

Mycorrhizal symbiosis of European larch (*Larix decidua*)



from seedlings to mature trees

Maria Rudawska, Tomasz Leski



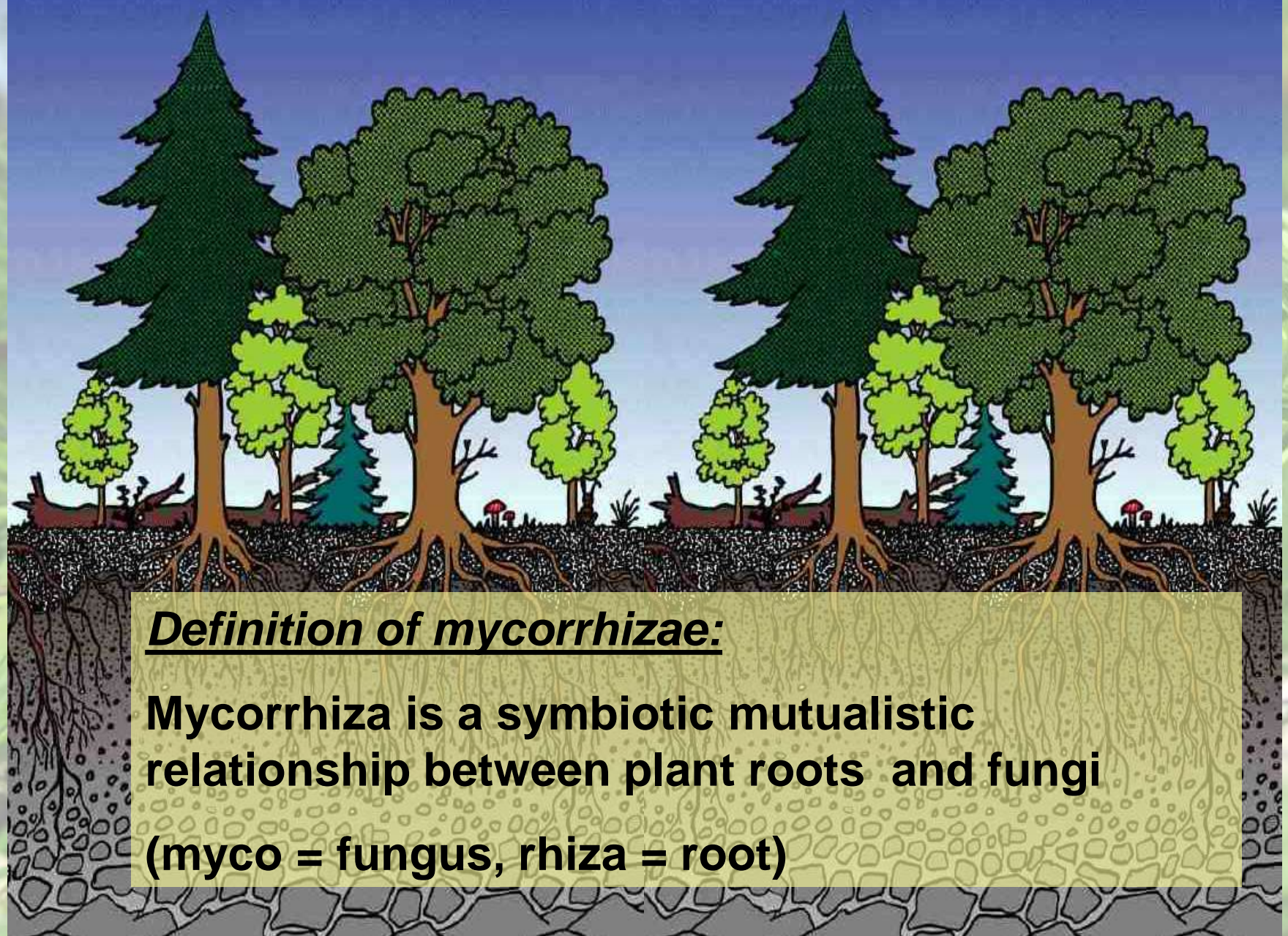
Larch in a warm climate



Most higher plants do not have (fine) roots, they have mycorrhizas

M. Begon, J. L. Harper & C. R. Townsend; Ecology, Blackwell Scientific Publications, Oxford 1986





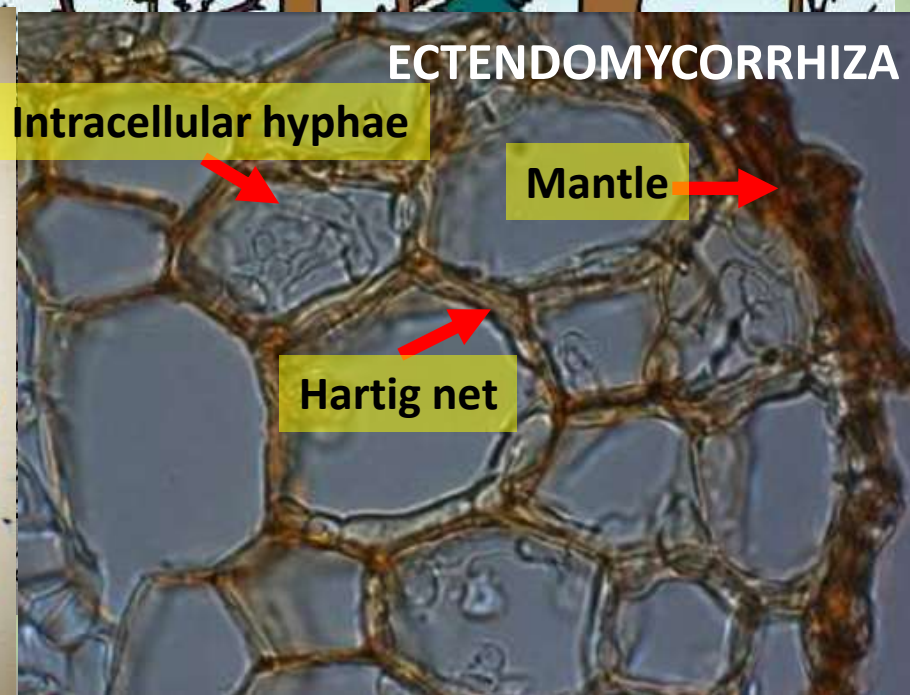
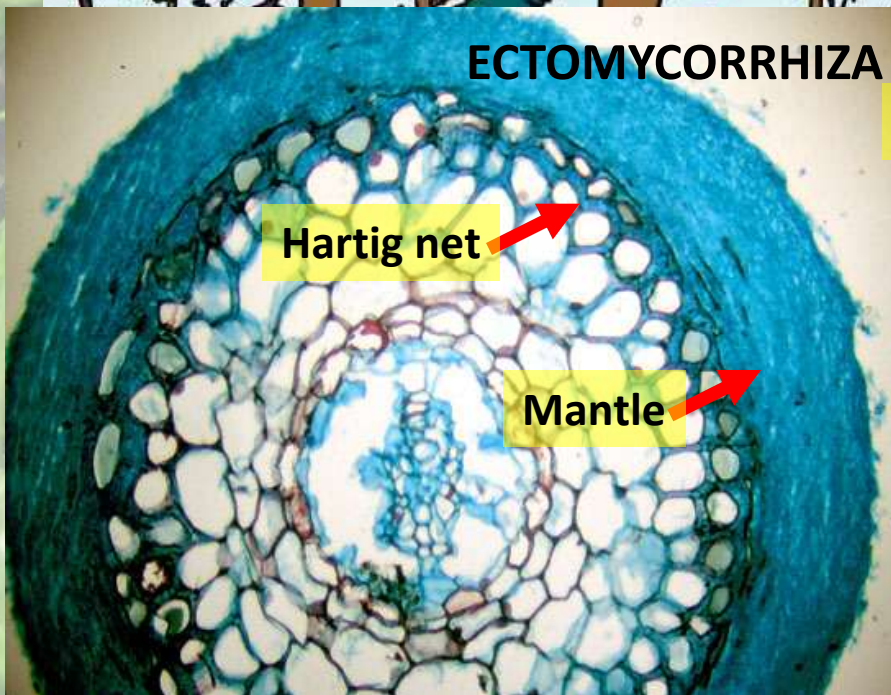
Definition of mycorrhizae:

