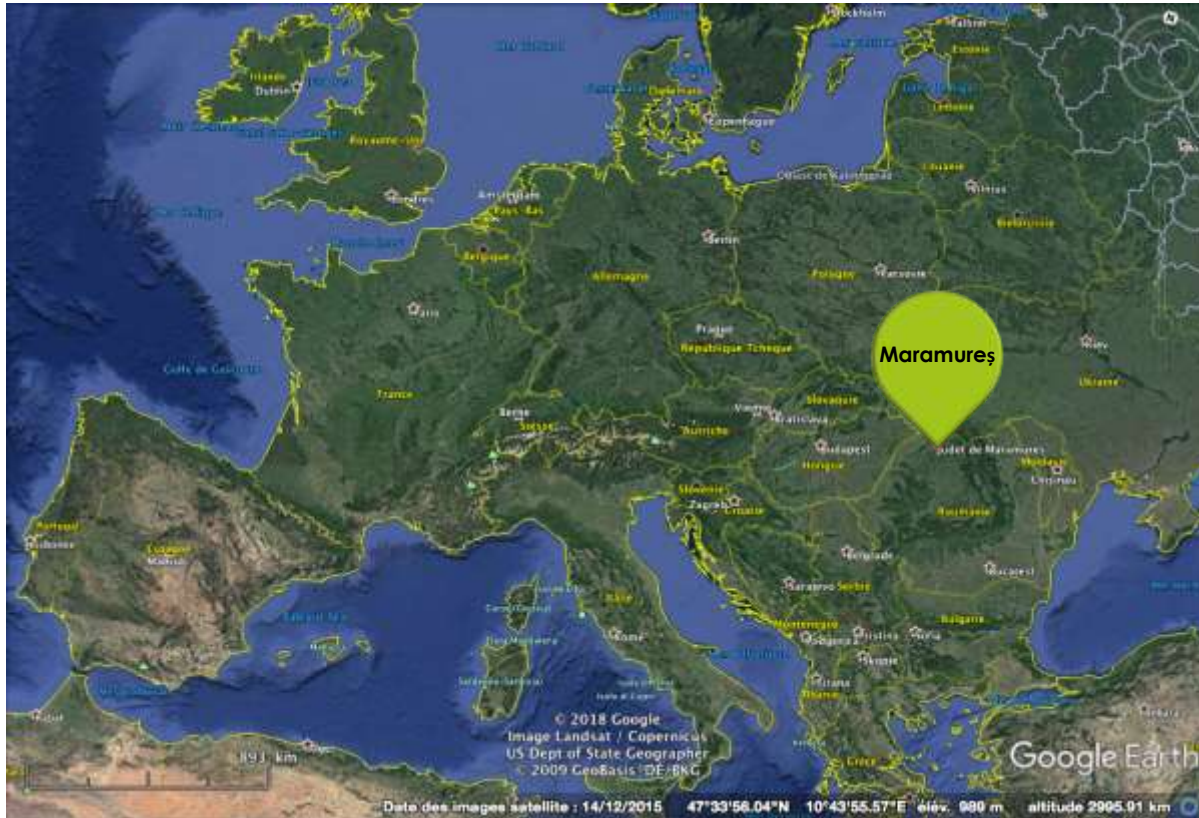
OASIC PROJECT: FORETEXIL



## ■ A French experience in Romania (Eastern Carpathians)

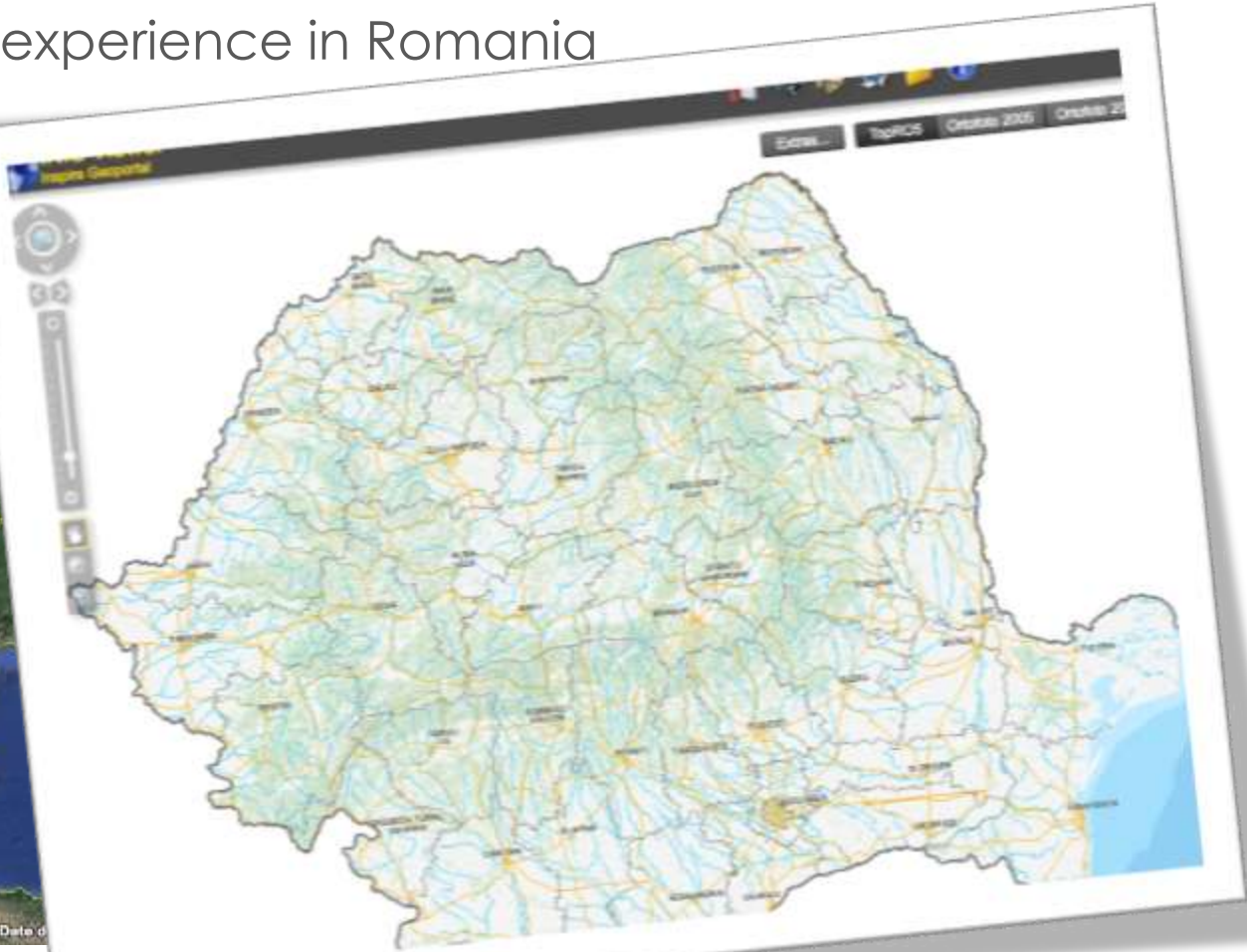


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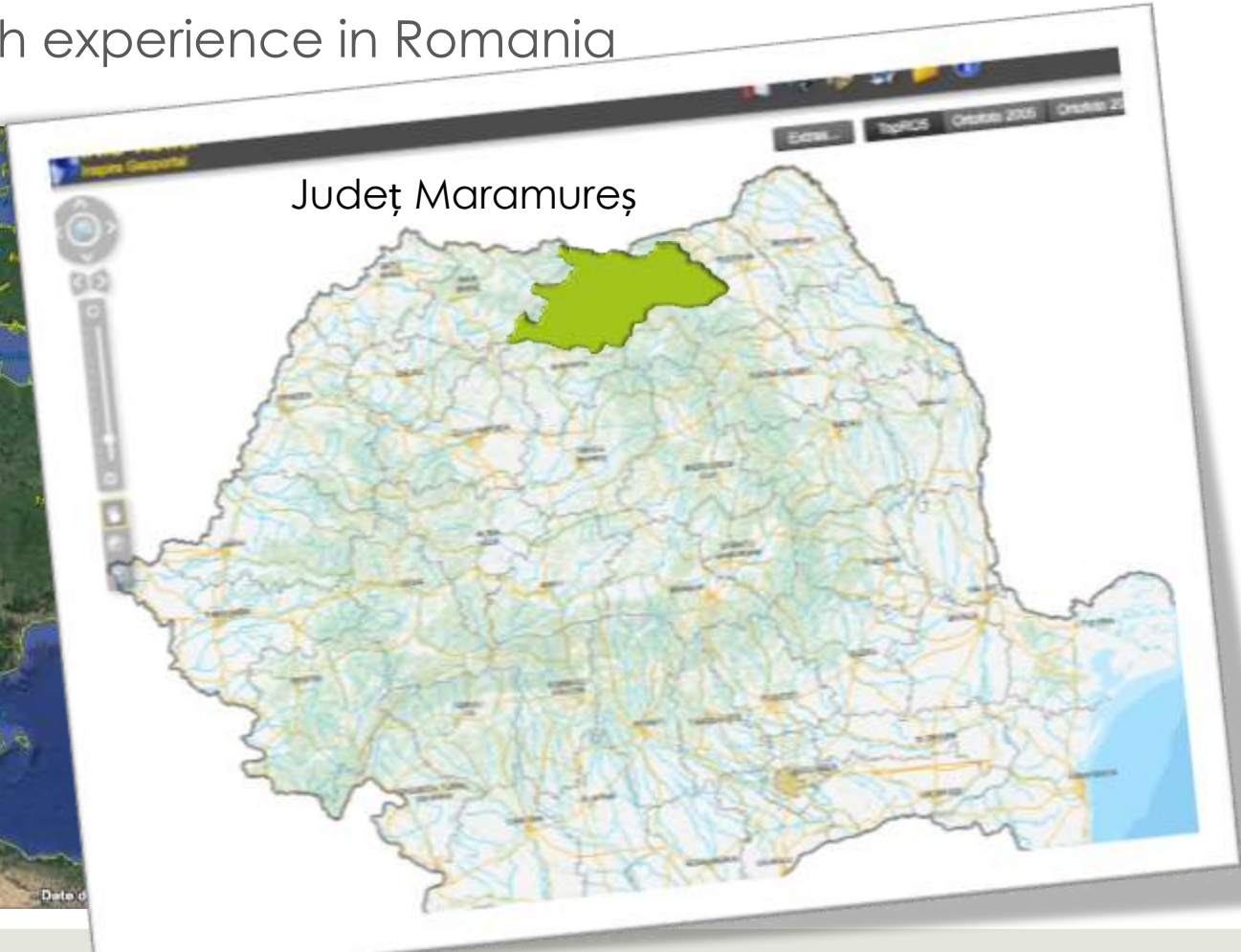




■ A French experience in Romania



■ A French experience in Romania





□ A specific rural landscape: **the « subnatural forest »**



Băiuț forest © V. Py





## 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"?

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❑ **Never or very little exploited**

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-> 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)

## TreMs examples



Nest of vertebrate © L. Larrieu



Black woodpecker feeding cavities © L. Larrieu



