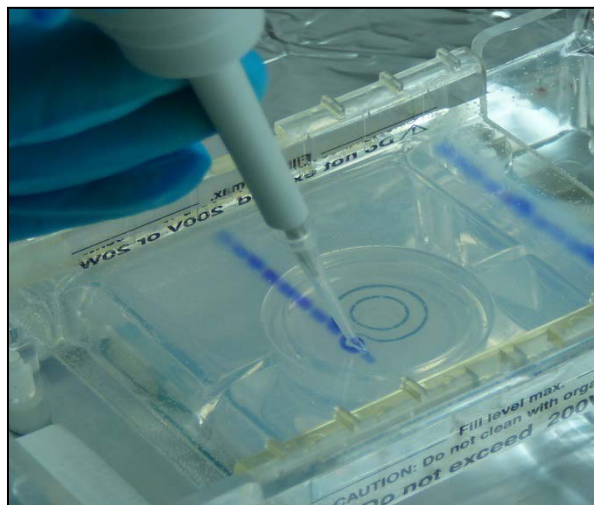


Diversity of wood decay fungi in test fields across Europe



K. Jacobs, B. Weiß, K. Plaschkies, W. Scheiding: Institute for wood technology Dresden (IHD)

E. Conti: Catas S.p.A., Udine

E. Melcher, Thünen Institut, Hamburg

A. Fojutowski: Wood Technology Institute (ITD), Poznań

I. Le Bayon: Institut Technologique FCBA, Bordeaux

Gefördert durch:



Bundesministerium
für Wirtschaft
und Technologie

Funded by the German Ministry of Economy and technology

aufgrund eines Beschlusses
des Deutschen Bundestages

■ Fungal diversity

- In buildings: about 30 typical and well known fungi (30 % to 50 % dry rot fungus),
- Much higher diversity of species in outdoor wood applications (UC 3/4),
- From worldwide estimated 1.5 to 3 million fungal species , only 200,000 have been described yet (Hawskworth 2003),
- Knowledge about mechanisms of wood degradation and involved fungal species insufficient,
- Better understanding of wood decay and involved fungi important for improvements in wood protection.



- New methods for microbial community analysis
 - Classical methods are increasingly supplemented by molecular biological methods, most important DNA analysis,
 - Detection of fungi in all stages of development; no need for specific morphological characteristics or cultivation,
 - Analysis of the full range of species within an habitat,
 - Revision of the taxonomy and nomenclature of fungi by genetic data,
 - DNA based analysis is reliable and objective and can be standardized.



- Investigation of diversity and succession of wood decay exposed in ground contact:
 - Different wood species,
 - Different test fields / locations,
- Development of molecular diagnostic methods,
- Providing genetic reference data.

Tubaria hiemalis around a scots pine sapwood stake in the test field Hamburg
Photo: E. Melcher 10/2010



Field exposure of wooden stakes



Collaboration with other european test laboratories:

- Bordeaux (FCBA)
- Hamburg (vTi)
- Udine (Catas)
- Dresden (IHD)
- Poznań (ITD)

Exposure conditions:

- in ground exposition according to EN 252
- Stakes: (50 x 25 x 500) mm³,
- scots pine sapwood (*Pinus sylvestris*) and beech (*Fagus sylvatica*),
- Sampling at intervals of 6 months,
- Analysis of 3 stakes per wood species, location and exposure time.



- Surface sampling
 - Taken from visible infested places at the whole specimen,
 - Distinguished by three areas: above ground (A), earth/air passage area (B) and in ground (C),
 - No defined number of samples.

