Potential contribution of marteloscopes to a forest biodiversity monitoring system in Europe -strengths, limitations and challenges

Christophe Bouget, Laurent Larrieu

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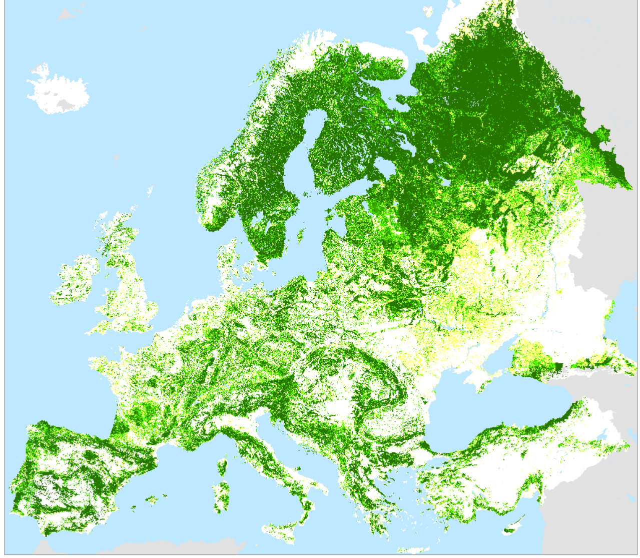

Potential contribution of marteloscopes to a forest biodiversity monitoring system in Europe

- strengths, limitations and challenges

Larrieu, L. & Bouget, C.

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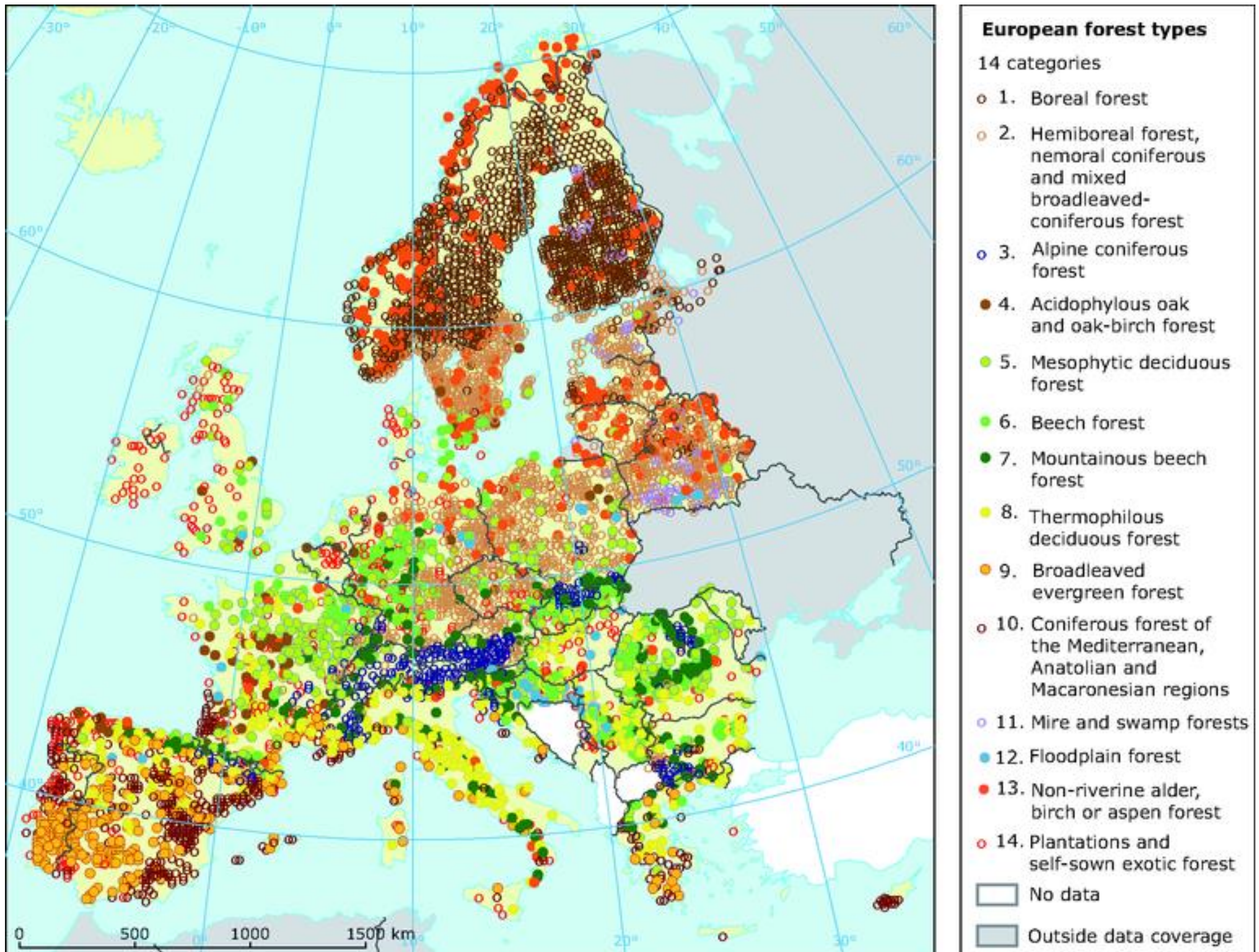
8th Integrate Network Annual Meeting (19-21 October 2022, Madrid)