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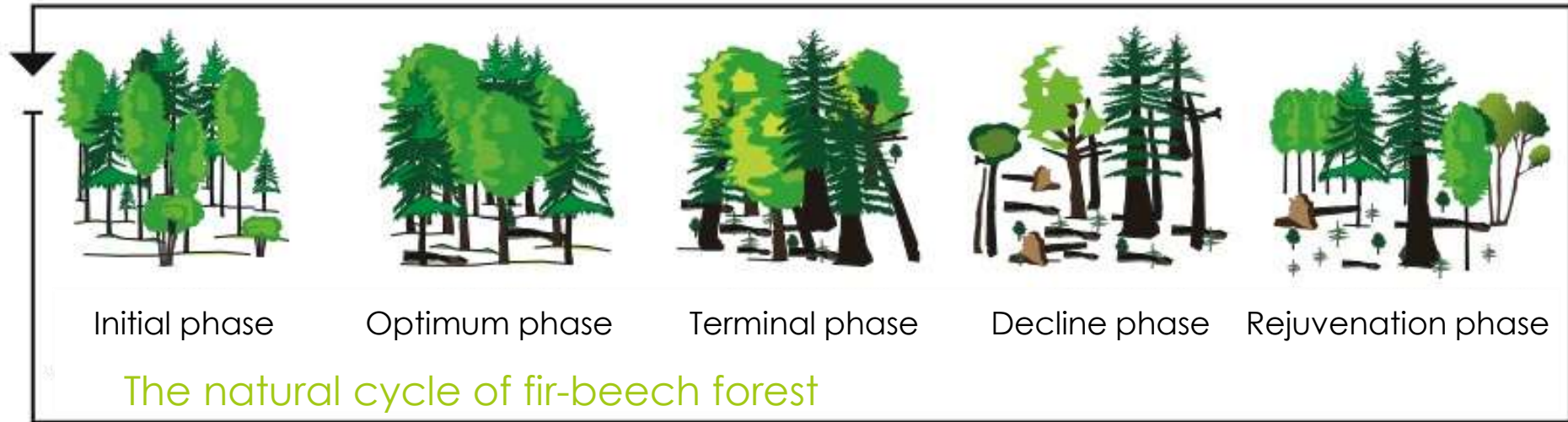
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- ❑ A long period without anthropogenic disturbance
- ❑ A high maturity
- ❑ A high biodiversity
- ❑ Stands dominated by *dryades*
- ❑ **Heterogeneity of the vertical structure**



## Old-growth forest (OGF)

⇒ A concept defined by ecologists

⇒ A definition excluding human uses/practices



OGF: a key role facing global change

□ **Carbon storage**

OGF: a key role facing global change

□ Carbon storage

□ **CO<sub>2</sub> fixing**

## OGF: a key role facing global change

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- ❑ **Reservoir of biodiversity**

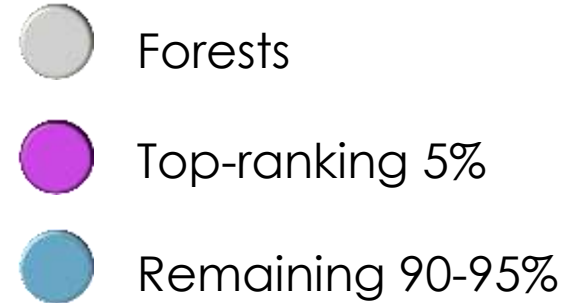
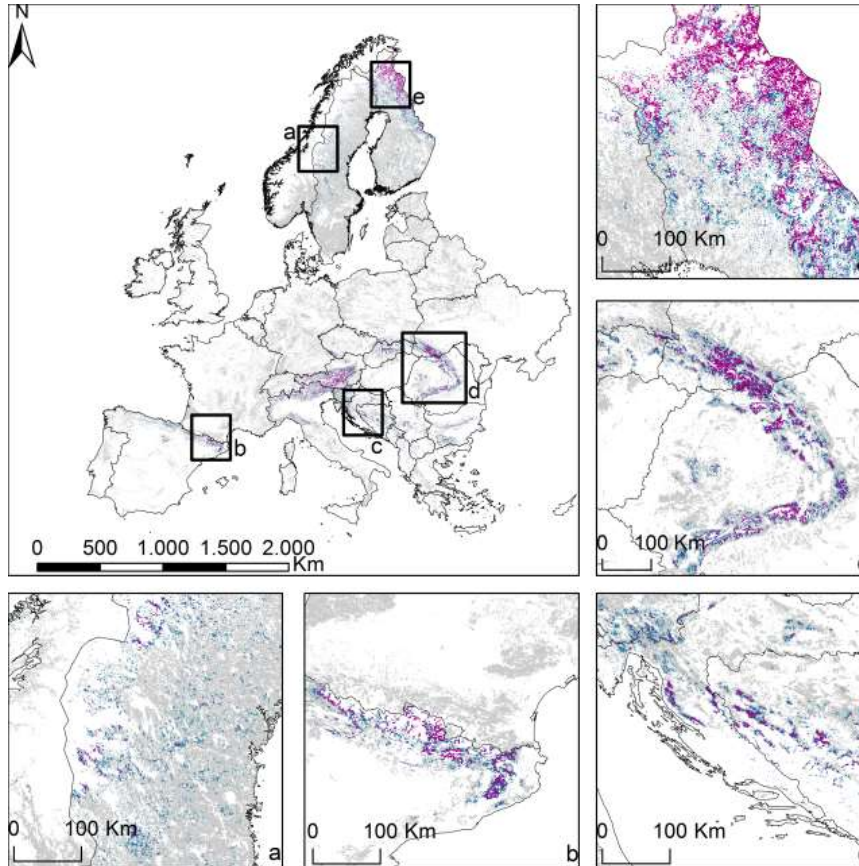