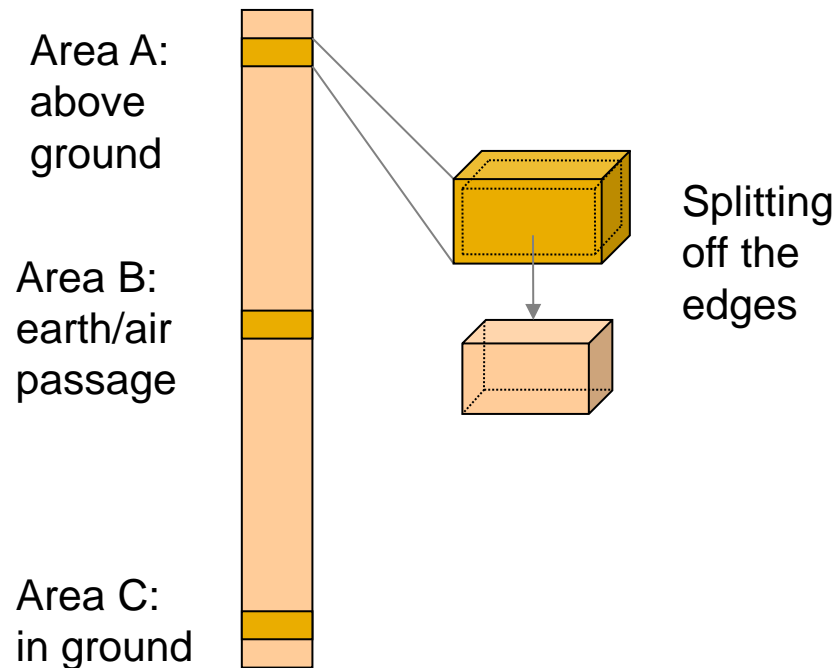


Surface sampling for DNA analysis

- Sampling from the interior of specimens
 - Systematic sampling from defined areas of each specimen,
 - Resulting in defined number of samples from each specimen and area.



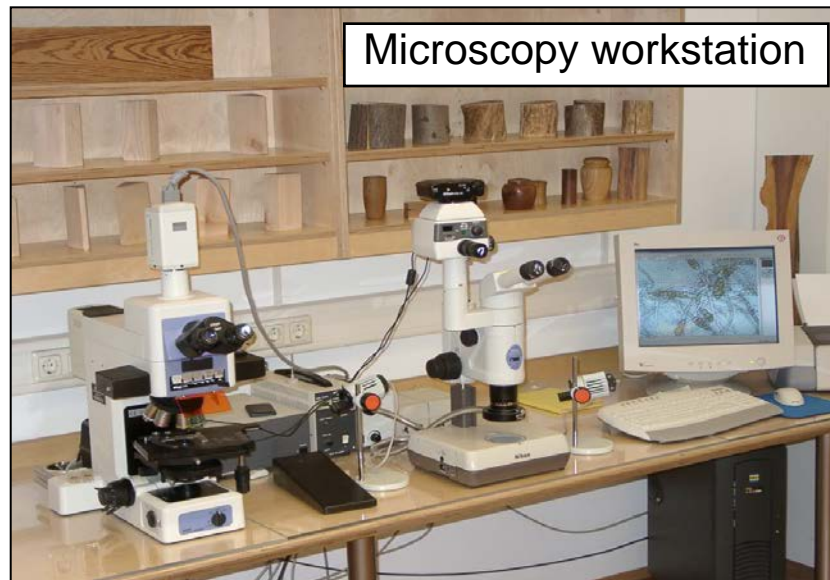
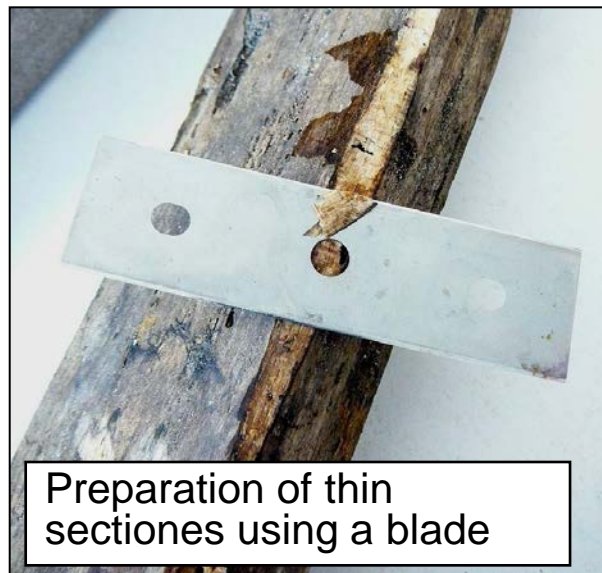
Specimens from Udine after 18 month exposition



Schematic illustration of interior sampling

■ Methods:

- Reflected light microscope: investigation in different areas with visible infestation at magnifications of 7.5 ... 110-fold,
- Transmitted light microscope: investigation of single locations at higher magnifications (up to 750-fold),
- Preparation of thin cross or longitudinal sections of infested areas using microtom device or blade.