Gaps in monitoring systems of forest biodiversity in Europe

Pan-European level I network

Circa 6000 small plots dedicated to other issues than biodiversity monitoring (tree defoliation…)



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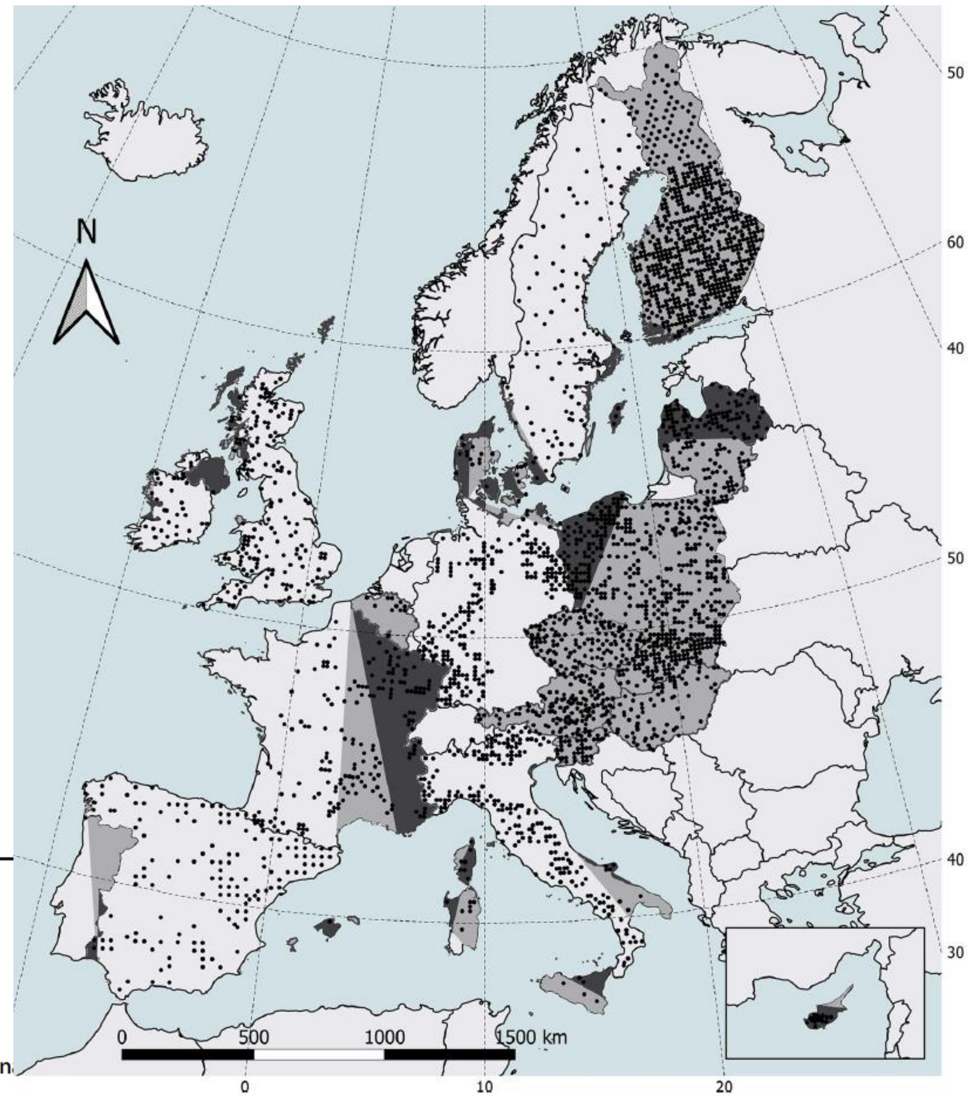
Gaps in monitoring systems of forest biodiversity in Europe

The Pan-European level I network has supported one-off initiatives, such as Forest Focus Biosoil 2005-2008



Deadwood and vascular plants recorded in ca 3,000 plots in 19 countries

Annals of Forest Science (2019) 76: 68
https://doi.org/10.1007/s13595-019-0832-0

DATA PAPER

A dataset of forest volume deadwood estimates for Europe

Nicola Puletti[1] • Roberto Canullo[2,3] • Walter Mattioli[1] • Radosław Gawryś[4] • Piermaria Coron