**Mycorrhiza is a symbiotic mutualistic relationship between plant roots and fungi
(myco = fungus, rhiza = root)**



Types of mycorrhizae:

- Arbuscular
- Ectomycorrhizae ←
- Ectendomycorrhizae ←
- Arbutoid
- Monotropoid
- Ericoid
- Orchid



„*Ubi Larix ibi Boletus elegans*”
(Lindrgen, 1845) **(*Suillus grevillei*)**



Research on larch mycorrhiza

Frank	1885
Melin	1922, 1925
Hammerlund	1923
Rayner	1927
Gilbert	1928
Colla	1931
Jaczewski	1933
Dominik T.	1936 <i>Badania nad mykorhizą niektórych obcych drzew iglastych aklimatyzowanych w Polsce</i> (Roczn. Nauk Rol. Leś. 36: 84-112) (in Polish with English summary)
How J.E.	1941-42 <i>The Mycorrhizal Relations of Larch I-III</i> (Ann. Bot.)
Lobanow	1949
Dominik T.	1950 <i>Modrzew w lasach czerniejewskich pod Gnieznem i dynamika rozwojowa jego mikoryzy</i> (Acta Soc. Bot. Pol. 20: 305-330) (in Polish with English summary)
Pachlewski R.	1953 <i>Badania mykotrofizmu siewek modrzewia polskiego i sudeckiego w naturalnych i sztucznych warunkach rozwoju.</i> (Acta Soc. Bot. Pol. 22: 133-168) (in Polish with English summary)



**Papers with (mycorrh* OR ectomycorrh*)
AND (larix OR larch*) in the title**

1939-1972 - 44 papers

1973-1996 - 8 papers

1997-2012 - 20 papers

Papers with ectomycorrh* in the title (1939-2012)
3638



List of ectomycorrhizal fungi associated with *Larix decidua*

(based on fruiting body appearance) (J.M.Trappe, 1962, modified)

<i>Amanita</i>	<i>muscaria, vaginata</i>
<i>Boletinus</i>	<i>cavipes</i>
<i>Boletus</i>	<i>edulis, erythropus</i>
<i>Cenococcum</i>	<i>geophilum</i>
<i>Cortinarius</i>	<i>balteatus, camphoratus</i>
<i>Gomphidius</i>	<i>maculatus</i>
<i>Hygrophorus</i>	<i>aureus, bresadolae, lucorum, queletii</i>
<i>Inocybe</i>	<i>dulcamara</i>
<i>Lactarius</i>	<i>aurantiacus, laricinus, porninsis, rufus</i>
<i>Laccaria</i>	<i>laccata</i>
<i>Paxillus</i>	<i>involutus</i>
<i>Ramaria</i>	<i>palmata</i>
<i>Russula</i>	<i>aeruginea, emetica, laricina, pseudofallax</i>
<i>Scleroderma</i>	<i>citrinum</i>
<i>Suillus</i>	<i>viscidus, grevillei, luteus, tridentinus, variegatus</i>
<i>Tricholoma</i>	<i>psammopus, imbricatum</i>



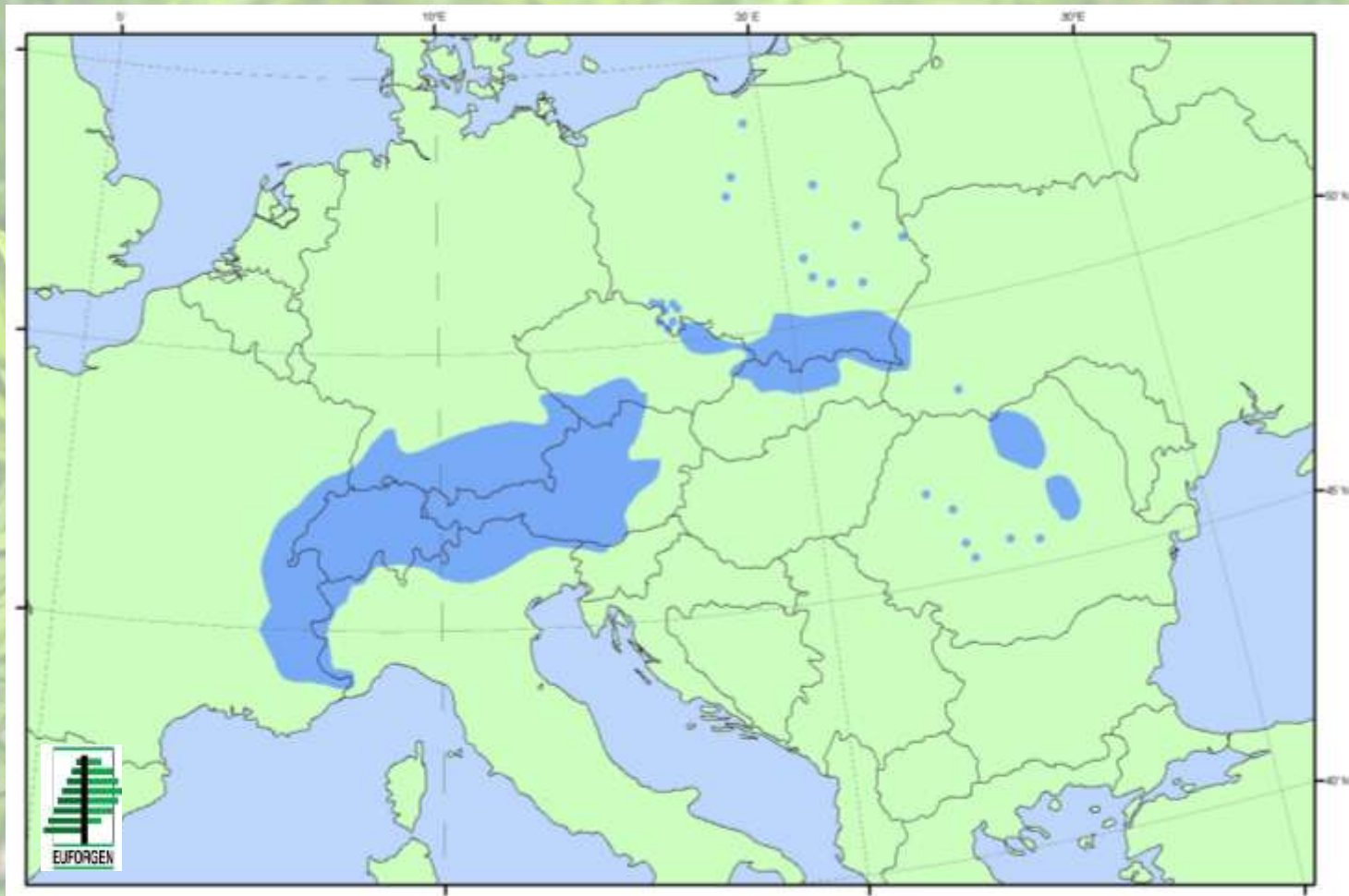
MORPHOLOGICAL AND ANATOMICAL DESCRIPTION OF *Larix decidua* ECTOMYCORRHIZAS

