

How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end-use class 3.2?



Context

- The project
- Planned experiments
 - Artificial weathering experiment
- Methods
 - Microscopy

How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI



The project

- End-use class 3.2
 - External
 - Above the ground
 - Not protected
 - No direct water contact
- Abiotic degradation factors (Light, Temperature, Moisture,...)
- Biotic factors (Fungi, Moulds, Algae and Bacteria)
- Interactions

How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI



Planned experiments

- Artificial weathering experiment
- Outdoor weathering experiment
- Identification of microorganisms on weathered wood surfaces
- Conduct microcosm scale experiment

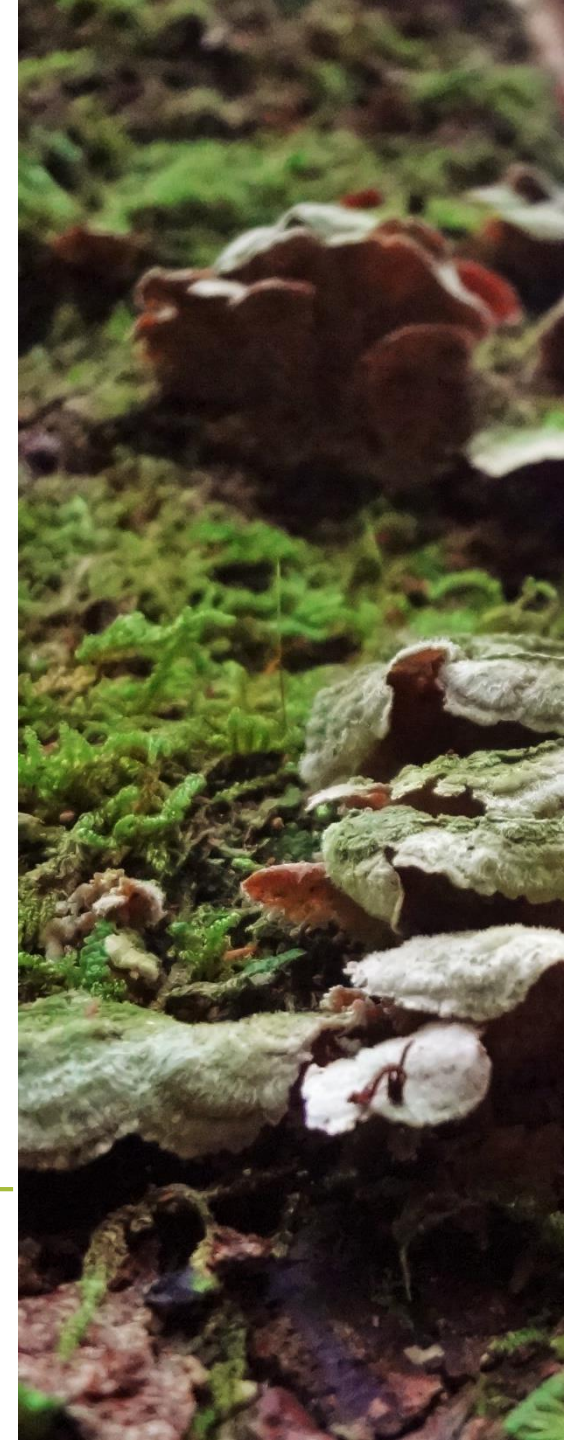
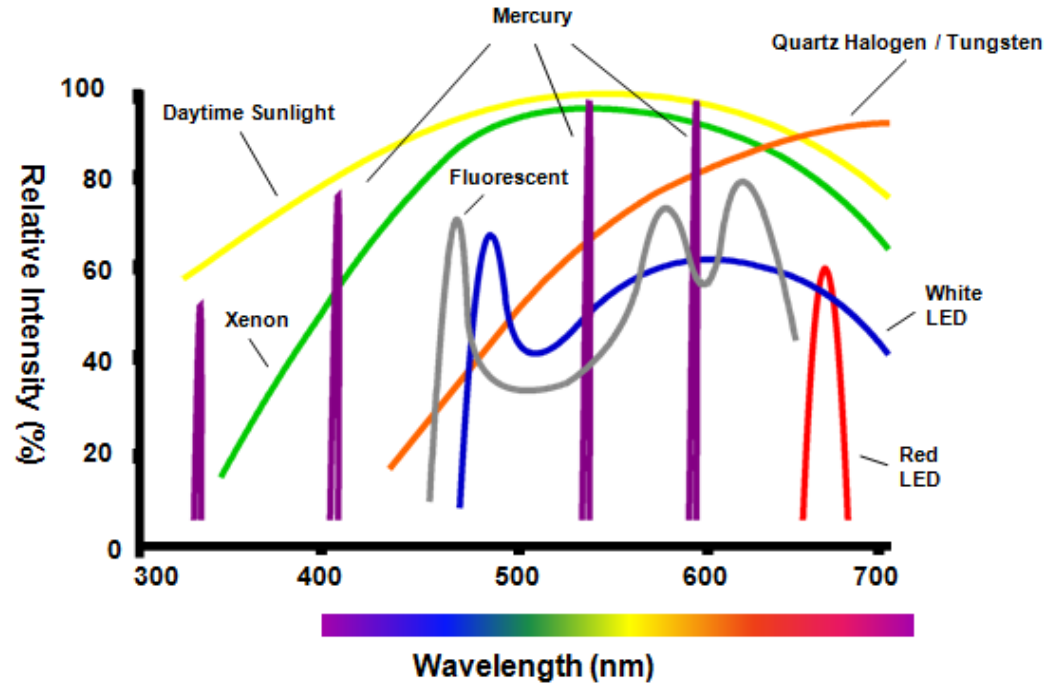
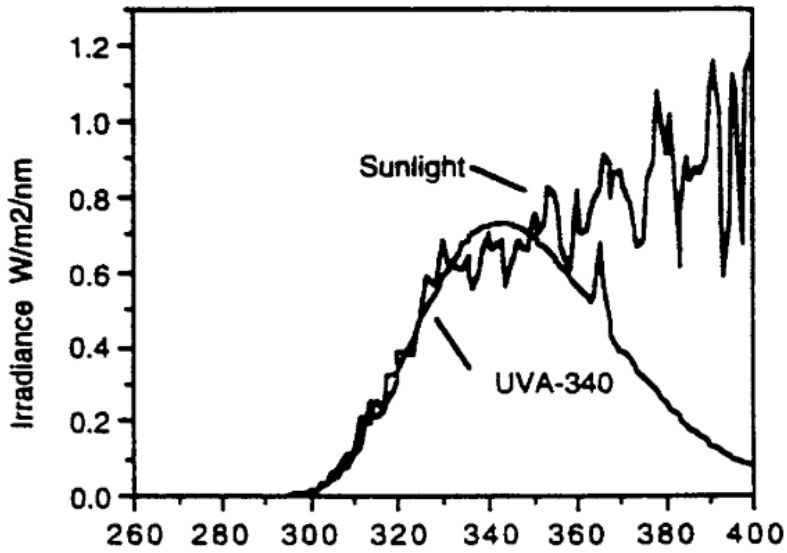
How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI

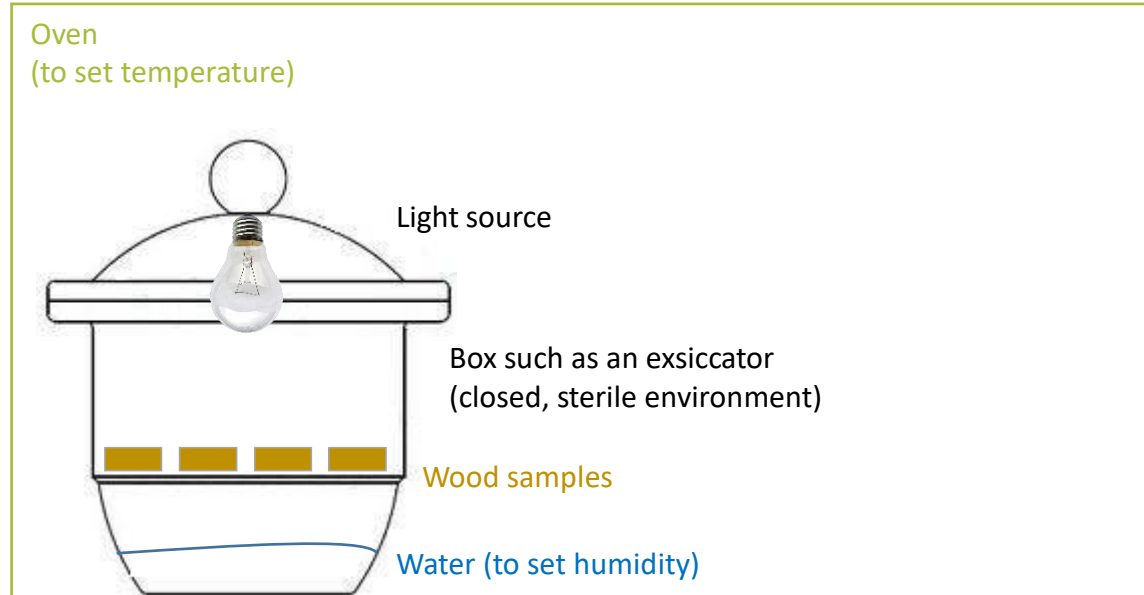


Artificial weathering experiment

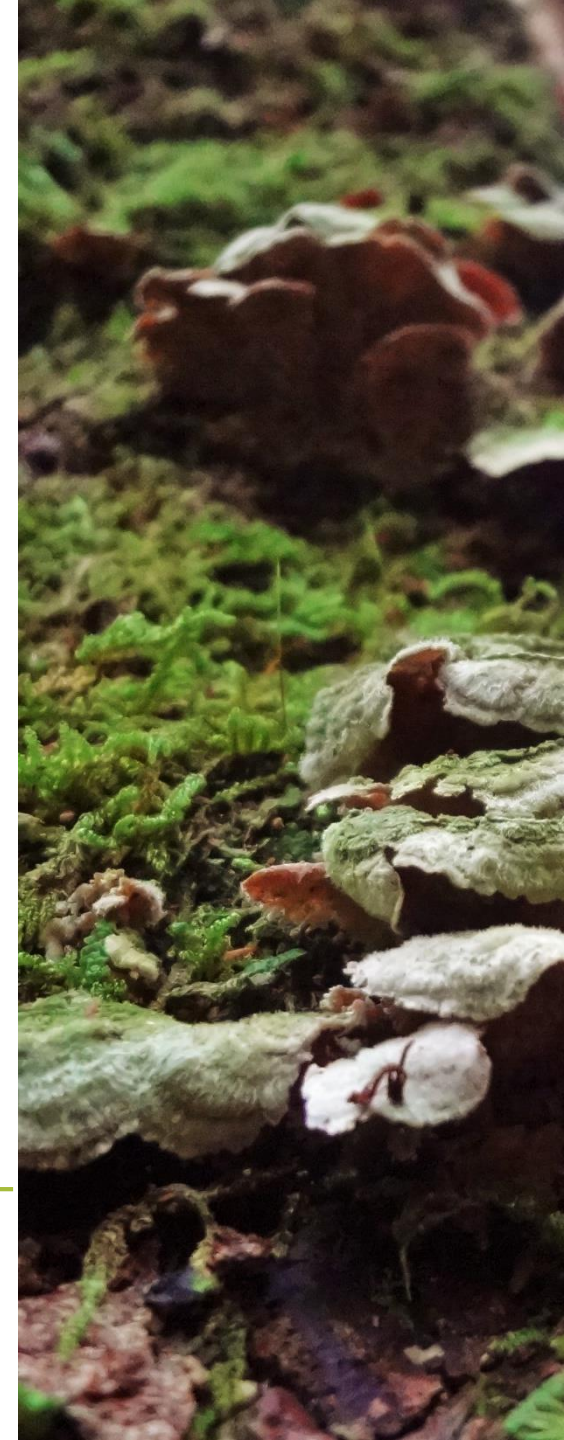


How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?