Gaps in monitoring systems of forest biodiversity in Europe

Pan-European level II network

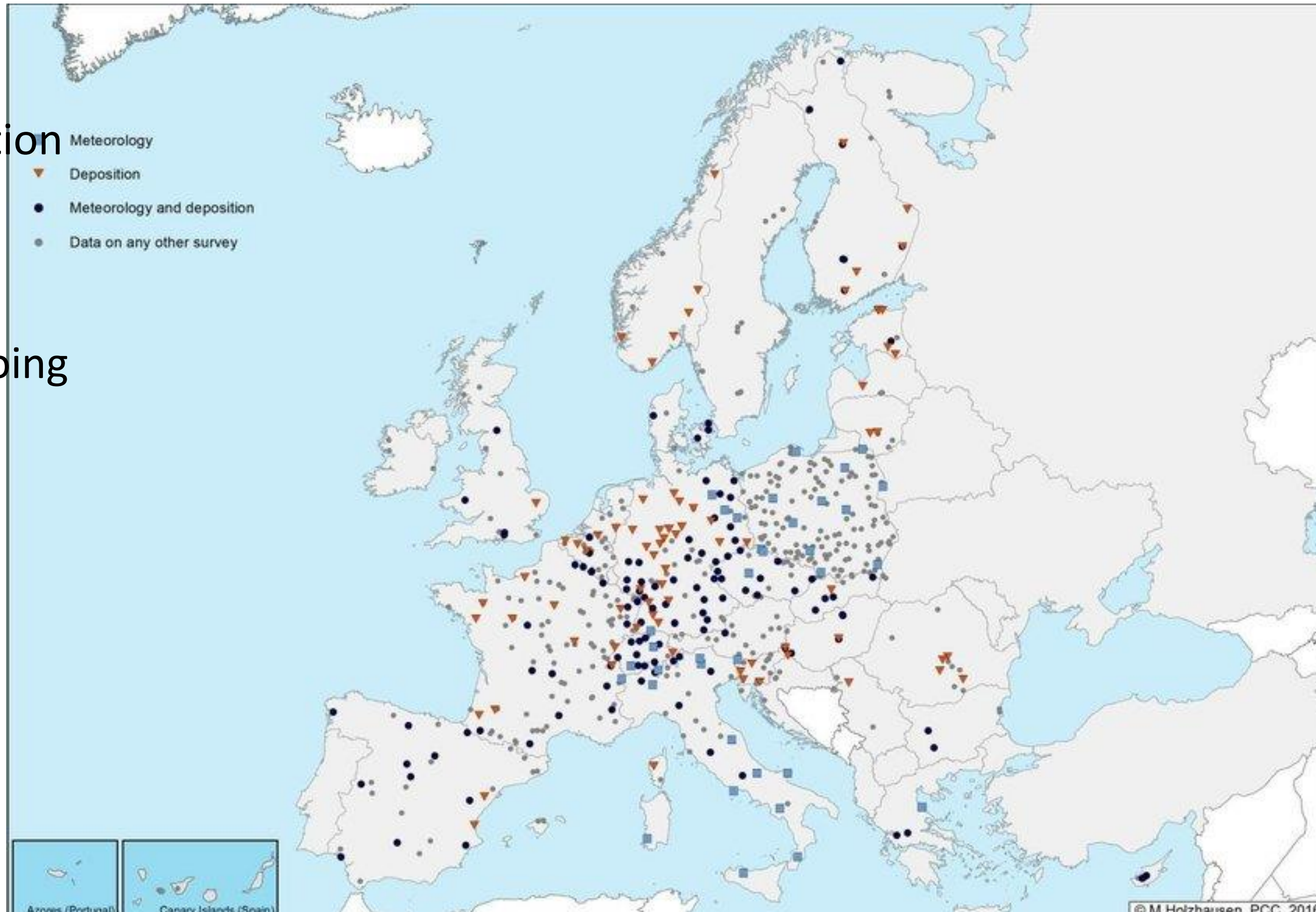
Circa 600 plots dedicated to other issues than biodiversity monitoring (forest condition)

BUT including :

- ground vegetation
- deadwood and

epiphytic lichens

in test phase ongoing



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Gaps in monitoring systems of forest biodiversity in Europe

Data from NFI are highly heterogeneous and mainly relate to indirect biodiversity indicators

Chirici et al. 2012:

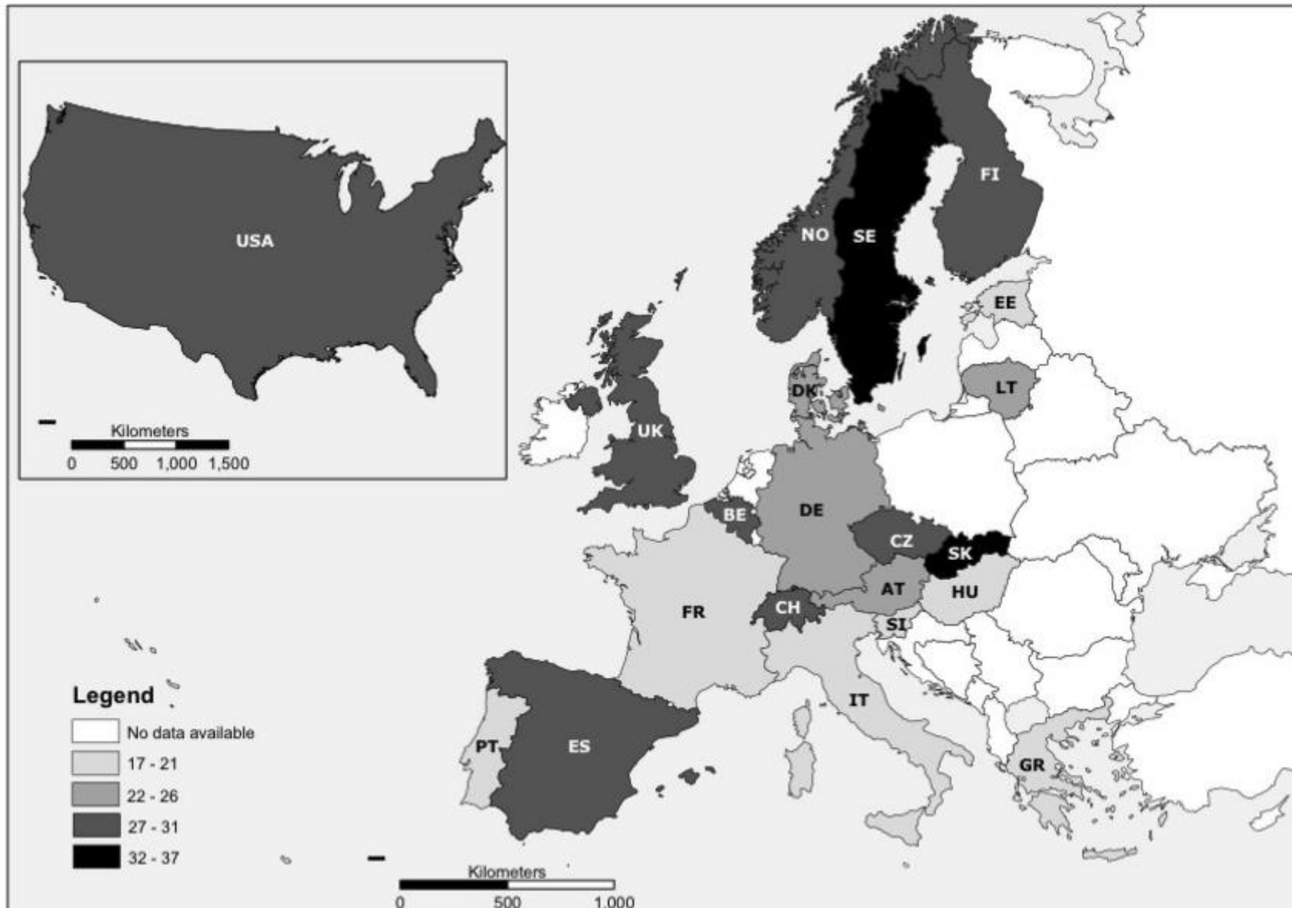

Figure 1. Number of forest biodiversity variables currently assessed by the NFIs of European countries and by the United States of the 41 proposed in the first questionnaire developed by WG3 of COST Action E43. See Chirici et al. (2011) for a detailed description of the variables investigated.

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Gaps in monitoring systems of forest biodiversity in Europe

Only a few national initiatives are focusing on the direct monitoring of taxa

Switzerland - all ecosystems

- Vascular Plant
- Bryophytes
- Molluscs
- **Rhopalocera**
- Breeding birds

Hesse (All.) – Forests

- Flora
- **Coleoptera**
- **Macrolepidoptera**
- **Annelida**
- **Aculeata**
- **Araneae**
- **Heteroptera**
- Breeding birds

Sweden - all ecosystems

- Vascular Plants (incl. trees)
- Bryophytes
- **Lichens**
- Soil fungi
- **Small mammals**

Contents lists available at ScienceDirect

Ecological Indicators

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

ELSEVIER

Review

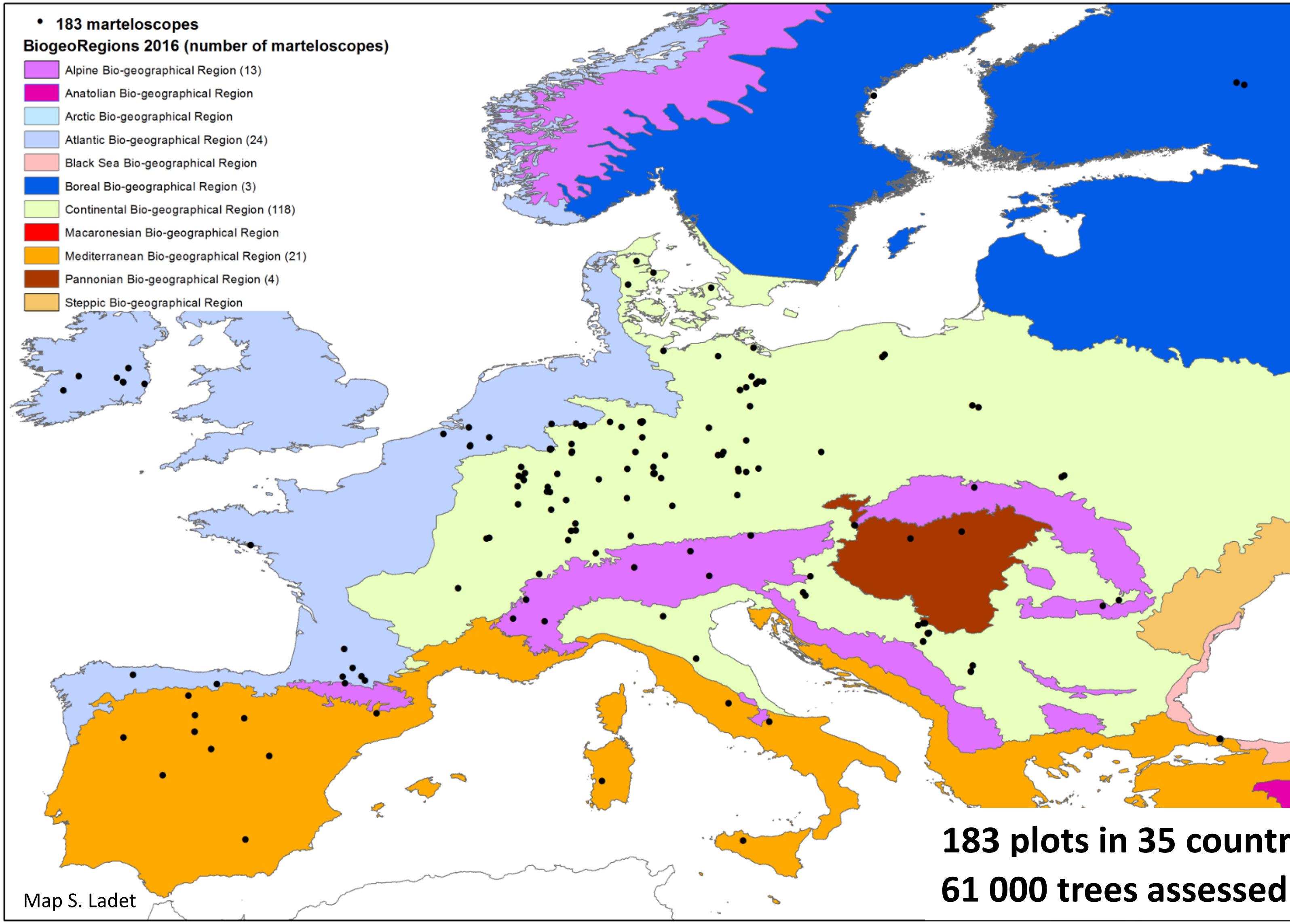
Handbook of field sampling for multi-taxon biodiversity studies in European forests