(R. Agerer, Colour Atlas of Ectomycorrhizae)

<i>Boletinus cavipes</i>	Treu 1990
<i>Cortinarius</i> sp.	Treu 1990
<i>Hebeloma edurum</i>	Treu 1990
<i>Hygrophorus lucorum</i>	Treu 1990
<i>Lactarius porninsis</i>	Treu 1990
<i>Russula laricina</i>	Treu 1990
<i>Scleroderma citrinum</i>	Rihter & Bruhn 1990
<i>Suillus flavus</i>	Treu 1990
<i>S. laricinus</i>	Treu 1990
<i>S. tridentinus</i>	Treu 1990
<i>Tricholoma imbricatum</i>	Treu 1990
Laricirhiza alpina	Treu 1990
Unidentified	Treu 1990



Distribution range of European larch in Europe



Ectomycorrhizal community structure :

⇨ the composition and relative abundance of ectomycorrhizal fungal species (above and below ground).



OUR PROJECTS

ECTOMYCORRHIZAL COMMUNITY STRUCTURE:

1. IN FOREST NURSERIES
2. IN NATURAL REGENERATION
3. IN FOREST CHRONOSEQUENCE
4. IN THE MOUNTAINS (EFFECT OF ALTITUDE)
5. IN PROVENANCE TRIAL (EFFECT OF TREE GENOTYPE)



Where?

STUDY SITES



32 FOREST BARE-ROOT NURSERIES

↓ NATURAL REGENERATION

★ FOREST CHRONOSEQUENCE

★ ALTITUDE a.s.l.

★ PROVENANCE TRIAL

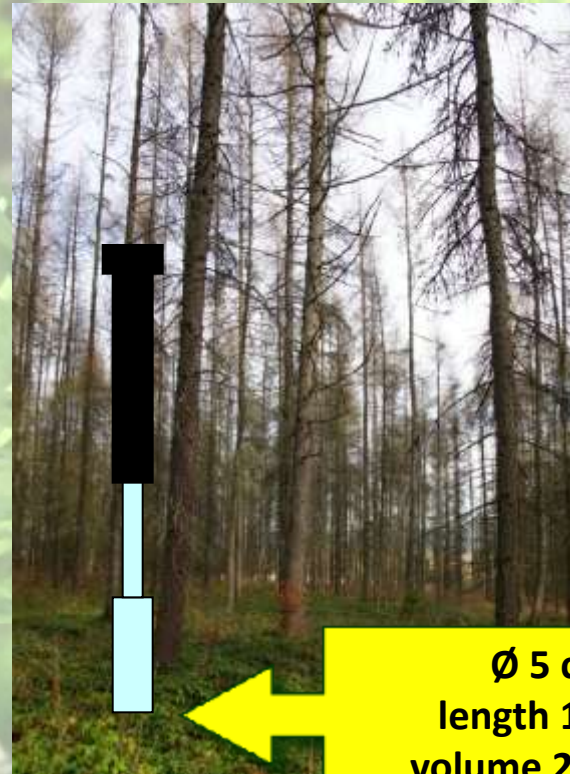
★ UNDER INVESTIGATION

How?

SAMPLING



SEEDLINGS



\varnothing 5 cm
length 10 cm
volume 200 cm³

MATURE TREES



Morphological methods = morphotyping



SHAPE AND DIMENSION:

type of ramification, length, diameter

FEATURES OF MANTLE SURFACE:

shiny, silvery, smooth

**densely or loosely: grainy, woolly, cottony,
stringy, spiny**

COLOUR OF MANTLE:

white, black, brown, orange, yellow

PRESENCE OF RHIZOMORPHS AND EMANATING HYPHAE



Molecular identification of detected morphotypes



DNA isolation



PCR amplification of ITS rDNA with fungal specific primer



Reference: Altshuler, Stephen F., Thomas L. Madden, Alejandro A. Schaffer, Zinghui Zhang, Zheng Zhang, Webb Miller, and David S. Lipman (1997), "Sapped BLAST and PSI-BLAST: a new generation of protein database search programs", *Nucleic Acids Res.* 25:3389-3402.

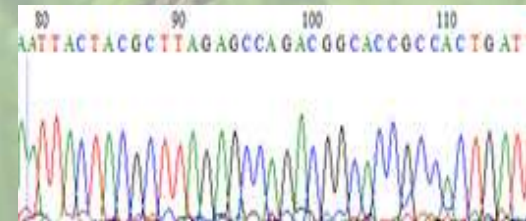
Query: H0866
(834 letters)

Database: data/Mycot.faa; data/ALL.faa
107,513 sequences; 64,569,192 total letters

Searching.....:done

Sequences producing significant alignments:	Score	E Value
GQ222881 uncultured ectomycorrhizal fungus	1417	0.0
GQ222882 uncultured ectomycorrhizal fungus	1376	0.0
GQ222776 uncultured ectomycorrhizal fungus	1366	0.0
F5521794 uncultured ectomycorrhizal fungus	1340	0.0
F2218314 uncultured ectomycorrhiza (Heliciummyces)	1344	0.0
GJ151741 uncultured ectomycorrhizal fungus	1344	0.0
GJ112821 voucherized mycorrhizae (Perizomyces)	1332	0.0
GJ112741 uncultured ectomycorrhiza (Cedopora)	1326	0.0
GJ112721 uncultured Helicium	1322	0.0
AT143284 uncultured ectomycorrhiza (Phialophora)	1316	0.0