Artificial weathering experiment



How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



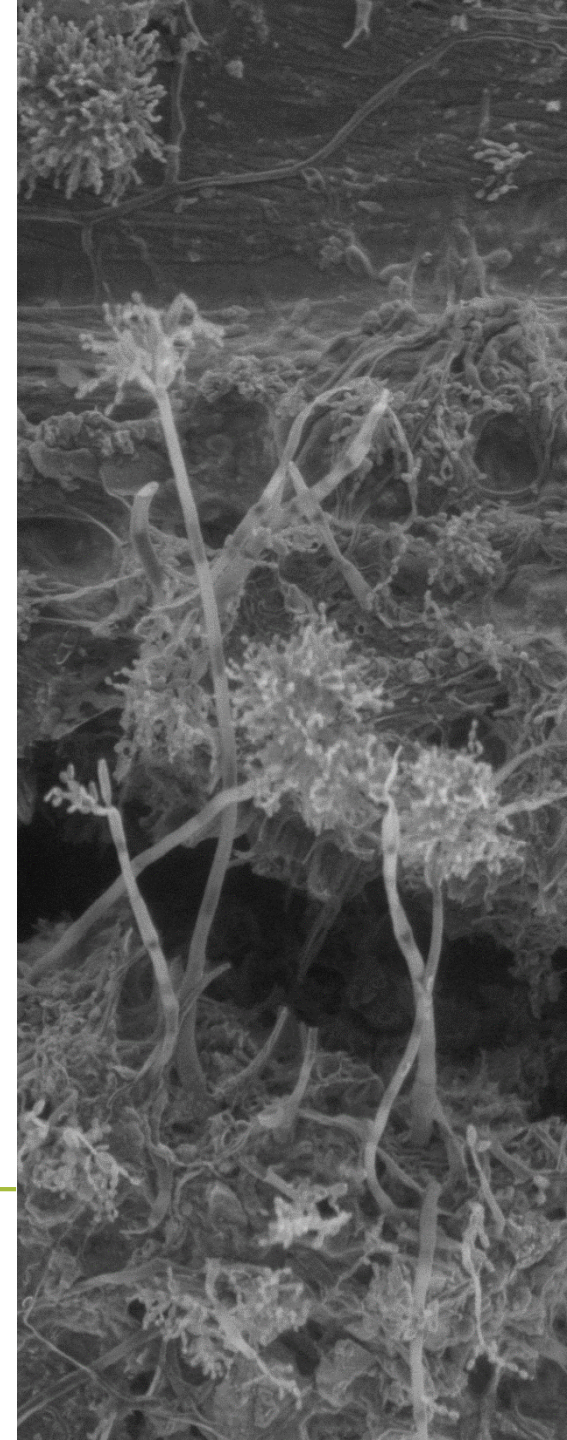
Methods

- Chemical: FTIR /ATR
- Visual: Colorimeter, Roughness testing
- Anatomical: SEM, Microscopy, X-ray densitometer
- Microbiological methods: Extraction, DNA Sequencing

How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI



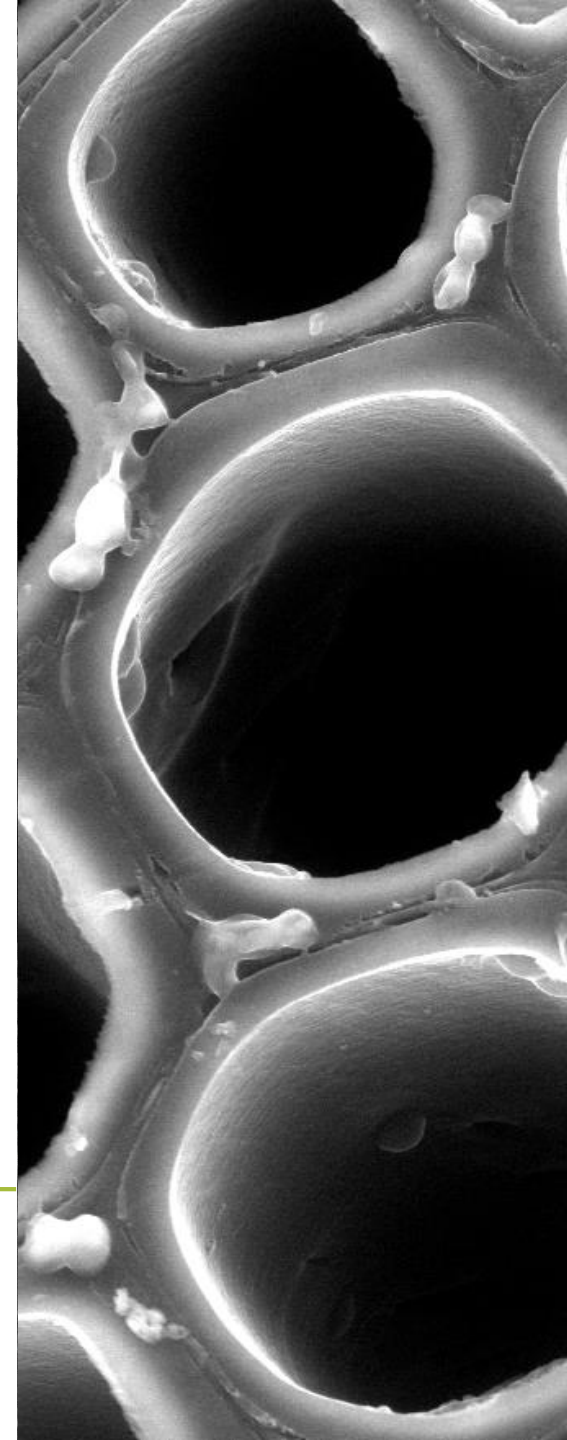
Microscopy

- Light microscopy:
 - General overview
 - Identification of bacteria presence
 - Crack measurements
 - Colour picture
- Electron microscopy:
 - High magnification
 - Detail information
 - Surface roughness (additional)

How do biotic and abiotic factors combine to affect the weathering of wood surfaces in end- use class 3.2?