## OGF: a key role facing global change

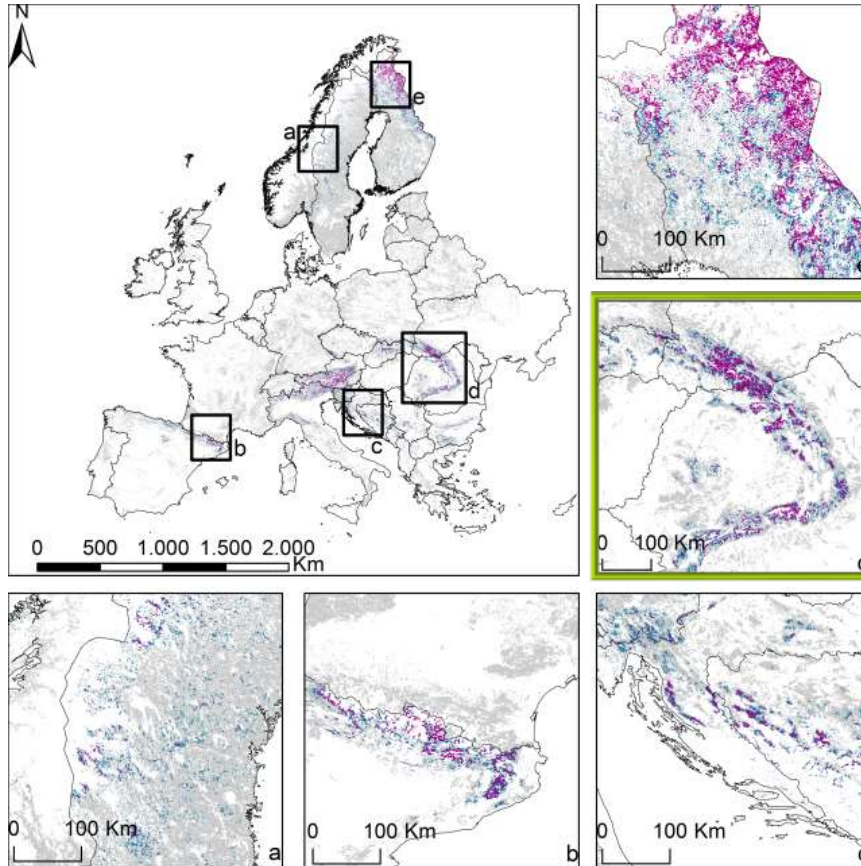
- ❑ Carbon storage
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**!! But underestimated ecosystem goods and services !!**

# OGF: less than 1% of European forest



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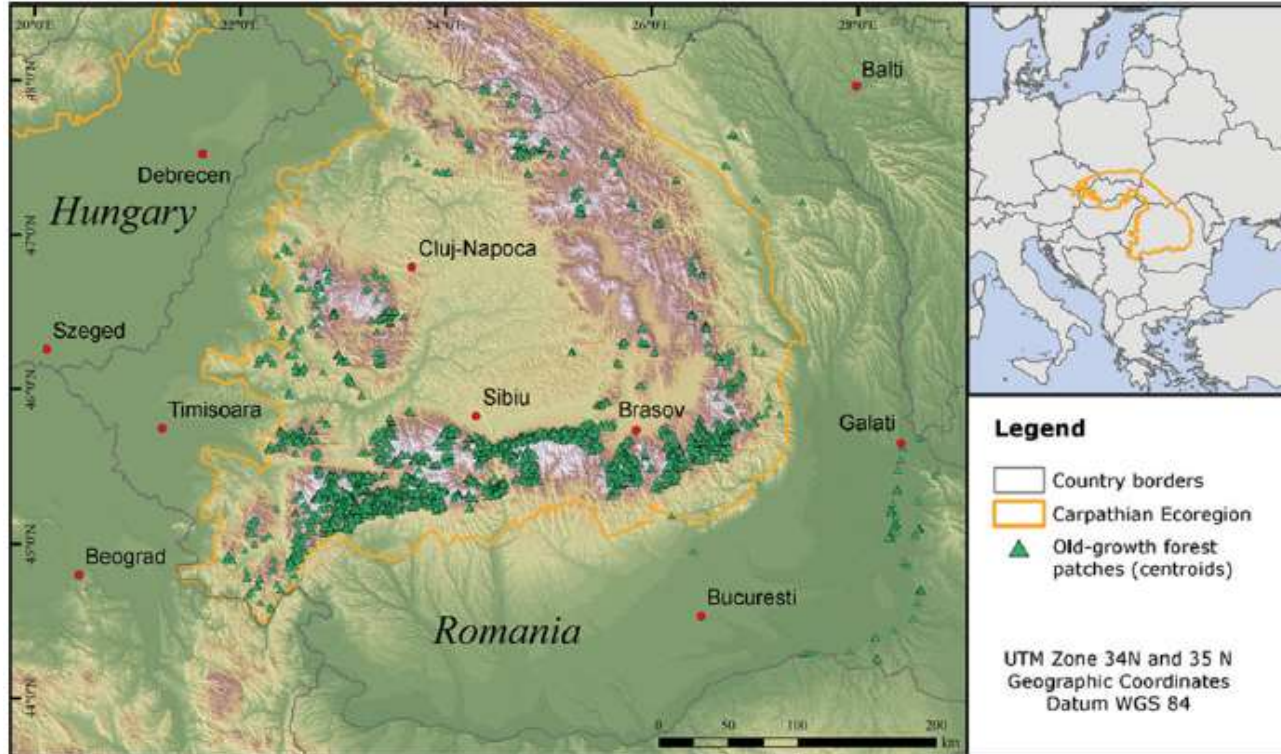


- Forests
- Top-ranking 5%
- Remaining 90-95%

Romanian Carpathians

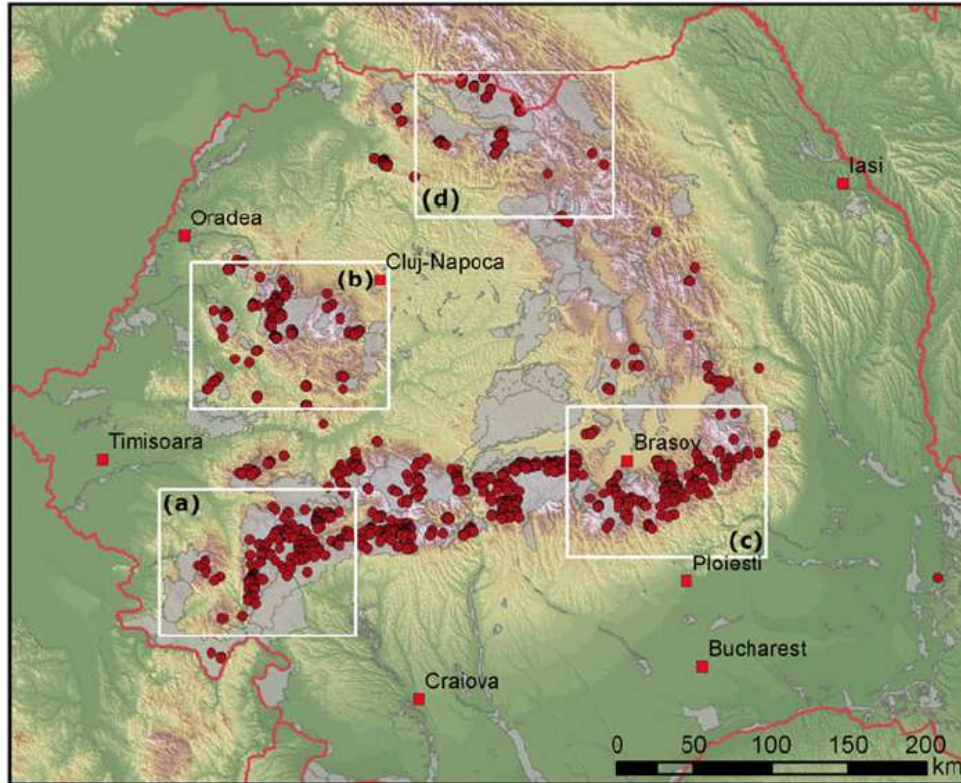
# OGF: a relict and vulnerable landscape