BLAST search (NCBI, UNITE) and identification



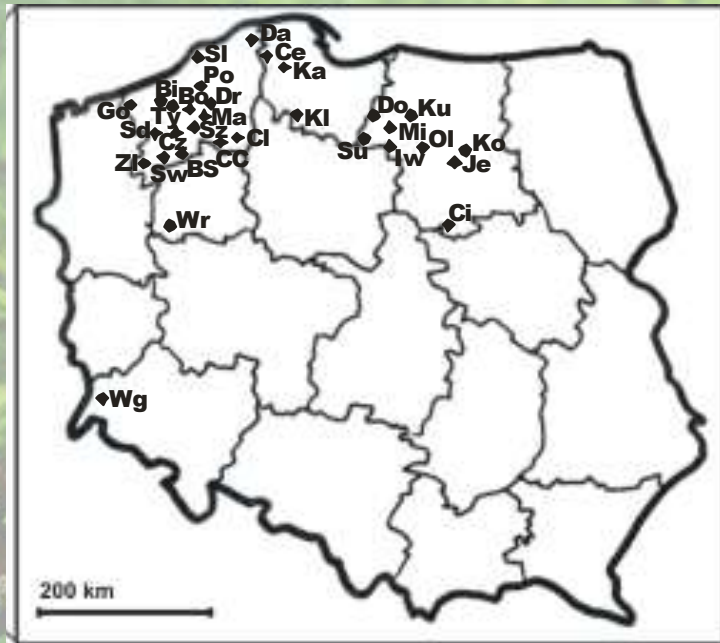
DNA sequencing



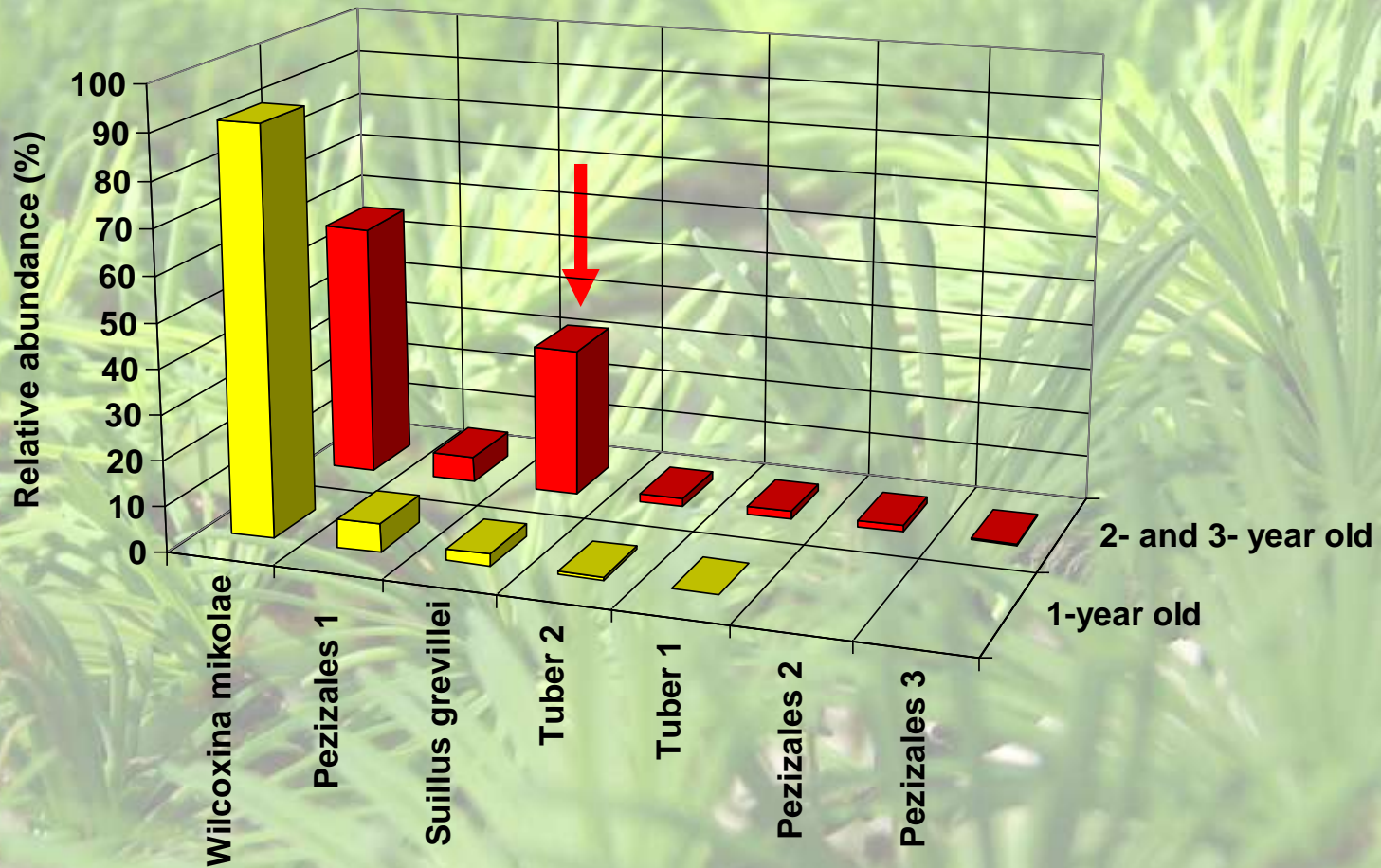


RESULTS

1. FOREST NURSERIES



Relative abundance of mycorrhizal fungal taxa found on 1-year- and 2 to 3-year-old European larch seedlings from bare-root forest nurseries



Low species richness and dominance of *Wilcoxina mikolae*





Wilcoxina mikolae



Suillus grevillei



NEW FUNGAL SPECIES/TAXA ON THE LIST OF MYCORRHIZAL PARTNERS OF LARIX DECIDUA

Wilcoxina mikolae, Tuber sp. 1, Tuber sp. 2, Pezizales 1, Pezizales 2, Pezizales 3 ...