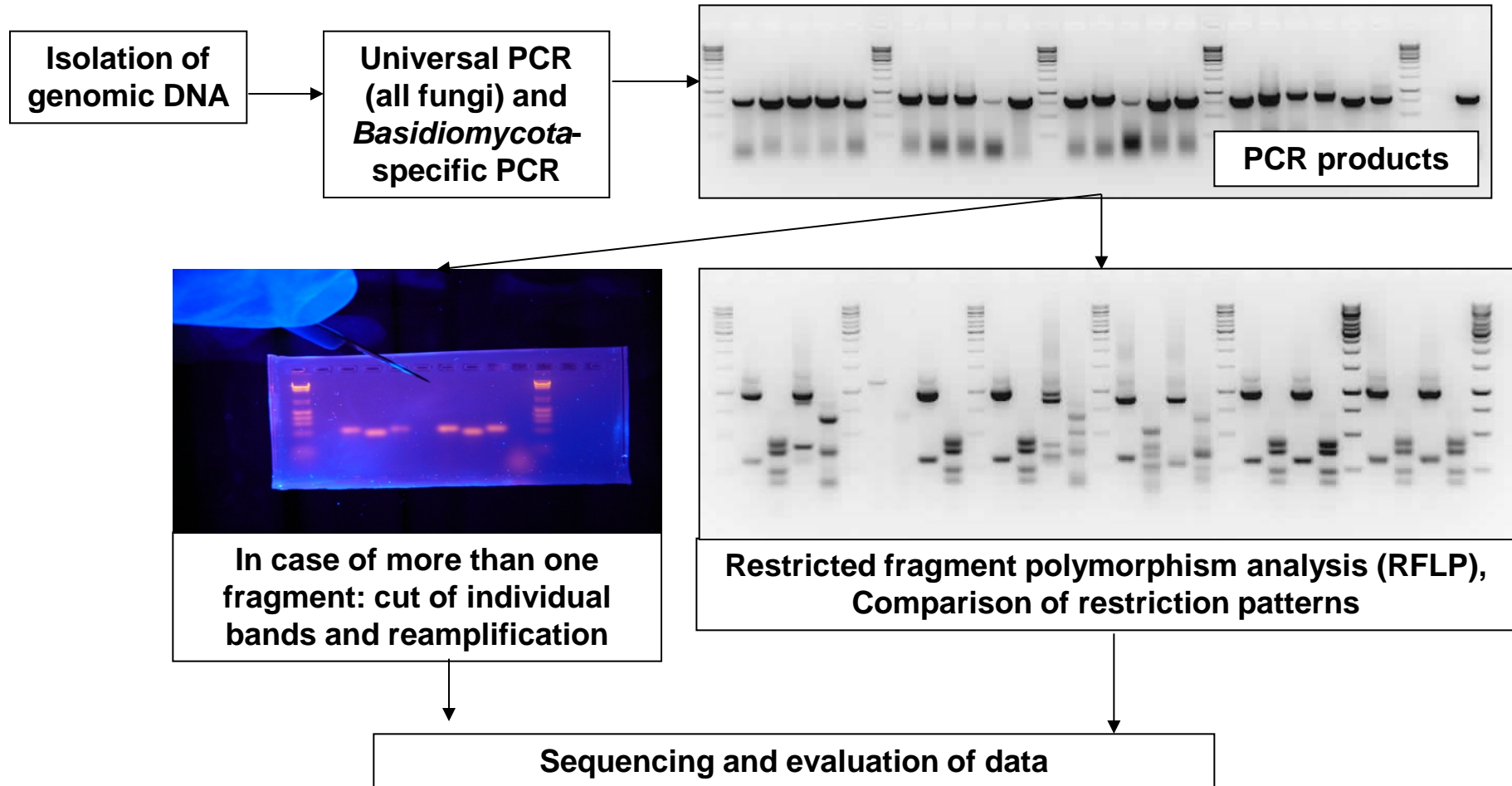


- Identification of fungi by
 - Investigation of morphological characteristics at fruiting bodies and spores, surface and substrate mycelium, strands;