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





# Industrial forestry exploitation and illegal logging

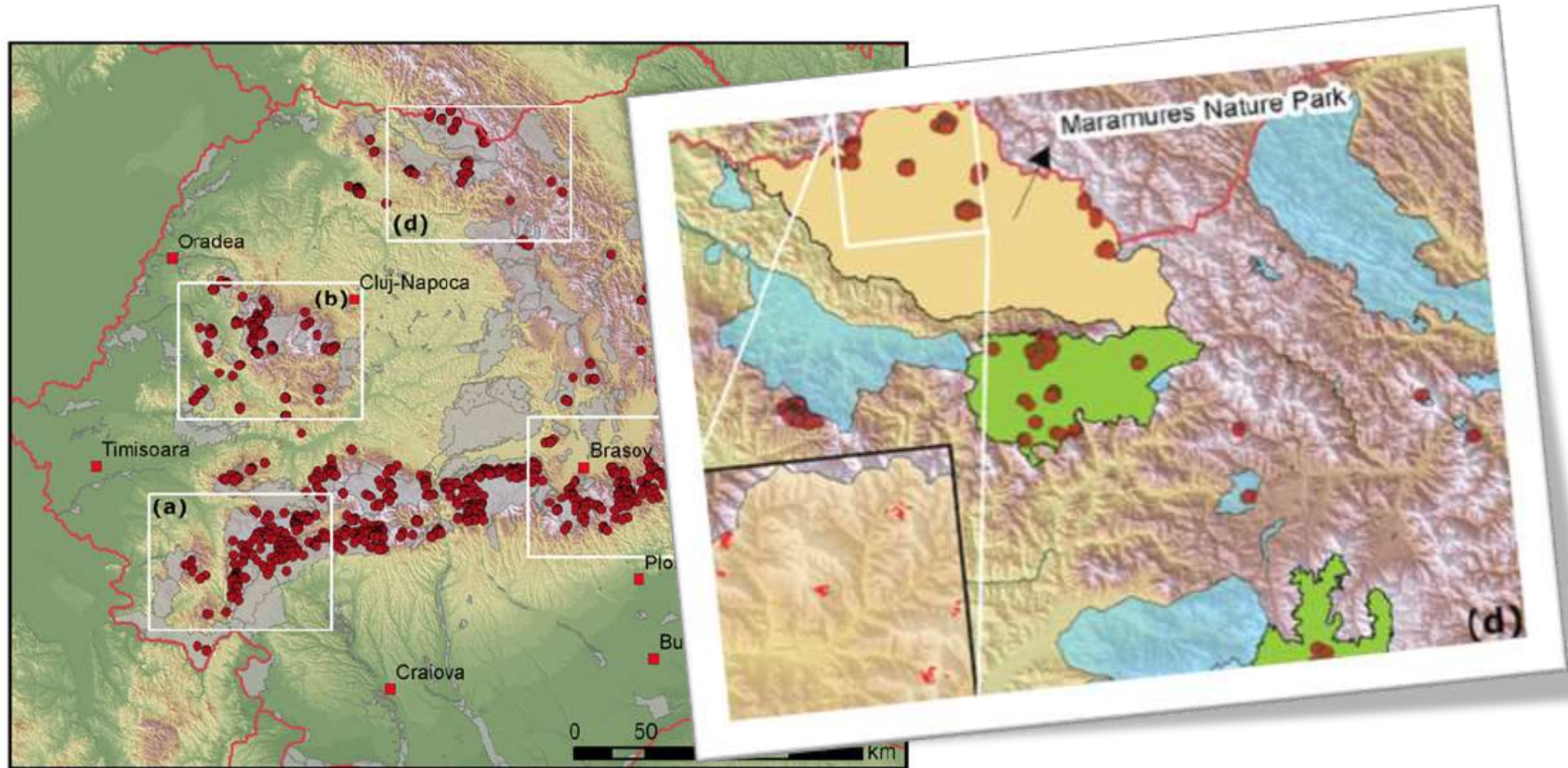


● Old growth forest disturbances

□ Protected area



# Industrial forestry exploitation and illegal logging



# Industrial forestry exploitation and illegal logging



<https://www.dailymotion.com/video/x59qar9>



■ Maramureș County: an “archaic ethnographic zone”

Rey et al. 2002



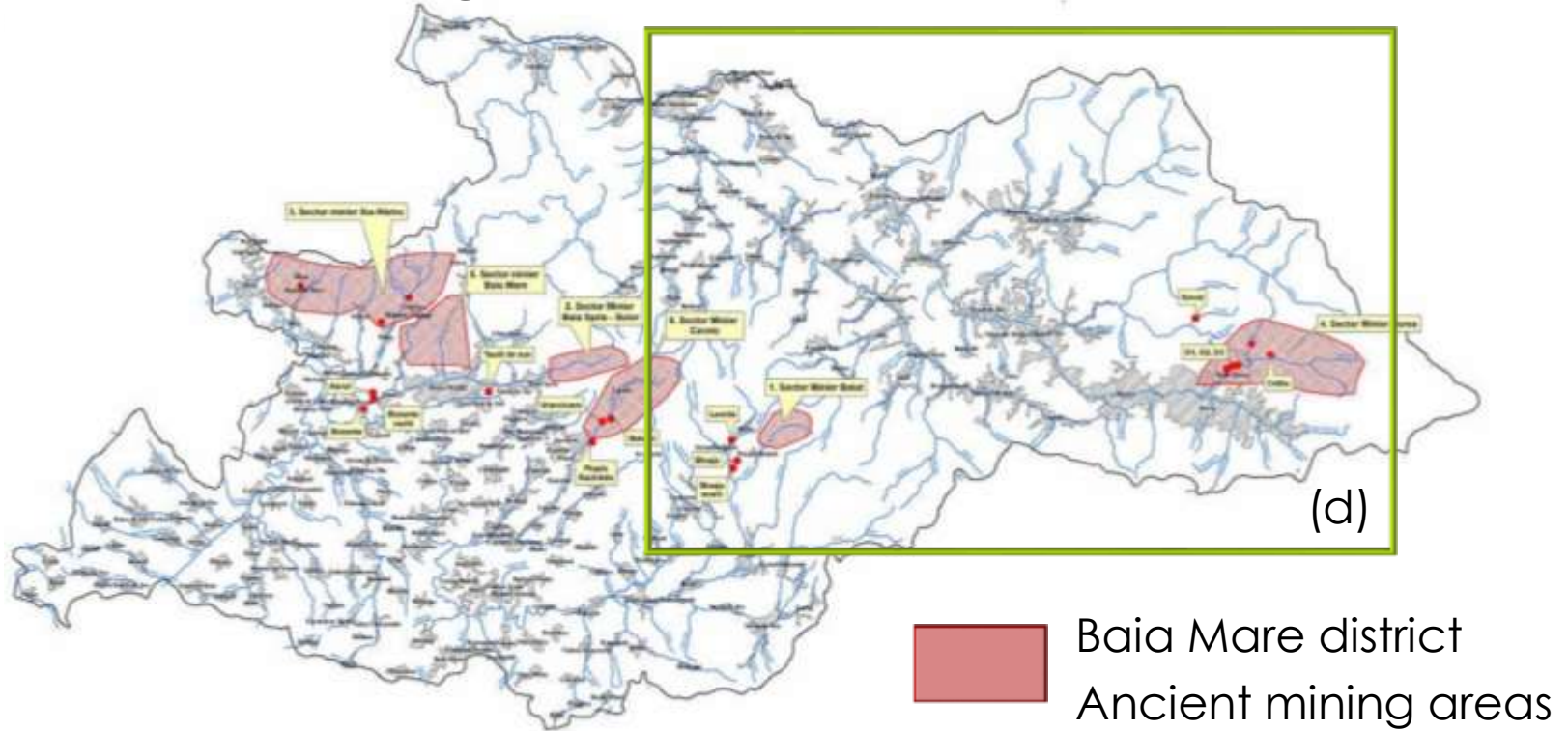
Agroforestry landscape © S. Guillerme



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

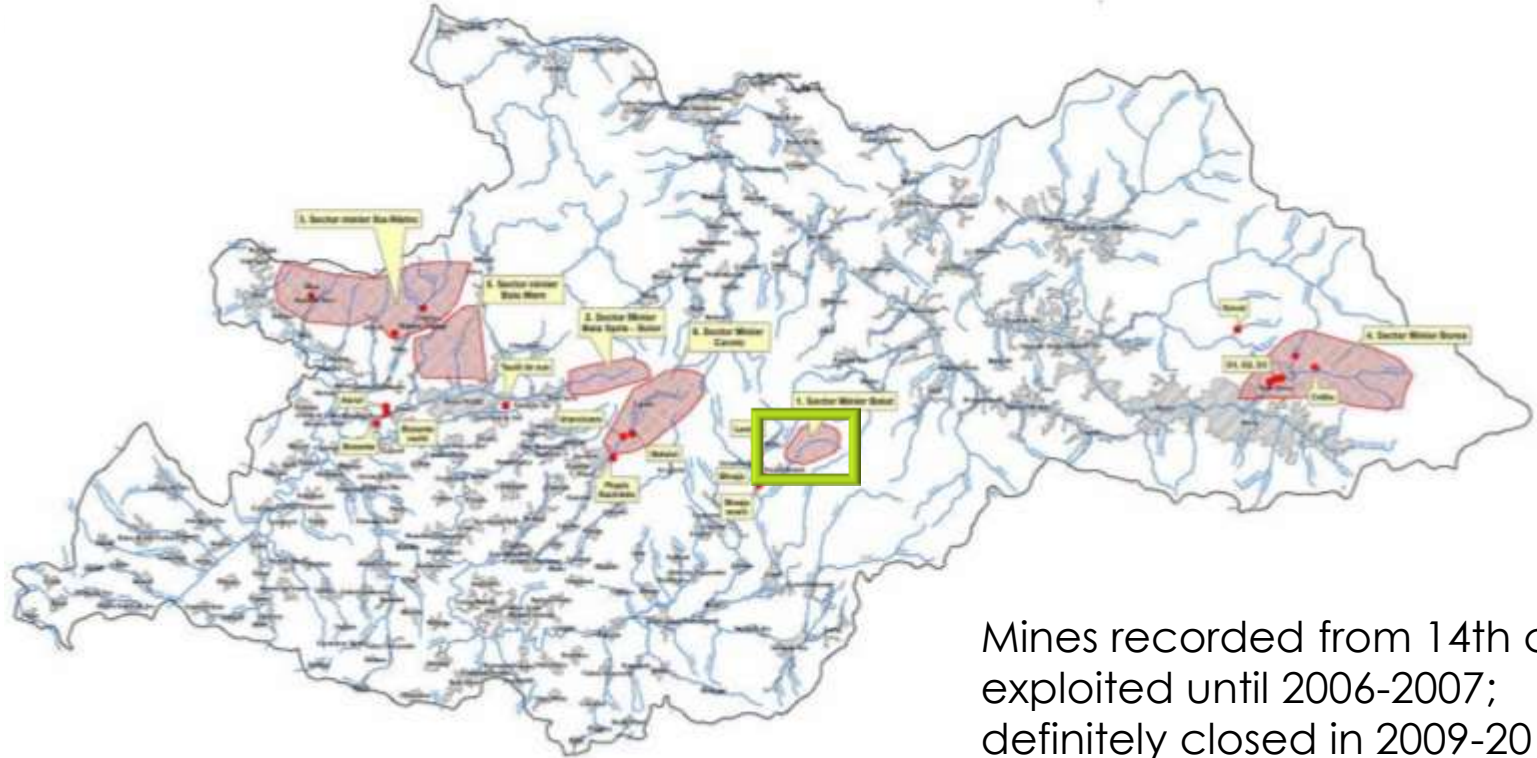
- Maramureș County has the last primeval beech forest!