Sabina Burrascano[a,*,1,42], Giovanni Trentanovi[b,2,42], Yoan Paillet[c,3],

Burrascano et al. 2022

- Vascular plants (incl. trees)
- Bryophytes
- Lichens
- Fungi
- Birds
- Bats
- Coleoptera
- Araneae & Opiliones

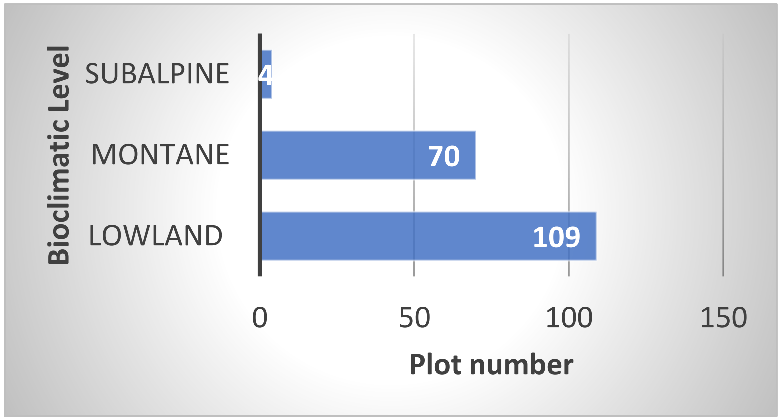
The European Marteloscope network
(October 2022)

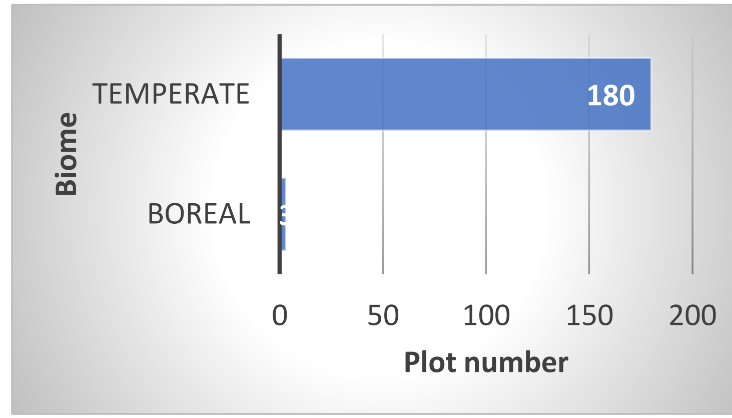


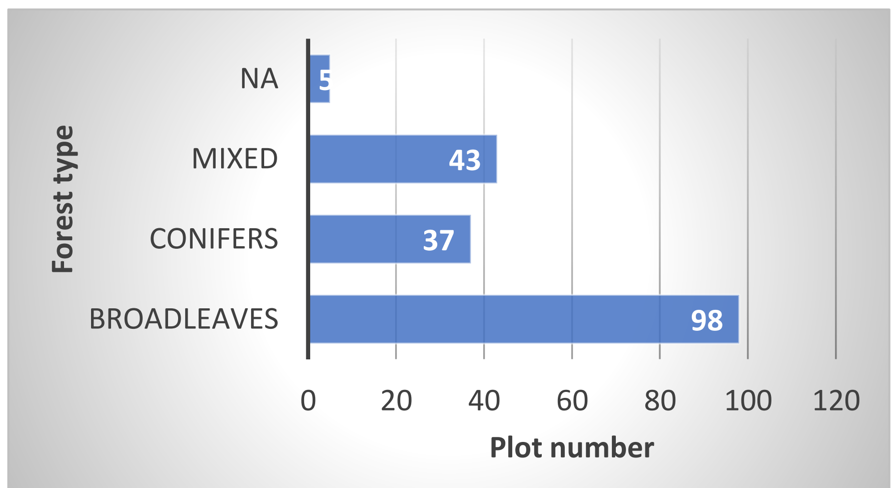
183 plots in 35 countries
61 000 trees assessed

The European Marteloscope network

A very wide array of forest contexts, however unbalanced







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The European Marteloscope network

Environmental data collected in plots

Plot scale

- Natural forest community
- Climate
- Elevation

Optional

- **Lying deadwood**

Tree scale

Mandatory

- Tree species
- Tree location
- Tree status (living vs standing dead)
- Diameter at breast height
- Timber quality
- **Tree-related Microhabitats**