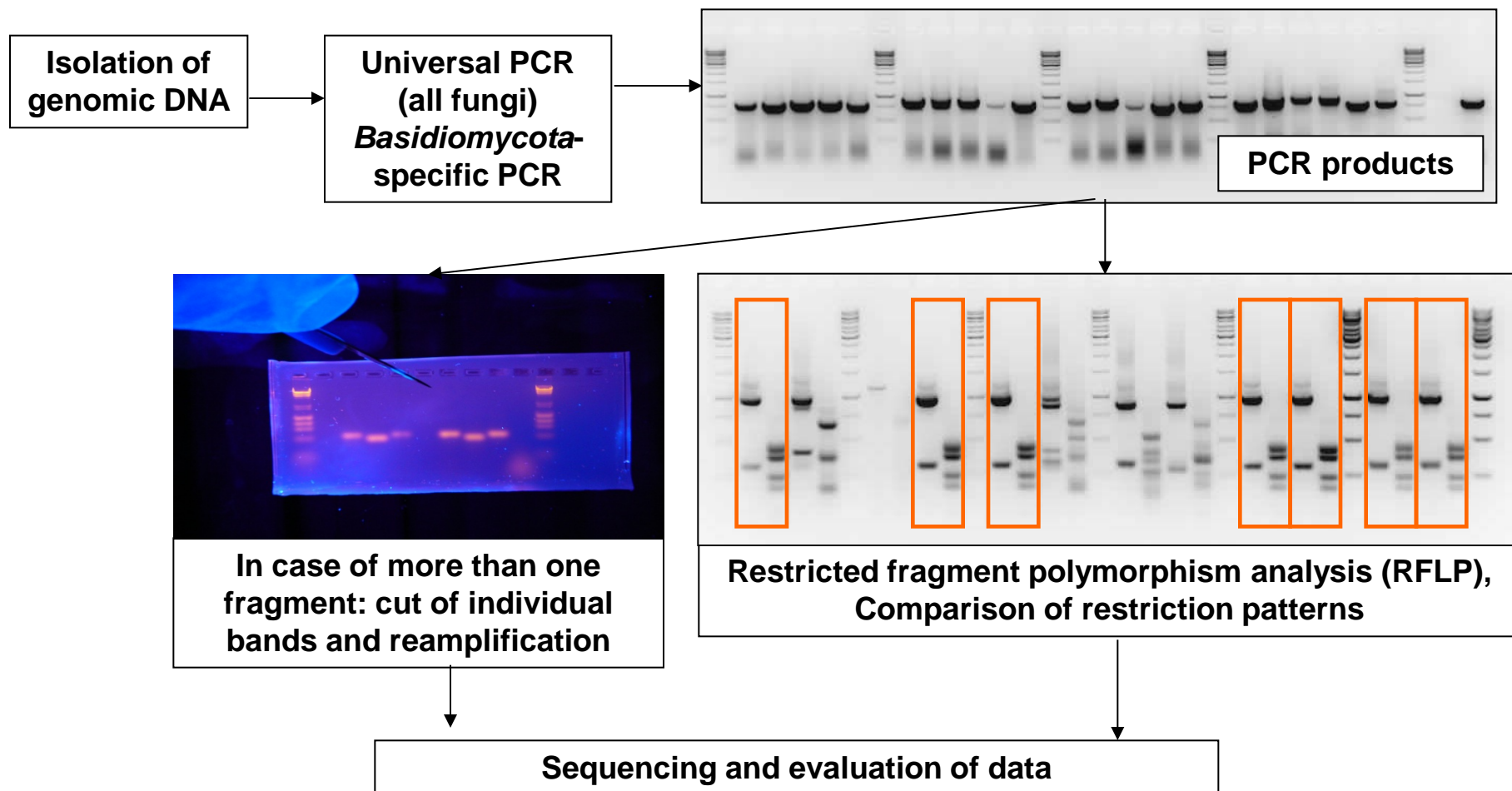


- Investigations of decay patterns in damaged wood (e.g. cavities caused by soft rot fungi);
- Specification of sampling spots for DNA analysis after conventional investigation and documentation, restricted to different fungi and infestation patterns, respectively.