**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?



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- ✓ 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?

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- ✓ 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

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- ✓ Multiproxy study of peat bog
- ✓ Soil charcoal analysis
- ✓ Archaeology and LiDAR
- ✓ Charcoal kiln analysis
- ✓ Texts and maps study

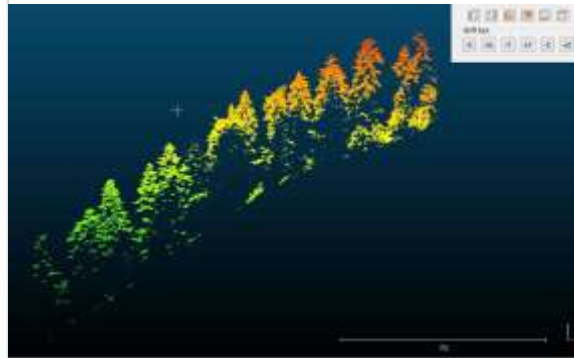
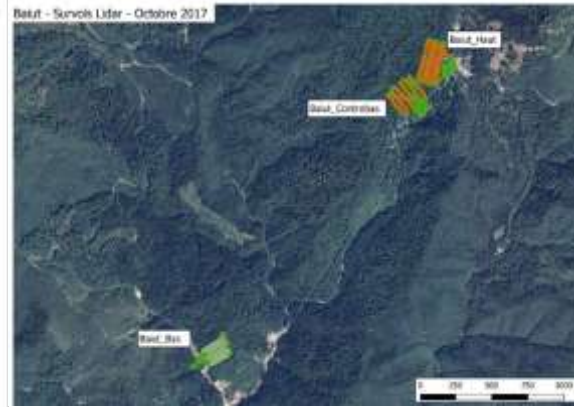
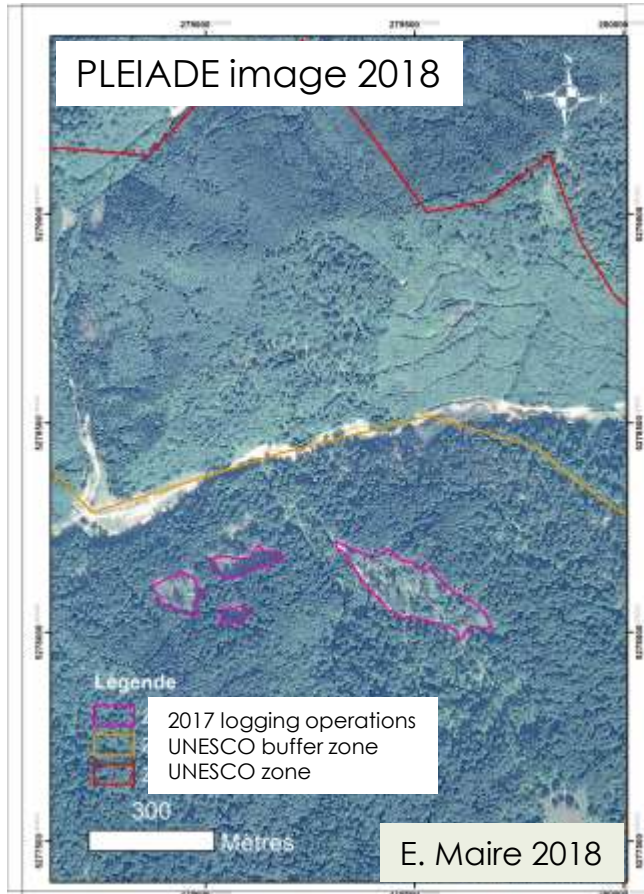


■ Observation: ecology & social geography



Forest ecology, dendrochronology, biogeochemistry, soil DNA analysis, social inquiries

## ■ Observation: high resolution satellite imagery and LiDAR

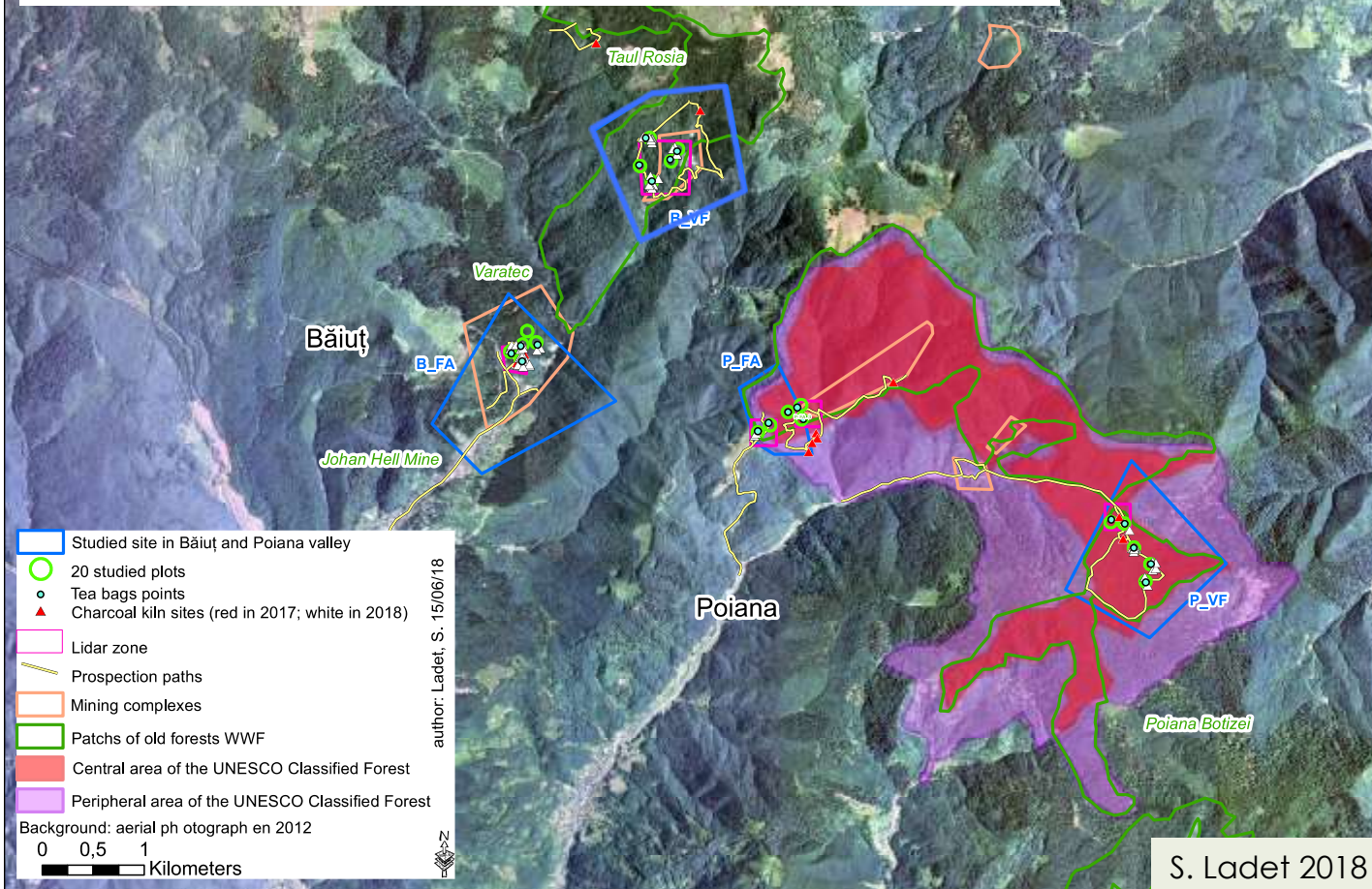


- ✓ Deforestation control
- ✓ Forest structure
- ✓ Structural components of biodiversity