Optional

- Crown base height
- Total height

No direct sampling of biotic communities (except tree species diversity)

Stand structure metrics may be considered indirect biodiversity indicators

Deadwood as a key feature for forest biodiversity

Facts and figures

25% of forest species depend on DW

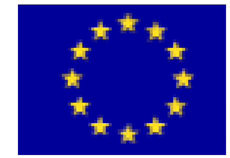
Deadwood volume as an indirect biodiversity indicator

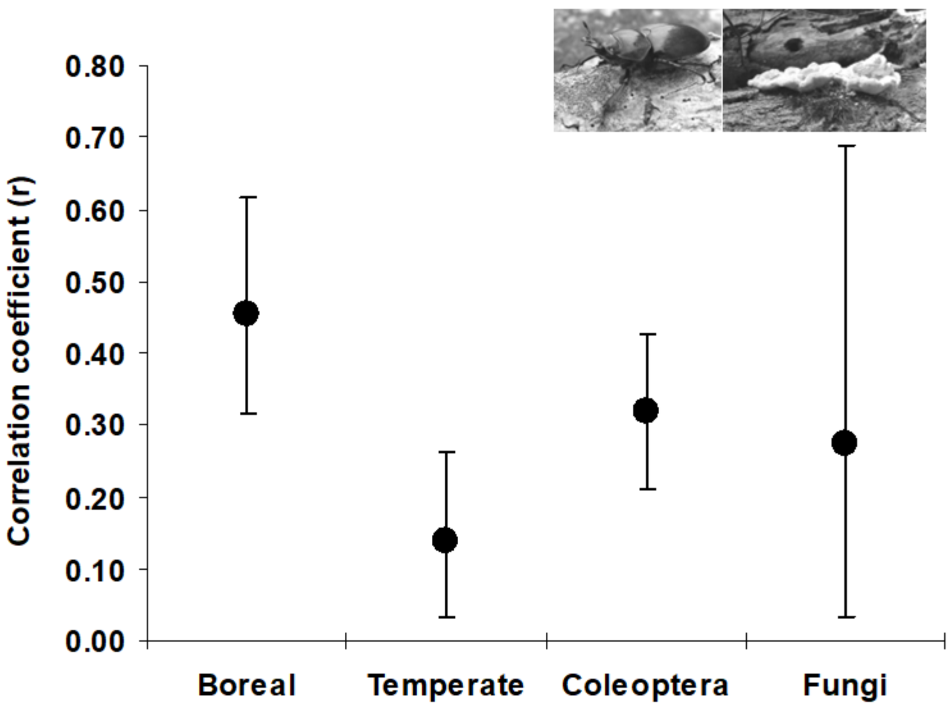
Relevance/Limitations

Biome-dependent & thresholded relationships

MCPFE indicators of sustainable management,

BEAR biodiversity indicators





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Review

Deadwood as a surrogate for forest biodiversity: Meta-analysis of correlations between deadwood volume and species richness of saproxylic organisms

Aurore Lassauce[a,b,*], Yoan Paillet[a], Hervé Jactel[c], Christophe Bouget[a]

Müller & Bütler, 2010

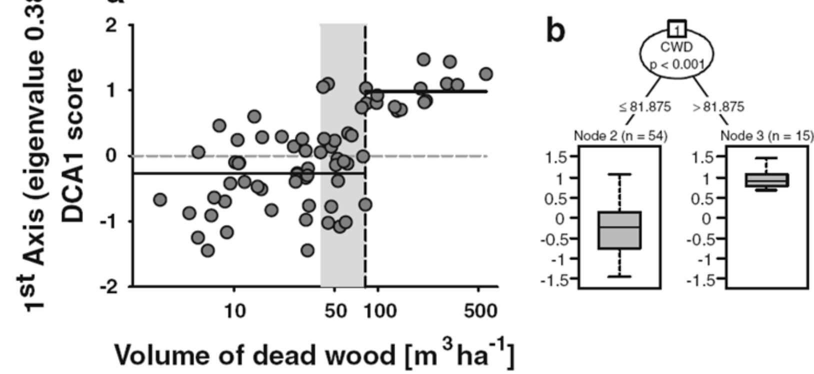
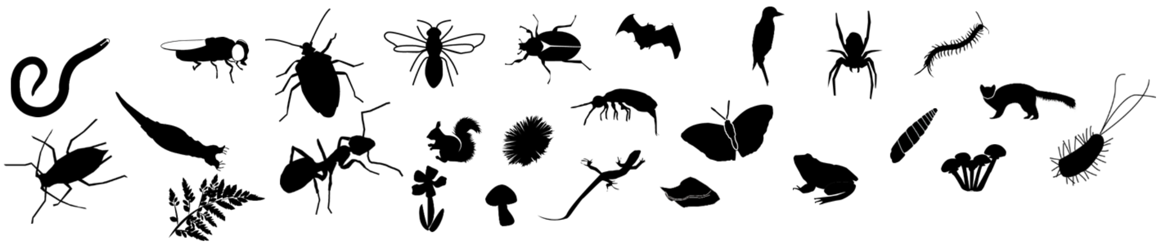