- Workflow of molecular identification of fungi

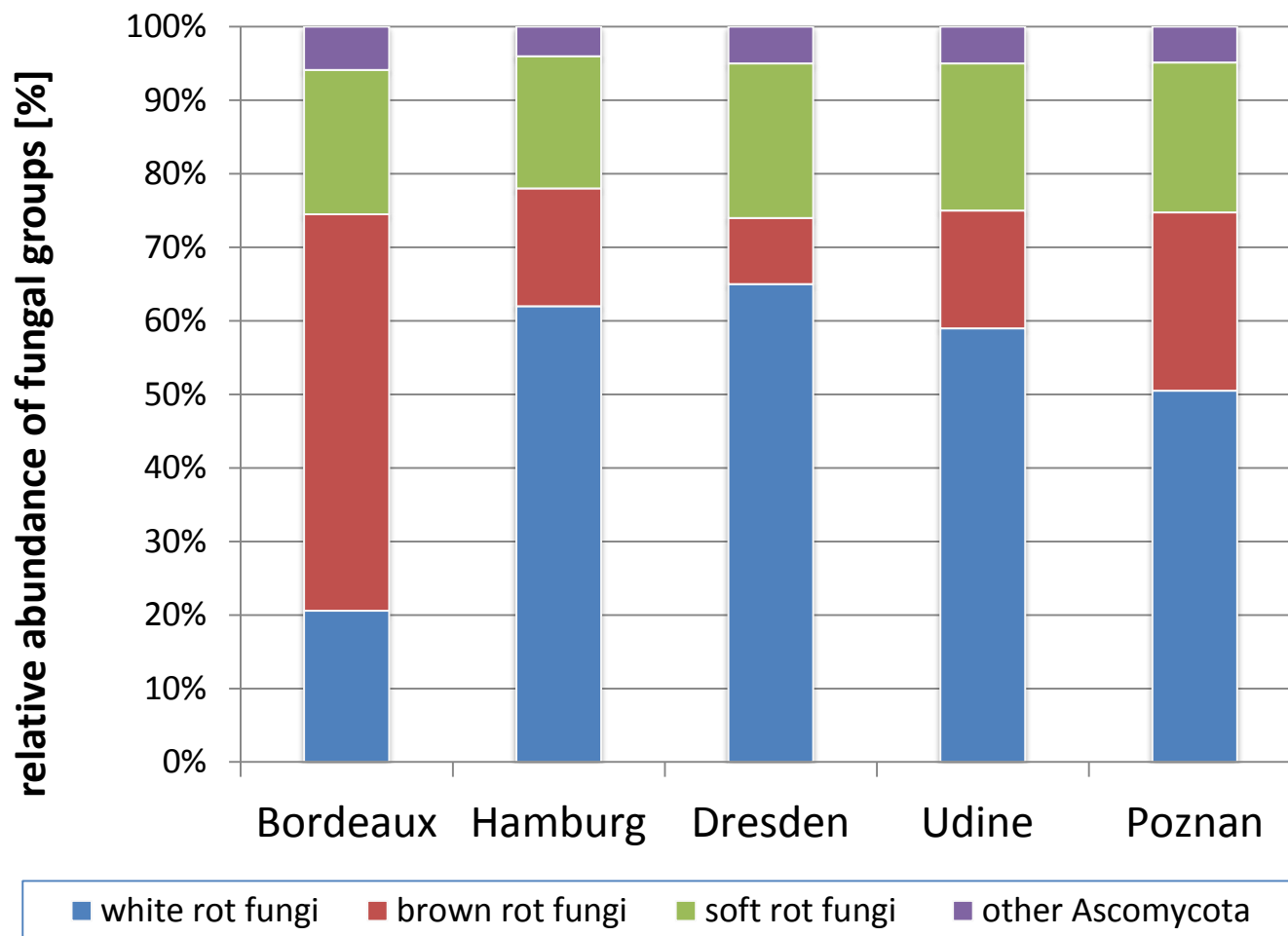


- Workflow of molecular identification of fungi



- Summarized results
 - Evaluation of 150 stakes from 5 locations (more than 1500 individual samples for DNA analysis),
 - Identification of 98 fungal species from 77 genera,
 - No clear species differentiation in 43 cases, mainly *Ascomycota*,
 - On average 25 different fungal species per test field and exposure time,
 - *Ascomycota* (soft-rot fungi) not completely detected due to the limits of the used methods,
 - A general increase of fungal diversity with increasing exposure time was not observed.