C. Calastrenc & N. Poirier 2017



# Study area: 2 valleys Băiuț and Poiana Botizii





# Peat bogs / 2 sites

NomPoint	XUTM35N	YUTM35N	SrcFile	Mission	Commentaire
Petite tourbière	276144,121	5282961,57	Taul_Rosia	oct-17	sondage prélèvement core 1 TM (carotte 1)
Grande tourbière	276209,244	5282852,47	Taul_Rosia	oct-17	sondage core 2 TG (carotte 2)

PetiteTourbière

GrandeTourbière

+ PointsGPS\_Tourbiere\_TaulRosia\_UTM35

Chemin de prospection

Vieilles forêts WWF

Fond de carte: photographie aérienne de 2012

0 50 100

Mètres

S. Ladet 2018



Managed forest (MF)

OGF

1 ha plot

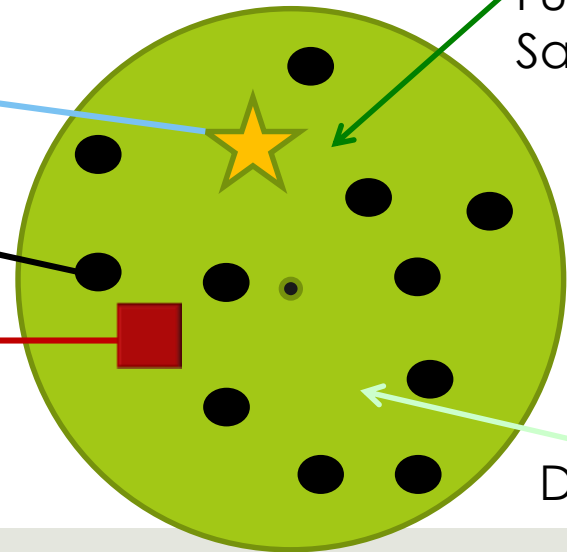
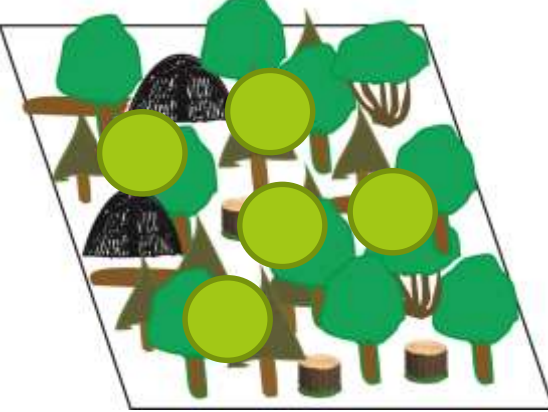
Species, dbh  
Dead wood, TreMs  
IBP, vertical structure  
DNA sampling  
Fungi  
Saproxylic beetles

Tea protocol  
+ XRF

Charcoal kiln

Soil pit sampling point

Dendrochronology





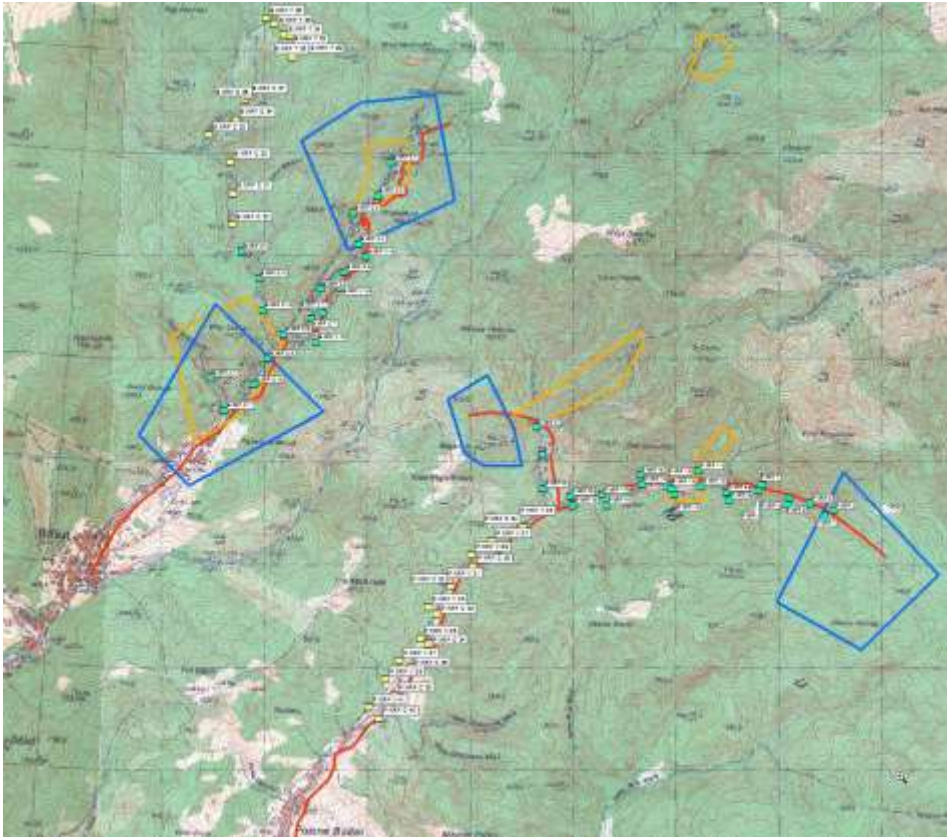
Forests are considered in a broader land use system

About 40 interviews with local population and main stakeholders



© S. Guillerme

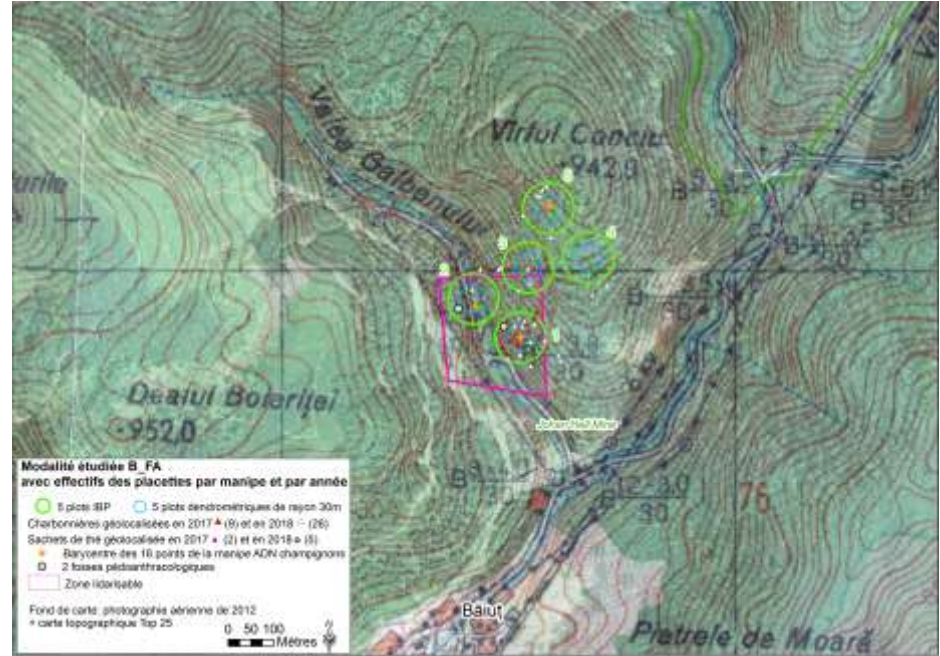
## 2 XRF Transects for measuring heavy metal pollution