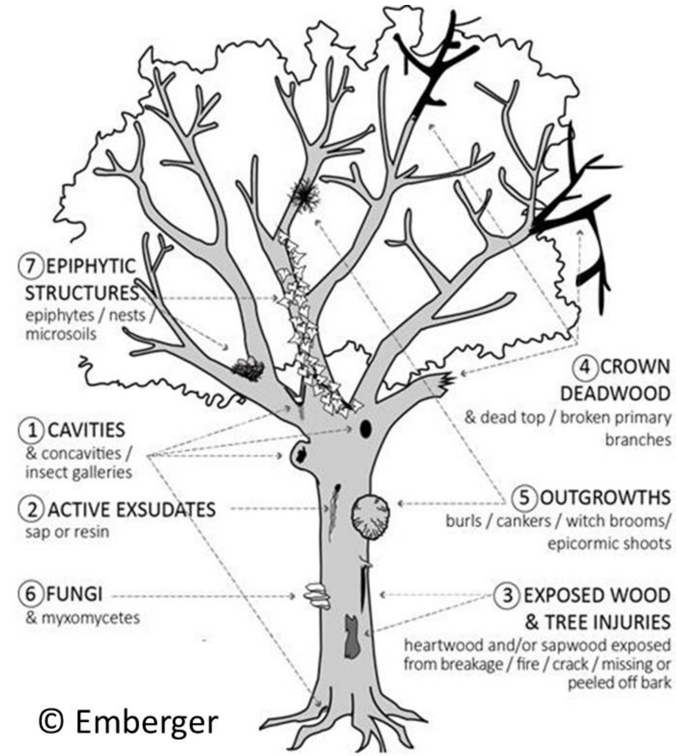
Fig. 4 **a** Threshold (*dashed line*) for wood-inhabiting fungi derived by maximally selected rank statistics (**b**) of a shift in communities of

Tree-related microhabitats (TreMs) as key features for forest taxa

Facts and figures

TReMs host a wide range of taxonomic forest groups





Fomes fomentarius

> 600 sp arthropods in Europe (Friess et al. 2019)

Base rot-holes borne by oaks

380 sp beetles (Gouix & Brustel BC 2012)

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TreMs as indirect biodiversity indicators at the stand scale

Facts and figures

Positive relationships between TreMs and species richness and/or abundance of taxa


Bats (Regnery et al. 2013; Paillet et al. 2018; Basile et al. 2020)


Saproxylic beetles (Bouget et al. 2013, 2014a,b; Larrieu et al. 2019; Winter and Möller 2008)


Birds (Regnery et al. 2013; Paillet et al. 2018)


Polypores (Larrieu et al., 2019)


Hoverflies (Larrieu et al. 2019)

several authors have suggested using TreMs as indirect biodiversity indicators in forest ecosystems and as tools to promote integrative forest management

(Kraus and Krumm 2013; Winter and Möller 2008, Regnery et al. 2013; Paillet et al. 2018; Bütler et al. 2013; Larrieu et al. 2018; Asbeck et al. 2021)

TreMs as indirect biodiversity indicators at the stand scale

Limitations

At stand scale, the relationships between TReMs and biodiversity are strongly context-dependent

(Bouget et al. 2013, 2014a,b; Paillet et al. 2018)

This is likely due to:

- **complex interactions between TreMs and other resources** such as deadwood items, flowering plants in clearings and water bodies (Larrieu 2014)
- **flaws in procedures for assessing both taxa and TreMs** (Larrieu and Bouget 2017)
- **time lags in the response of certain TreM-dwelling species** to TreM presence (Herrault et al. 2016)
- **spatial distribution of source populations** (Komonen and Müller, 2018)

Which assets ?

1. **Standardized protocol (fixed 1 ha-plots, location of each tree…)**
2. **A person in charge of each plot**
3. **Wide range of contexts (forest types, climate conditions…) throughout the whole network**
4. **A database to gather plot data**

Using marteloscope data for biodiversity monitoring and marteloscope sites for additional biodiversity data collection

Which limitations ?

- Opportunistic strategy to implement marteloscope sites : no sampling strategy to cover European forest types
  - Low representativeness at the European scale, and few replicates for each forest context
- Difficult to set up binding instruments
- Great heterogeneity of management between plots
- Large variations in plot size
  - 30% of plot areas differ in fact from 1 ha
- DW is not systematically measured

Using marteloscope sites for additional biodiversity data collection

Which additional challenging variables?

Field measurements

- Recording ground-lying deadwood everywhere (not only snags and dead trees)
- Vertical structure (number of strata)
- Canopy openness

Ex situ measurements using GIS data

- Landscape context (forest cover, fragmentation index…)
- Forest tradition (ancientness)

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Using marteloscope sites for biodiversity monitoring