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Journal homepage: www.elsevier.com/locate/foreco

The ectomycorrhizal status of European larch (*Larix decidua* Mill.) seedlings from bare-root forest nurseries

Tomasz Leski^a, Maria Rudawska^{a,*}, Algis Aučina^b

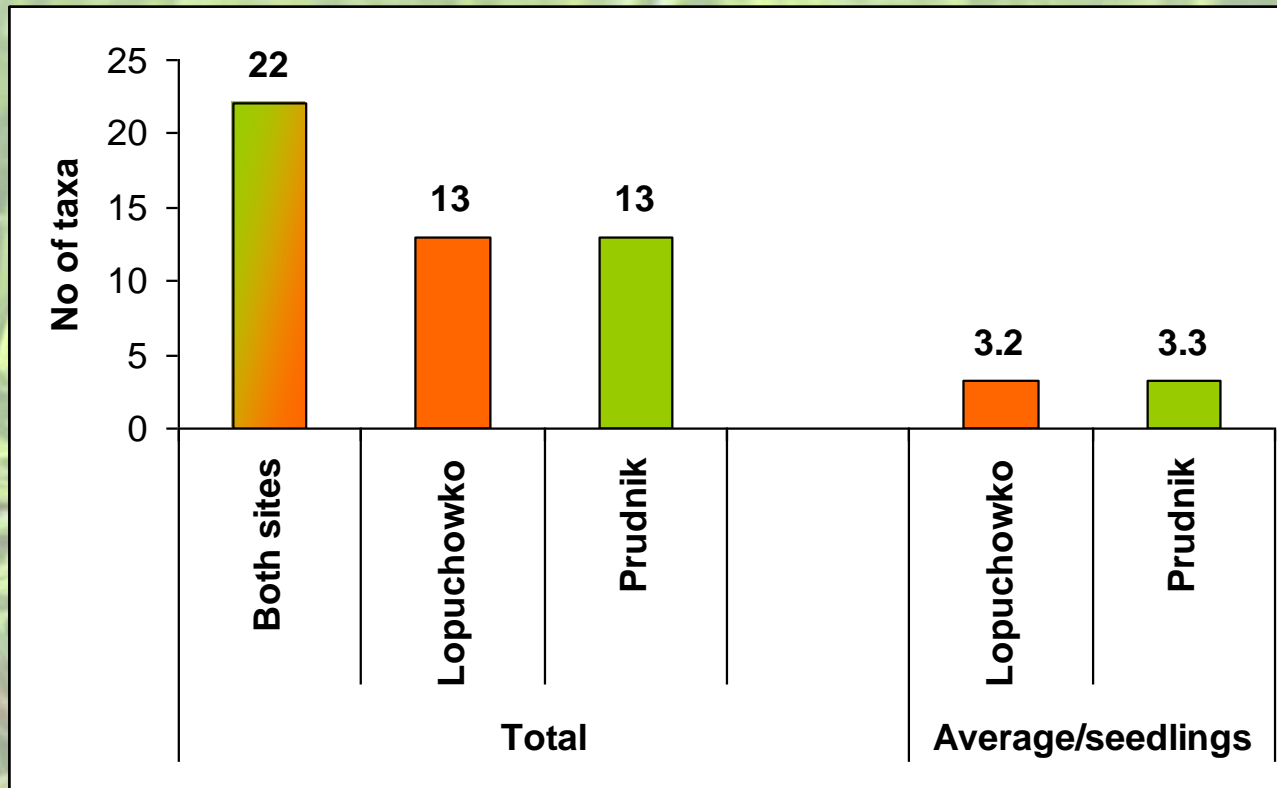
^aInstitute of Dendrology, Polish Academy of Sciences, 5 Parkowa Street, 62-035 Kórnik, Poland
^bBotanical Garden of Vilnius University, 43 Koivėnų Street, LT-10239 Vilnius-40, Lithuania



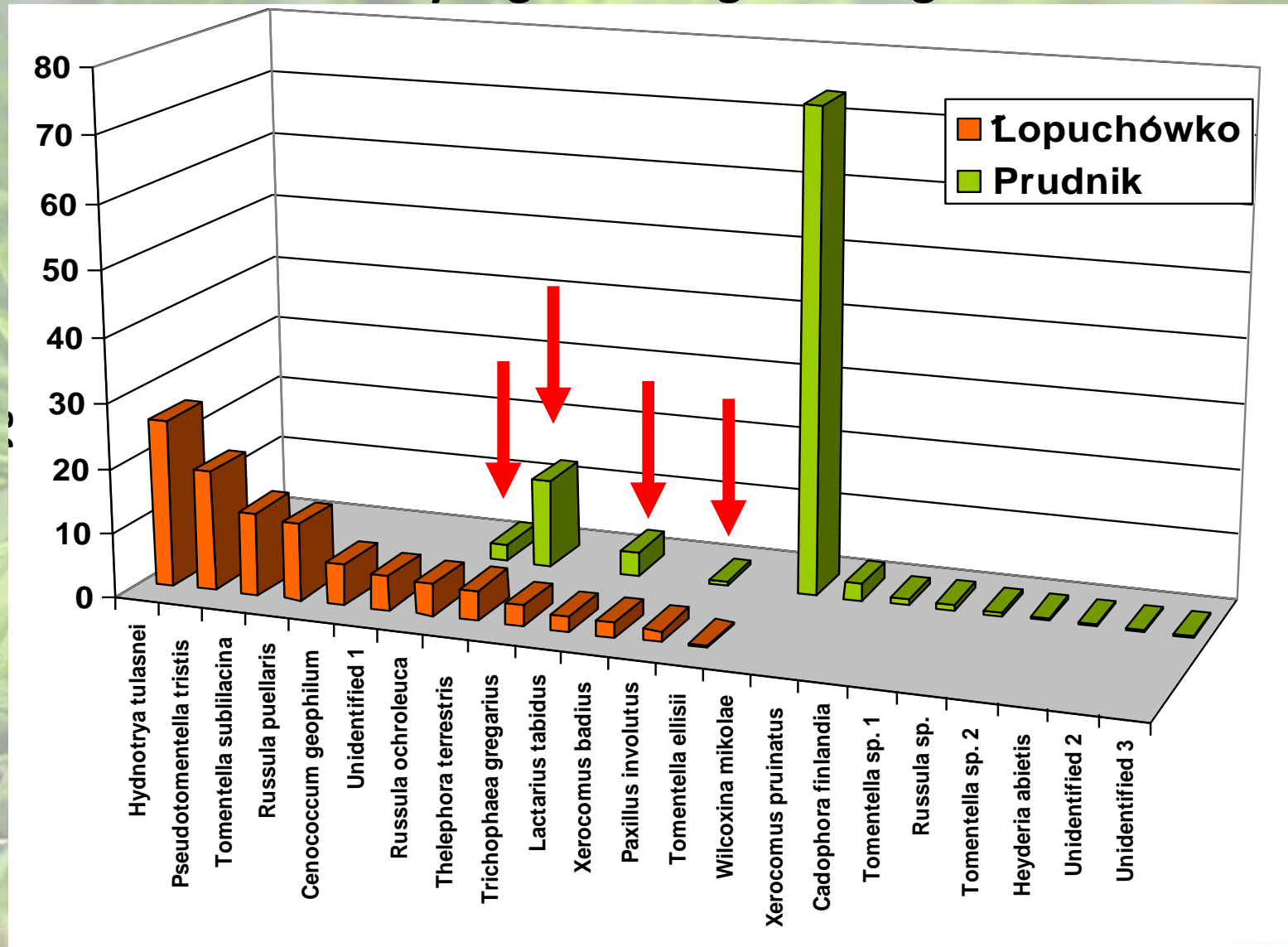
2. NATURAL REGENERATION



TAXA RICHNESS



Relative abundance of ectomycorrhizal taxa on the roots of naturally regenerating seedlings of *L. decidua*