- 3 measures per point
- > alluvium
- > soil horizon A within forest



■ All forest sites and types are/were managed and used



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



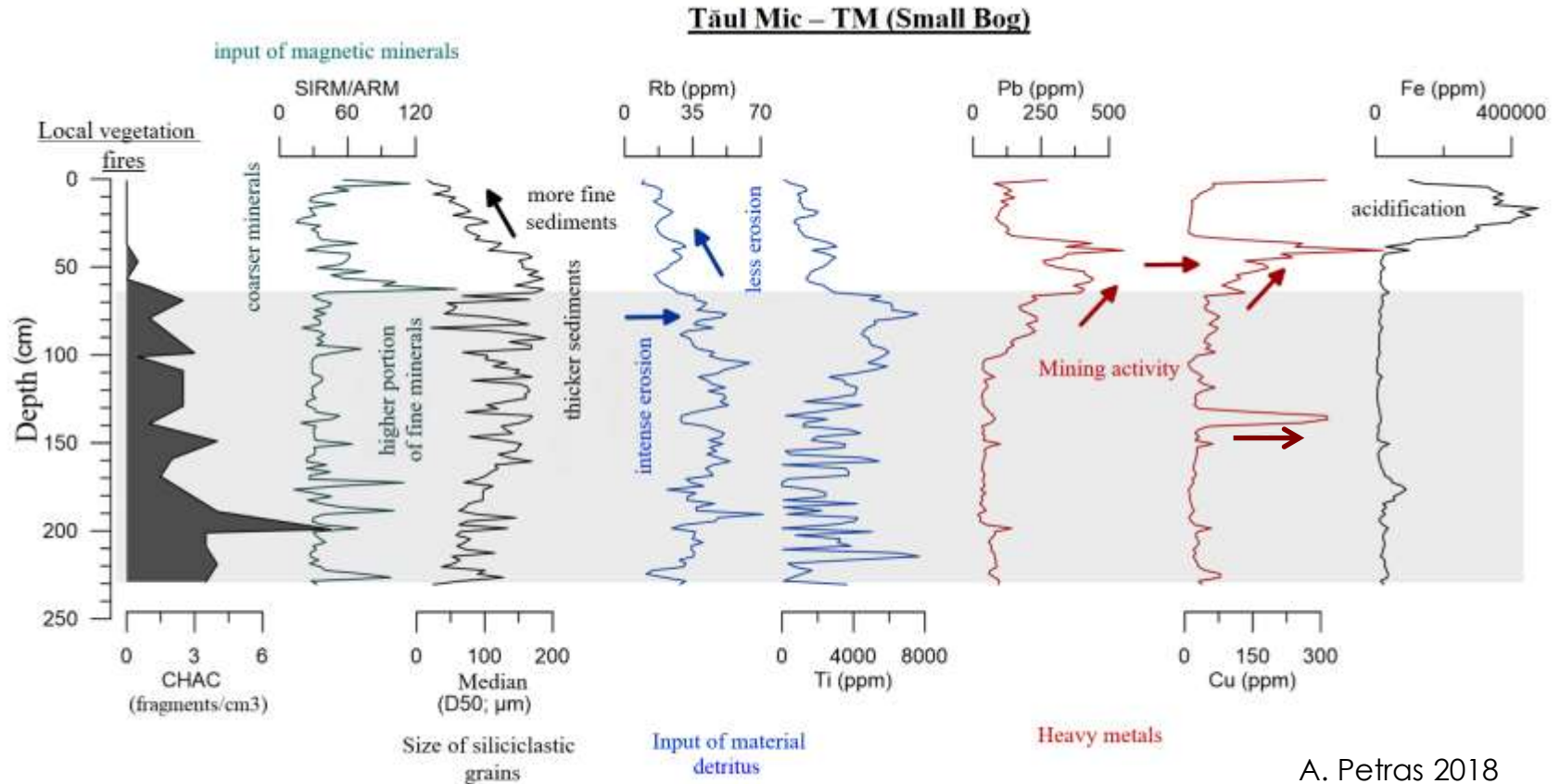
■ All forest sites and types are/were managed and used



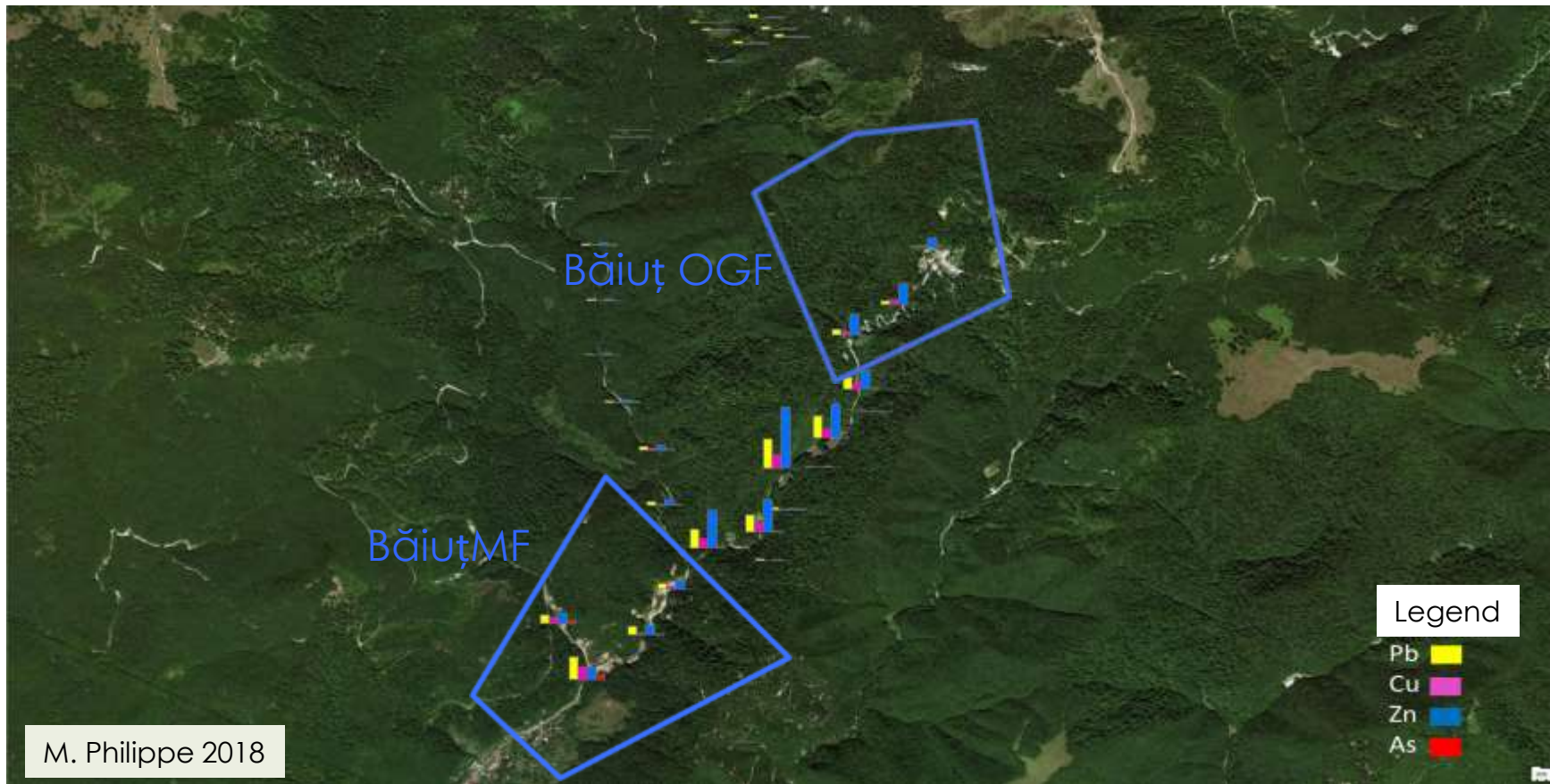
« Fitting notchs »