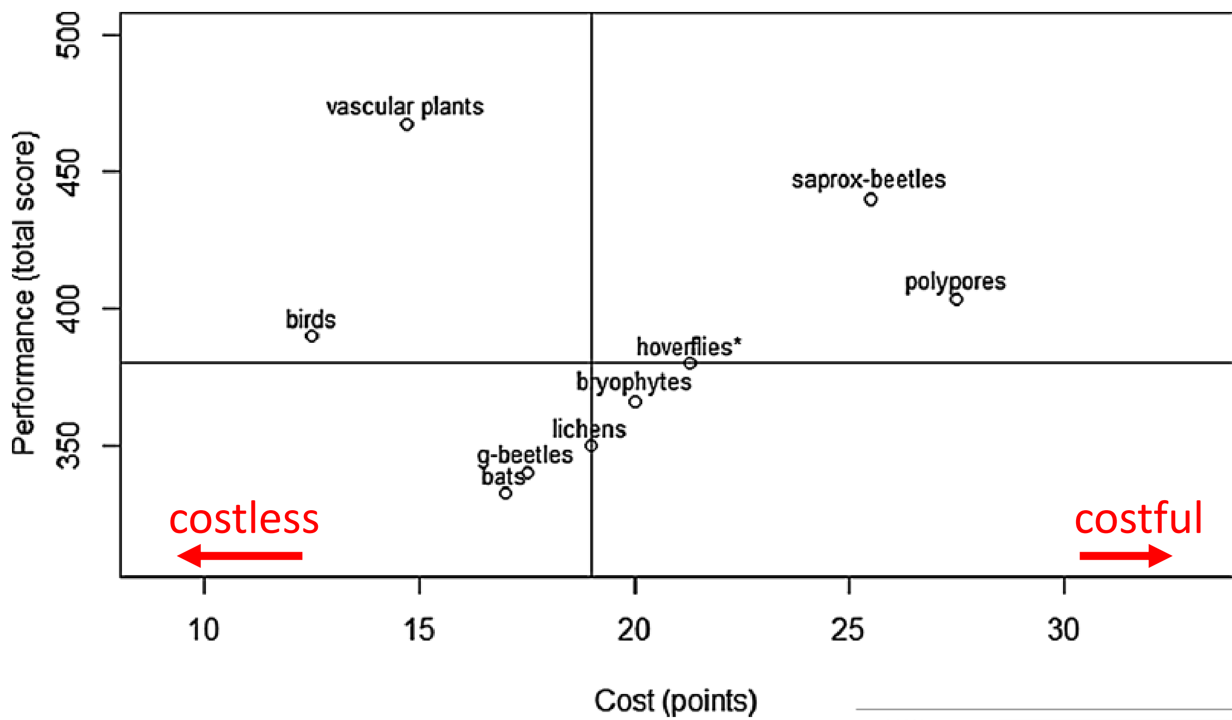
Direct taxon sampling

Key properties for candidate taxa

1. Specific to forests
2. Responsive to environmental changes
3. Adequacy between sampling scale and plot area
4. Pivotal for ecosystem functionning
5. High species diversity
6. Between-taxon complementarity
7. Low redundancy with NFI data (e.g. flora)
8. Supplemental to indirect indicators
9. Standardized & cost-efficient sampling method

Using marteloscope sites for biodiversity monitoring

Selection of priority taxa: a first attempt using the relevance/cost ratio



Ecological Indicators 87 (2018) 56–65

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ELSEVIER

Original articles

Cost-efficiency of cross-taxon surrogates in temperate forests

Laurent Larrieu[a,b,*], Frédéric Gosselin[c], Frédéric Archaux[c], Richard Chevalier[c], Gilles Corriol[d], Emmanuelle Dauffy-Richard[c,1], Marc Deconchat[a], Marion Gosselin[c], Sylvie Ladet[a], Jean-Marie Savoie[a], Laurent Tillon[e], Christophe Bouget[c]

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Using marteloscope sites for biodiversity monitoring

Selection of priority taxa using Multi-Criteria Decision Analysis (MCDA)

Arthropoda

- Ephemeroptera
- Mecoptera
- Neuropterida
- Odonata
- Orthoptera
- Plecoptera
- Raphidioptera
- Hymenoptera Apoidea
- Hymenoptera Chalcidoidea
- Hymenoptera Braconidae
- Hymenoptera Parasitica
- Hymenoptera Symphyta
- Hymenoptera Formicidae
- Coleoptera Carabidae
- Dung beetles
- Saproxylic beetles
- Coleoptera Scolytinae
- Diptera Ceratopogonidae
- Diptera Syrphidae
- Diptera Tipuloidea
- Hemiptera
- Lepidoptera Heterocera
- Lepidoptera
- Lepidoptera Rhopalocera
- Collembola
- Crustacea Isopoda
- Myriapoda Diplopoda
- Myriapoda Chilopoda
- Araneae
- Opiliones
- Acarii Phytoseiidae
- Acarii Tetranychidae

Invertebrates non.Arthropoda

- Annelida Enchytreids
- Annelida earthworms
- Gasteropoda.aquatic
- Gasteropoda.terrestrial
- Nematods
- Rotifers

Vertebrates

- Amphibians
- Anura
- Urodela
- Reptiles
- Bats
- Ungulates
- Small mammals (Rodents + Insectivores)
- Birds
- Picidae

Fungi

- Hydnes Bankeraceae
- Ectomycorhizal
- Pezizales
- Polyporoids (Hymenochaetales + Gloeophyllales + Polyporales)
- Lichens
- Myxomycetes

Plants

- Algae
- Algae Bacillariophyta
- Algae Charophyta
- Algae Chlorophyta
- Bryophytes
- Vascular plants
- Phanerogams
- Pteridophytes
- Trees

MCDA →

- **Birds**
- **Vascular plants**
- **Bats**
- **Ectomycorhizal fungi**
- **Gasteropoda.terrestrial**
- **Bryophytes**

Using innovative sampling methods: acoustic records, eDNA…

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Bouget, C. et al. (2022) Selection of priority taxa for forest biodiversity monitoring using Multi-Criteria Decision Analysis (MCDA), Passifor2 project

Using marteloscope sites and data for biodiversity monitoring

Conclusion and perspectives

- Ensuring the network sustainability
- Giving added value to the marteloscope network
- Coordinating with other EU-level networks :
  - Focusing on interactions with pan-*European ICP* level I and level II networks and with NFI data