Wilcoxina mikolae

LOPUCHOWKO



Hydnotrya tulasnei



Pseudotomentella tristis



Tomentalla sublilacina

LOPUCHOWKO



Rusulla puellaris



Rusulla ochroleuca

LOPUCHOWKO



Thelephora terrestris



Xerocomus pruinatus

NEW FUNGAL SPECIES/TAXA ON THE LIST OF MYCORRHIZAL PARTNERS OF LARIX DECIDUA

Wilcoxina mikolae, Tuber sp. 1, Tuber sp. 2, Pezizales 1, Pezizales 2, Pezizales 3 ,
Hydnotrya tulasnei, Tomentella sublilacina, Tomentella ellisii, Tomentella sp. 1,
Tomentella sp. 2, Pseudotomentella tristis, Russula puellaris, Russula ochroleuca,
Russula sp. 1, Thelephora terrestris, Heyderia abietis Trichophea gregaria, Lactarius
tabidus, Xerocomus badius, Xerocomus pruinatus, Cadophora finlandia...

Symbiosis (2012) 56:45–53
DOI 10.1007/s13199-012-0164-4

16 new taxa

Ectomycorrhizal fungal community of naturally regenerated European larch (*Larix decidua*) seedlings

Tomasz Leski • Maria Rudawska

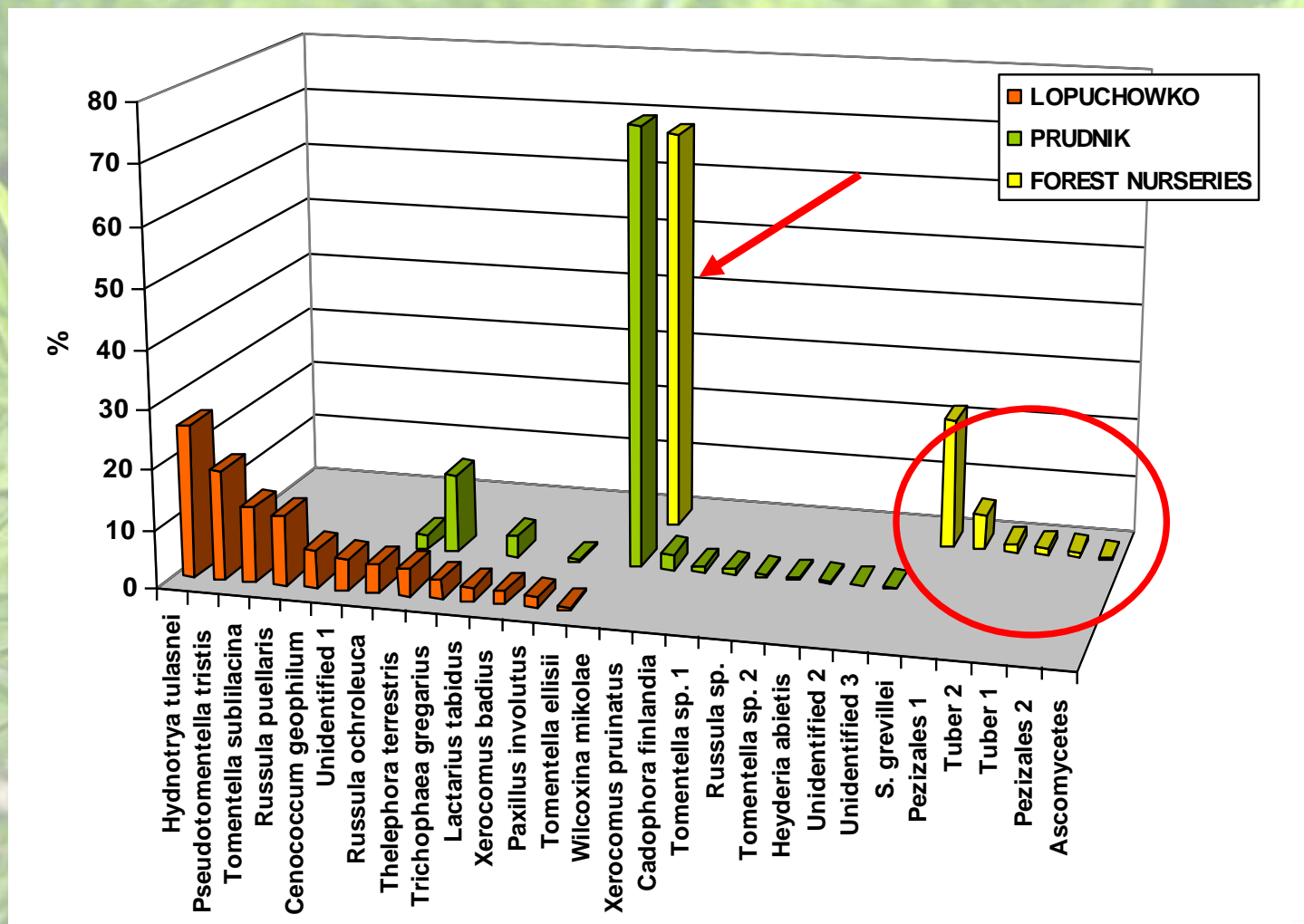


NATURAL REGENERATION VS. FOREST NURSERY



NATURAL REGENERATION VS. FOREST NURSERIES

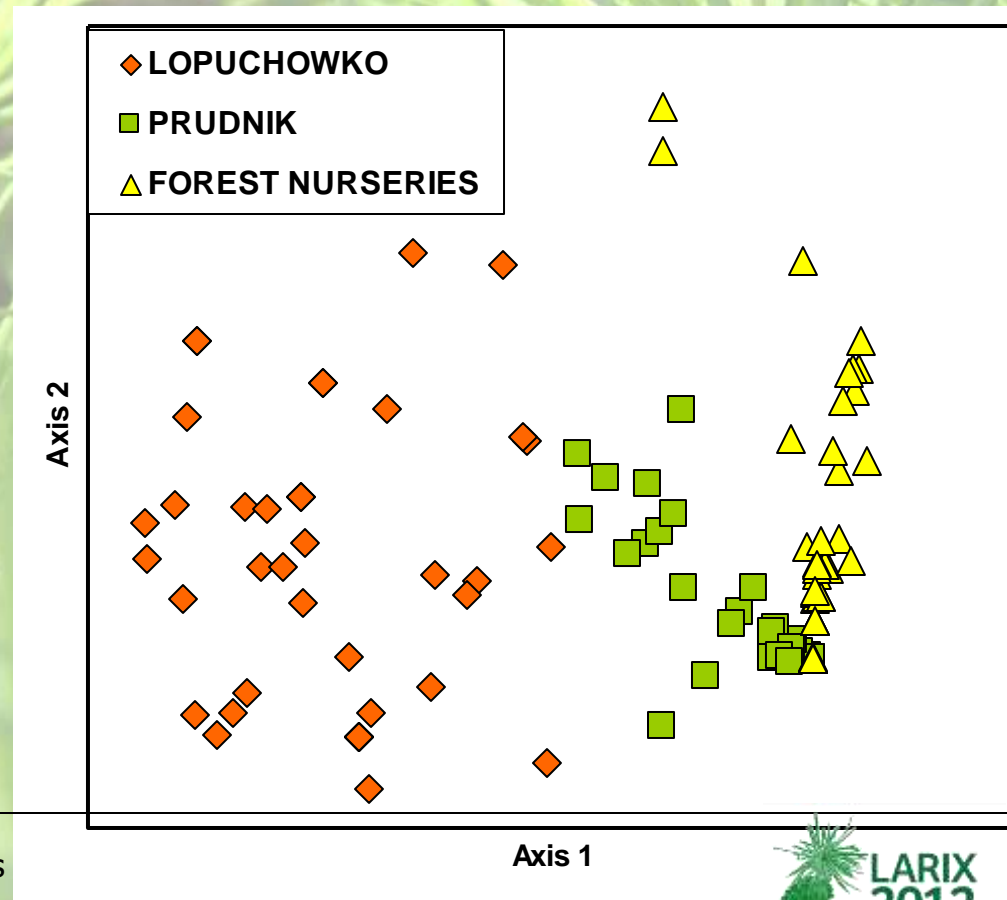
RELATIVE ABUNDANCE



NATURAL REGENERATION VS. FOREST NURSERIES

ANOSIM (analysis of similarities) and NMDS (non-metric multidimensional scaling)

R \ P	LOPUCHOWKO	PRUDNIK	FOREST NURSERIES
LOPUCHOWKO		0.0001	0.0001
PRUDNIK	0.667		0.0001
FOREST NURSERIES	0.804	0.267	



3. FOREST CHRONOSEQUENCE

„L”

Zielonka Forest
L. decidua
ŁOPUCHÓWKO

- 15 years
- 30 years
- 60 years
- 80 years
- 110 years
- 200 years

„H1”

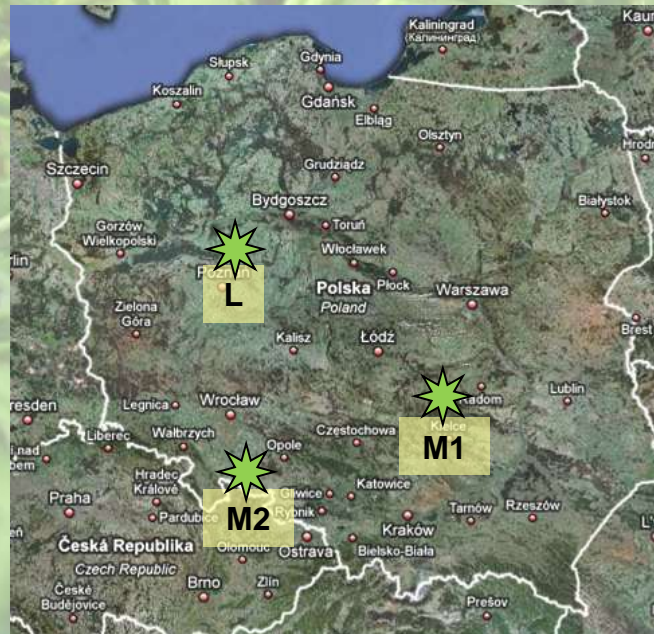
Świętokrzyskie Mountains
L. decidua subsp. *polonica*
SUCHEDNIÓW

- 10 years
- 20 years
- 60 years
- 80 years
- 150 years

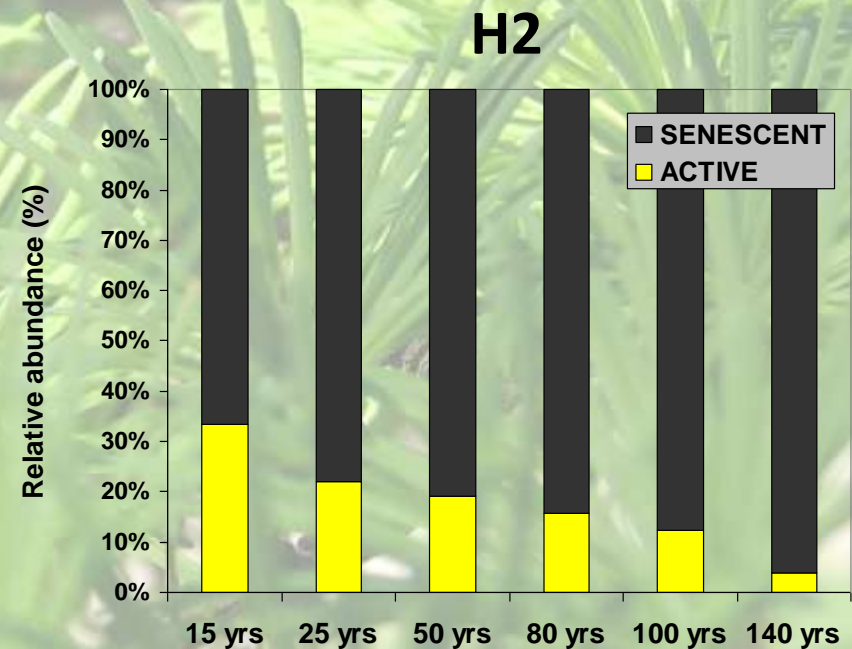
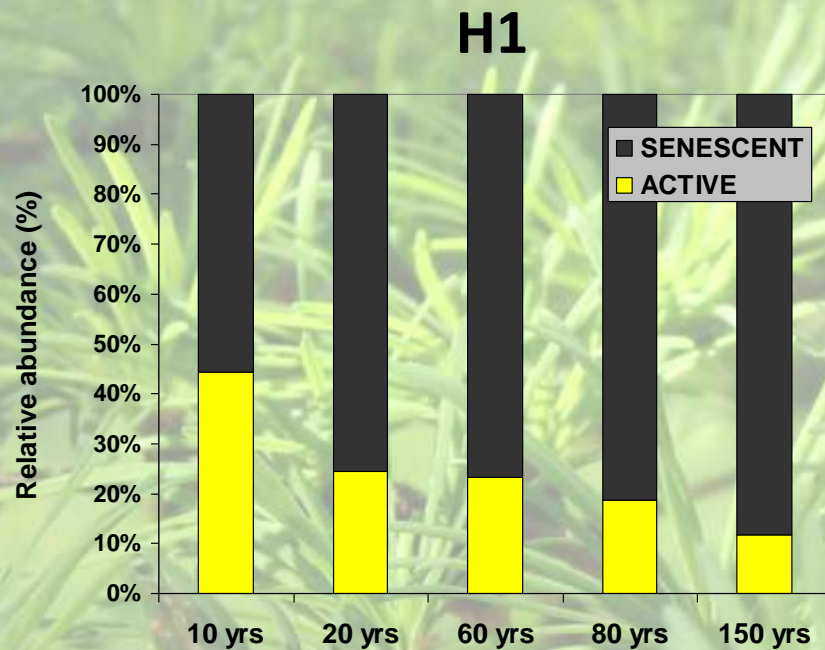
„H2”