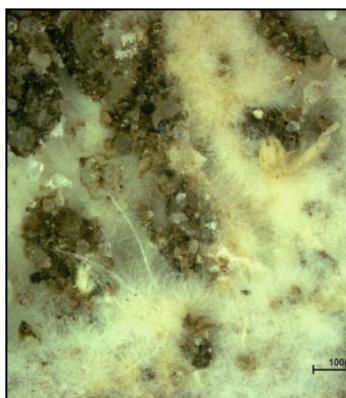
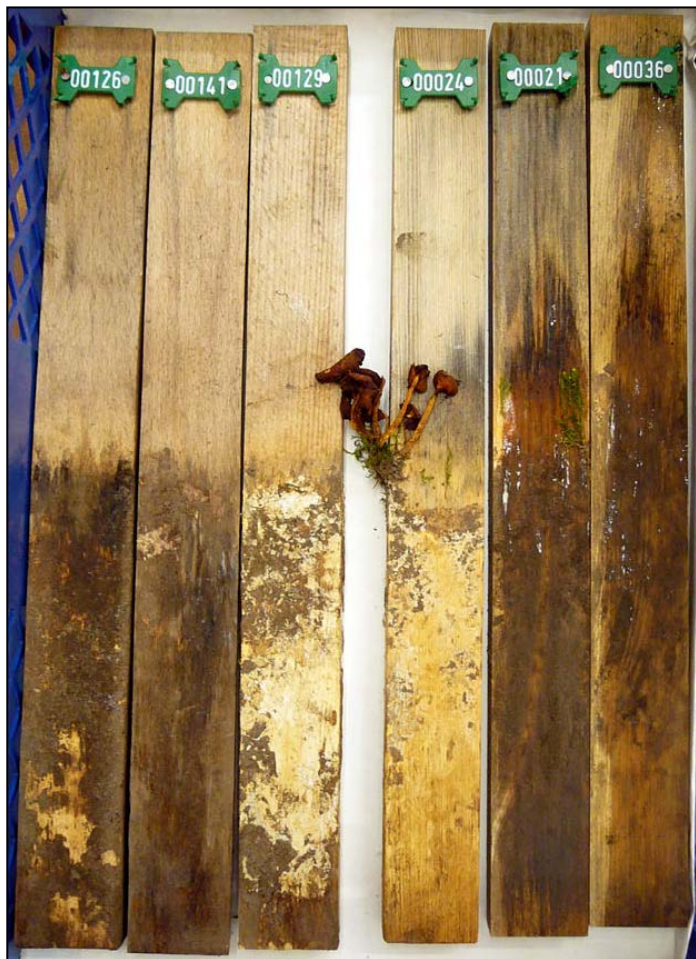
- Types of wood degradation



- Dominant fungal species at different locations

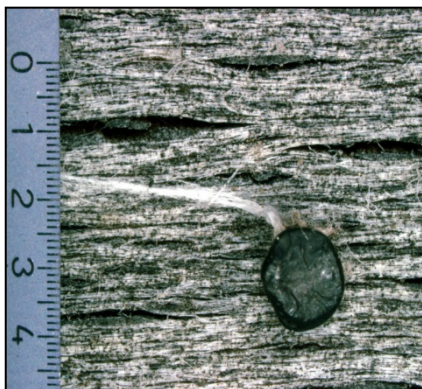
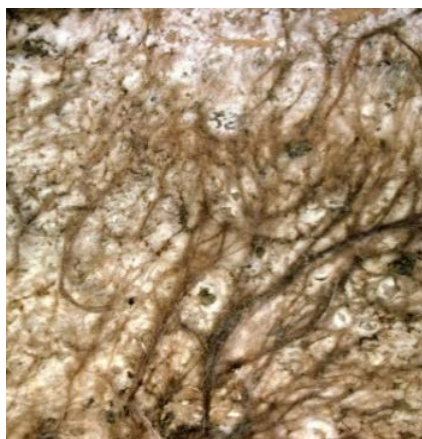
Test field	Scots pine sapwood	Beech
Hamburg (11)	<i>Cyathus striatus</i> , <i>Cylindrobasidium evolvens</i> , <i>Helicosporium</i> sp., <i>Hypholoma fasciculare</i> , <i>Peniophora</i> sp., <i>Psathyrella</i> sp., <i>Scopuloides hydroides</i> , <i>Sistotrema brinkmanii</i>	<i>Armillaria</i> sp. , <i>Bjerkandera adusta</i> , <i>C. striatus</i> , <i>C. evolvens</i> , <i>Exidia glandulosa</i> , <i>H. fasciculare</i> , <i>Psathyrella</i> sp., <i>S. hydroides</i> , <i>S. brinkmanii</i>
Dresden (9)	<i>C. striatus</i> , <i>Helicosporium</i> sp., <i>Resinicium bicolor</i> , <i>S. brinkmanii</i>	<i>B.adusta</i> , <i>C. striatus</i> , <i>E. glandulosa</i> , <i>Hypochnicium</i> sp., <i>S. brinkmanii</i> , <i>Trametes versicolor</i>
Udine (11)	<i>Helicosporium</i> sp., <i>Oxiporus</i> sp. , <i>Peniophora</i> sp., <i>Schizophyllum commune</i> , <i>Sistotrema</i> sp.,	<i>B.adusta</i> , <i>C. stercoreus</i> , <i>E. glandulosa</i> , <i>Oxiporus</i> sp. , <i>Stereum</i> sp., <i>T. versicolor</i>
Bordeaux (8)	<i>Coniophora</i> sp., <i>Mycena</i> sp., <i>Peniophora</i> sp., <i>Sistotrema</i> sp. , <i>Leucogyrophana</i> sp.	<i>Postia ptychogaster</i> , <i>Serpula himantioides</i> , <i>Stereum hirsutum</i>
Poznań (7)	<i>H. fasciculare</i> , <i>Postia</i> sp., <i>Sistotrema</i> sp.,	<i>B.adusta</i> , <i>E. glandulosa</i> , <i>H. fasciculare</i> , <i>Mycena</i> sp., <i>Psathyrella</i> sp.