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI



How do biotic and abiotic factors combine to affect the weathering of wood surfaces?

Wood weathering

Julia BUCHNER, Mark IRLE, Christophe BELLONCLE,

Franck MICHAUD, Nicola MACCHIONI



RESEARCH BACKGROUND

Wood in exterior applications is currently rather fashionable, but, is still used only in small quantities. Customers seek, for instance, for facades with low maintenance effort and want the colour of the wood to be homogeneous and stable. Through the weathering of wood however, the mechanical and chemical properties alter and the visual appearance changes over time.

This thesis is focusing on **biotic factors**- such as bacteria, fungi and moulds- and **abiotic factors** -such as light, temperature and moisture- during weathering of wooden facades.

Research on wood decay by fungi and bacteria in soil and water has already been carried out which is related to the end-use class 4 and 5. Not a lot of research has been conducted on wood in exterior use that is not in ground contact, i.e. end- use class 3.

Occurrence of biological agents in use classes (EN 335-1: 2006)

Type of use	General situation in service	Biological agents
1	Internal or under cover, dry	Wood boring beetles
2	Internal or under cover, occasionally ≤ 20%	
3	External, above the ground, protected External, above the ground, not protected	As above + disfiguring fungi and decay fungi
4	External in contact with the ground and / or water	As above + soft rot
5	In salt water	Decay fungi, soft rot and marine borers

AIM

The aim of this project is to find out if bacteria have an influence on weathering and if so, what is the **interaction between fungi, moulds and bacteria** in the wood degradation process. This approach will facilitate the design of stable wooden facades that require little maintenance over a long period of time.

MATERIALS

Douglas fir (*Pseudotsuga menziesii*) and **oak** (*Quercus robur*) are the wood species to be analysed since they both are used in various exterior applications such as facades in France and overall in Europe.

METHODS

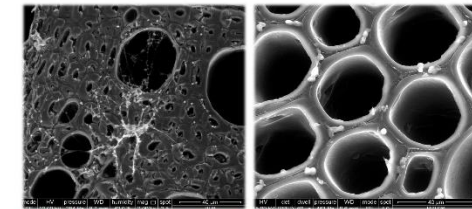
Microbiological
Extraction- selective media

Anatomical
Electron microscope
Light microscope
X-ray densitometer

Molecular biological
Non selective media- DNA

Chemistry
Fourier- transform infrared spectroscopy (FTIR)
Attenuated total reflection (ATR)

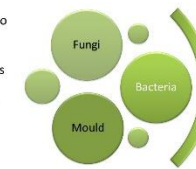
Visual
Colorimeter
Roughness testing



Fungi on beech wood (left) and bacteria on pine wood (right)

OBJECTIVES

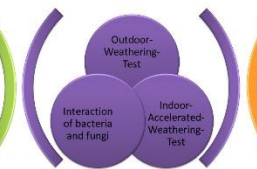
Defining biotic factors
Bacteria and fungi are likely to be present in weathered wood especially in humid environments. Bio-organisms in wooden facades after different degradation stages will be identified and quantified.



Identification and quantification of fungi, bacteria and moulds

Microcosms- experiments

Through the imitation of a degradation process in a microcosms environment the interaction between fungi and bacteria can be analysed.



Experiments in different Environments

Indoor- accelerated- weathering experiments

The indoor- tests will allow us to achieve a deeper insight into the chemical changes on the chosen wood species during weathering with specific bacteria, fungi and moulds in controlled environment.



Analysis

Analysis

The chosen methods will show the changes due to the weathering process of wood on microbiological, anatomical, visual and chemical level. Furthermore results from indoor- and outdoor- experiments with and without taking biotic factors into account can be compared.

Outdoor- weathering experiments

Outdoor testing should serve for overall understanding and understanding for industry for the specific wood species.

CONTACTS

ECOLE SUPERIEURE DU BOIS | Rue Christian Pauc | 44306 | Nantes
| Julia Buchner | julia.buchner@ecoledubois.fr

ACKNOWLEDGEMENT

ECOLE SUPERIEURE DU BOIS
Mark Irle | Franck Michaud | Christophe Belloncle | IVALSA
Nicola Macchioni

Thank you for your attention



Julia BUCHNER
Mark IRLE
Christophe BELLONCLE
Franck MICHAUD
Nicola MACCHIONI