- ✓ To test the quality of wood
- ✓ Selective timber extraction

## □ A plurisecular exploitation?



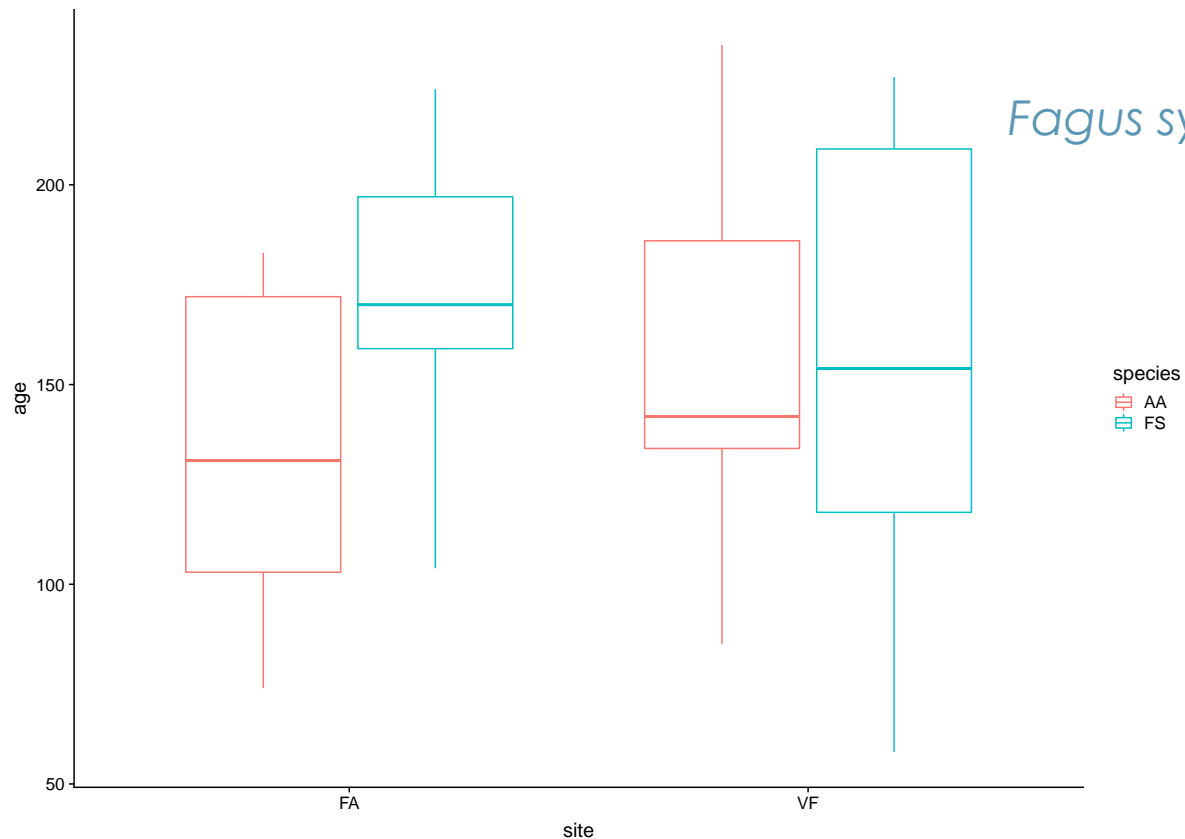
## XRF Băiuț: environmental contamination by heavy metals



## Not very old stands

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

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



## ■ 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



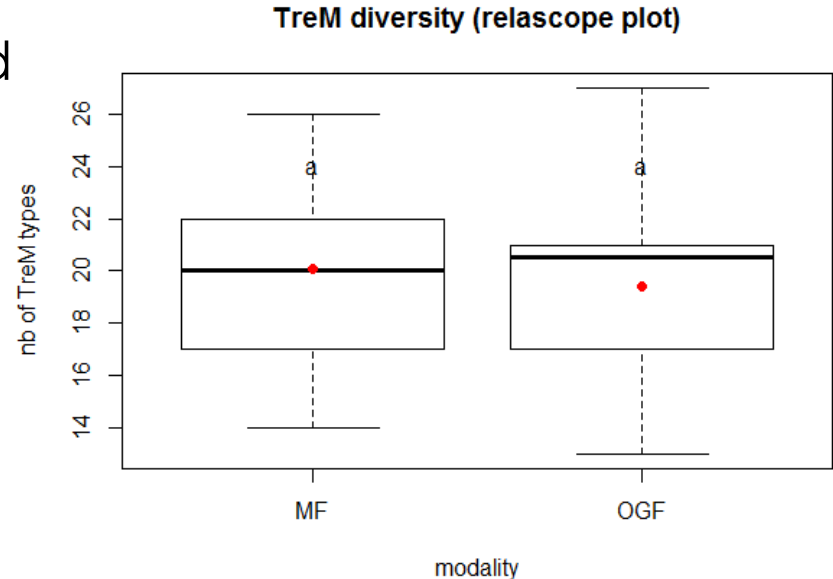
## ■ **Very ancient wooded areas?**

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

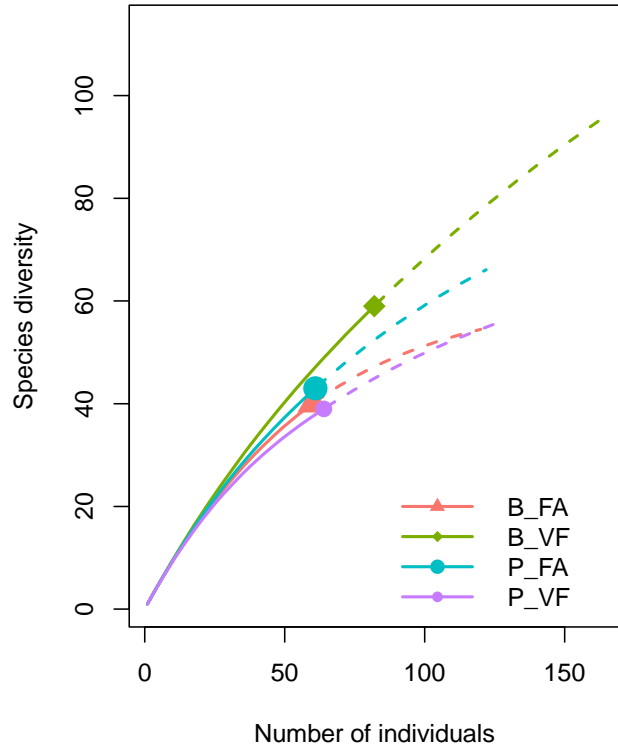
## □ No significant differences between AM and OGF

- ✓ 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*

■ Saproxylic beetles diversity higher in Băiuț MF



4 high-value species  
[inpn.mnhn.fr](http://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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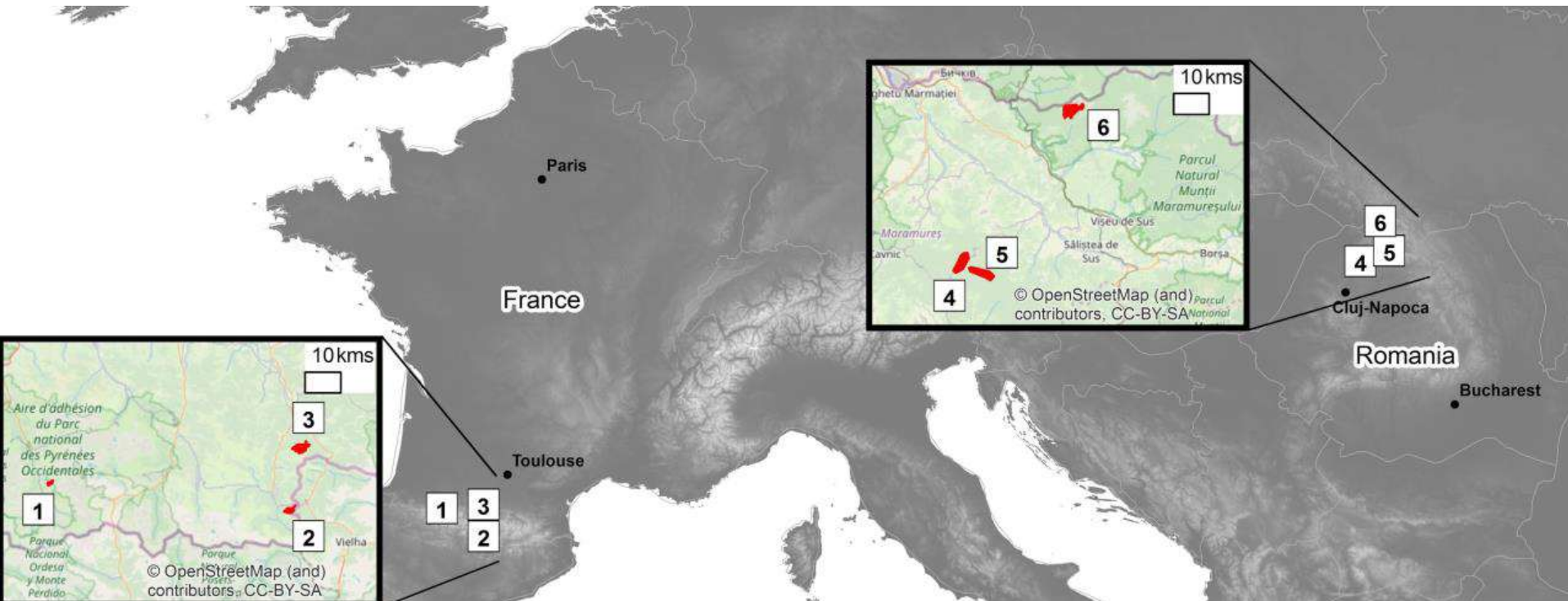
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=> Towards a new definition of the “subnatural forest” concept



- Is there an antagonism between biological diversity, its conservation and local human practices?
- What are tolerable trajectories for biodiversity conservation?

# BENDYS PROJECT



Thank you!