- Selected dominant fungal species: *Hypholoma fasciculare*



- Frequent occurrence in Hamburg and Poznań,
- found on the majority of stakes (pine and beech), also in the interior,
- white rot fungus,
- widespread saprophyte on dead hardwood and softwood within Europe.

- Selected dominant fungal species: *Cyathus striatus*, *C. stercoreus*

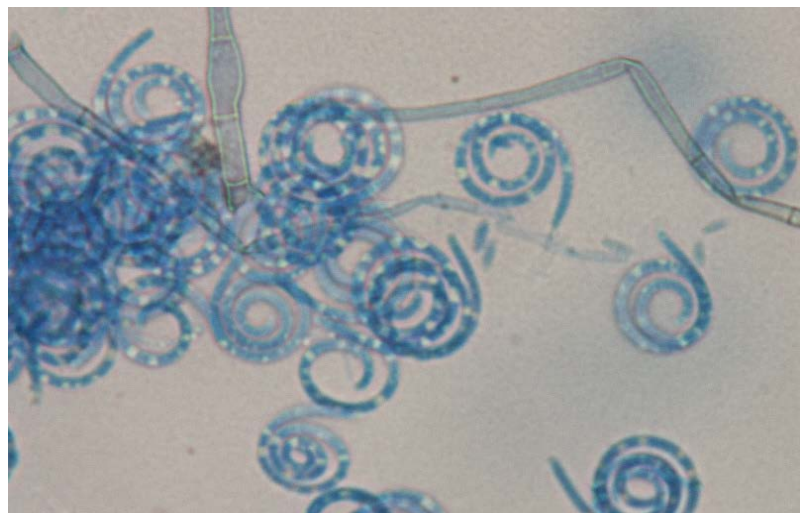


- Frequently found in Dresden, Hamburg, Udine,
- Only external infestations of beech but strong attack in the inside of pine sapwood,
- Associated with intense white rot,
- Common saprophyte of deciduous and coniferous trees,
- Formation of red-brown surface mycelia (also strands) and cup-shaped fruiting bodies with spore carriers (peridioles).

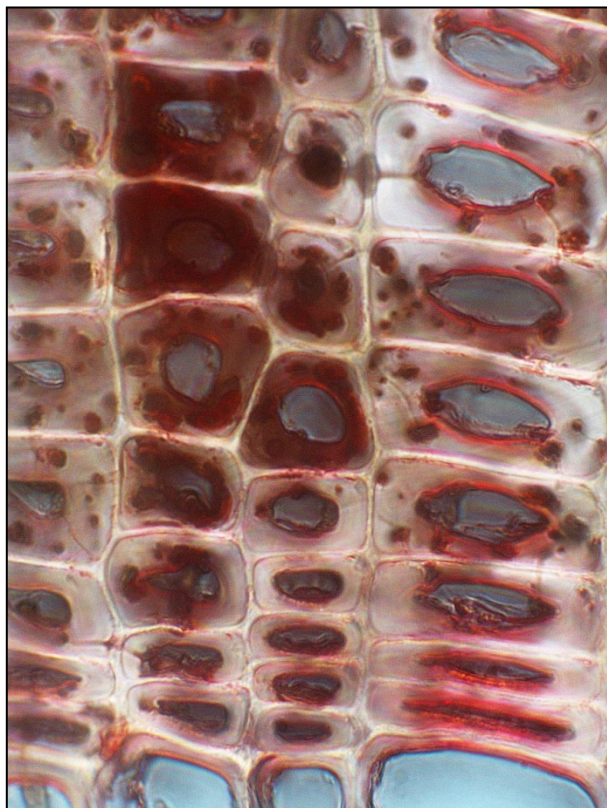
- Selected dominant fungal species: *Helicosporium* sp.



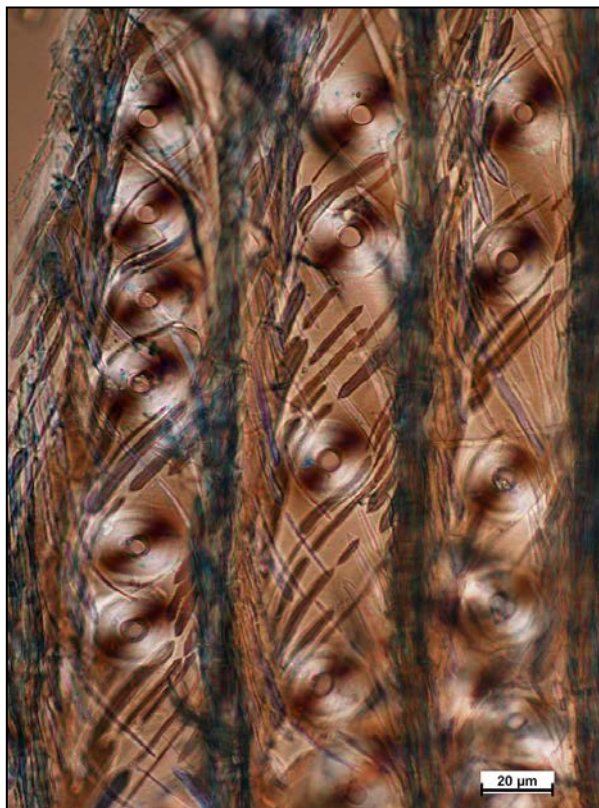
- Frequent occurrence at the sites of Dresden, Hamburg, Udine, Poznań,
- Exclusively on pine sapwood, exterior and interior,
- Always associated with soft rot (underneath),
- Blue-grey surface mycelia with characteristic helical spores,
- DNA analysis on species level by rDNA-ITS sequencing failed due a lack of reference data.



- Microscopic detection of soft rot



Cross section,
M 1000:1; Soft rot cavities in
the late wood cell walls of
tracheids



Radiale section, M 600:1;
diagonal directed soft rot in
the tracheids wall of early
wood

- Thin cuts of pine wood in cross and longitudinal direction,
- Detection of soft rot in beech and scots pine sapwood stakes at all locations,
- Differentiation of fungal species often failed due to insufficient reference data base,
- e.g. *Heliotales* spp., *Sordariales* spp. , *Phoma* spp.

- Wood decay by termites



- Special situation in Bordeaux (Île d'Oléron) because of massive infestation by termites (*Reticulitermes santonensis*),
- Found at pine and beech wood,
- Accelerated breakage of stakes caused leak of fungal diagnostic results for longer exposure time (3 and 3,5 years).

- White and soft rot fungi are the predominant type of decay excepting the field near Bordeaux.
- A total of 98 different fungal species from 77 genera were identified.
- In 43 cases an identification on species level failed due to lack of reference data or limits of used analysis methods.
- 25 different fungal species were found on average at each location and exposure time.
- A general increase of fungal diversity with exposure time was not observed.
- At each test field 7-11 dominant fungal species were found.
- The majority of the identified dominant fungal species are not commonly known as decomposers of used wood.

Thank you for your attention!



Presented work was part of a project, funded by the German Ministry of Economy and technology (Reg.-Nr. VF090010) .