Opawskie Mountains
L. decidua subsp. *decidua* var. *sudetica*
PRUDNIK

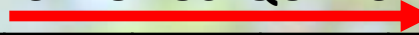
- 15 years
- 25 years
- 50 years
- 80 years
- 100 years
- 140 years



Relative abundance of senescent/dead and active mycorrhizas in a chronosequence of *L. decidua*



CHRONOSEQUENCE

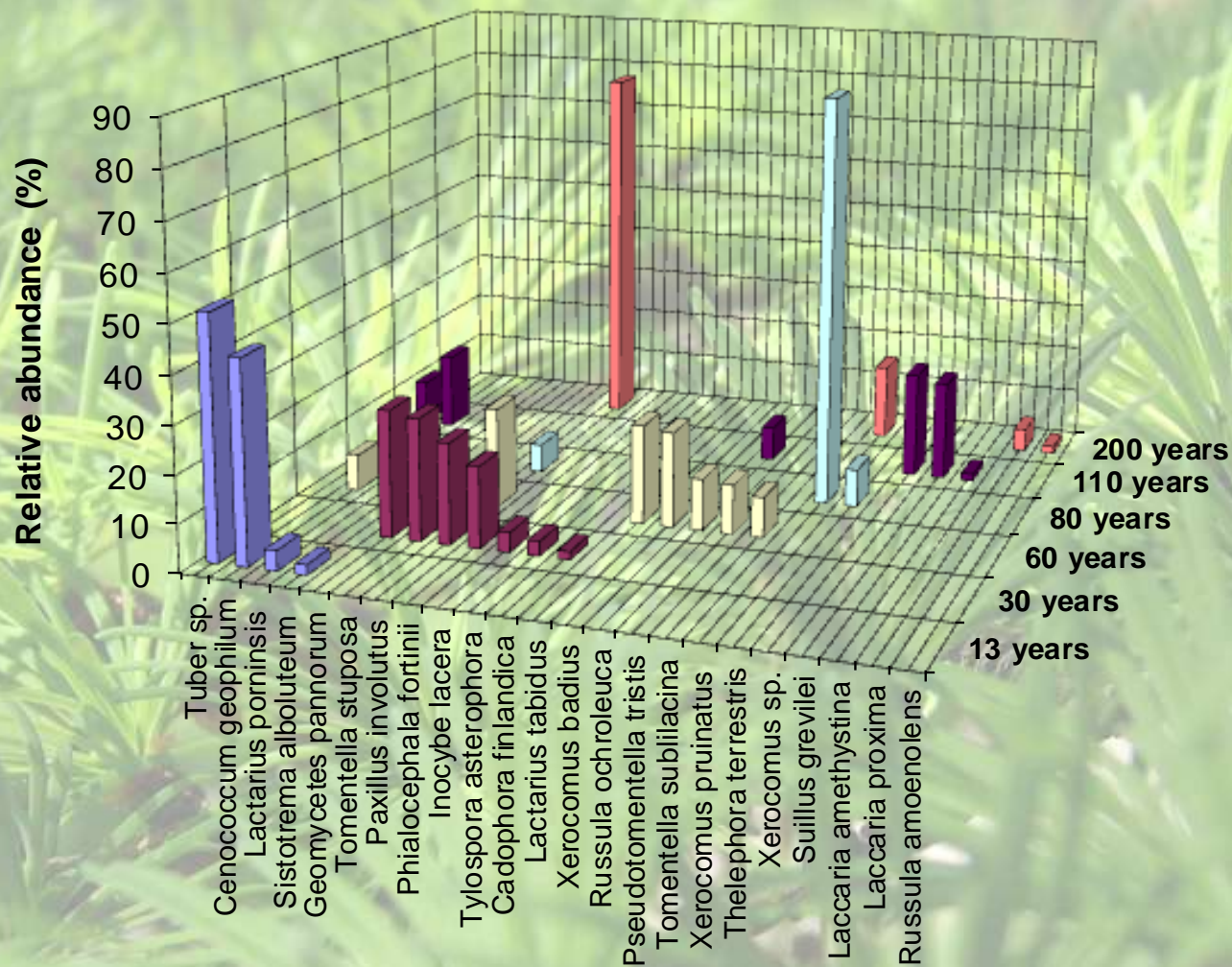


Ectomycorrhizal fungal taxa in the chronosequence of *Larix decidua* at „L”stand

Total taxa richness = 23

	15 years	30 years	60 years	80 years	110 years	200 years
<i>Cenococcum geophilum</i>	Orange	Green	Orange	Green	Orange	Green
<i>Tuber</i> sp.	Orange	Green	Green	Green	Orange	Green
<i>Lactarius porninsis</i>	Orange	Green	Green	Green	Green	Green
<i>Sistotrema alboluteum</i>	Orange	Green	Green	Green	Green	Green
typ <i>Lactarius</i>	Green	Orange	Green	Green	Green	Green
<i>Tomentella stuposa</i>	Green	Orange	Green	Green	Green	Green
<i>Paxillus involutus</i>	Green	Orange	Orange	Orange	Green	Orange
<i>Phialocephala fortinii</i>	Green	Orange	Green	Green	Green	Green
<i>Inocybe lacera</i>	Green	Orange	Green	Green	Green	Green
<i>Tylospora asterophora</i>	Green	Orange	Green	Green	Green	Green
<i>Cadophora finlandica</i>	Green	Orange	Green	Green	Green	Green
<i>Lactarius tabidus</i>	Green	Green	Orange	Green	Green	Green
<i>Xerocomus badius</i>	Green	Green	Orange	Green	Green	Green
<i>Russula ochroleuca</i>	Green	Green	Orange	Green	Orange	Green
<i>Pseudotomentella tristis</i>	Green	Green	Orange	Green	Green	Green
<i>Tomentella subilacina</i>	Green	Green	Orange	Green	Orange	Green
<i>Xerocomus pruinatus</i>	Green	Green	Green	Orange	Green	Orange
<i>Thelephora terrestris</i>	Green	Green	Green	Orange	Green	Green
<i>Xerocomus</i> sp.	Green	Green	Green	Green	Orange	Green
<i>Suillus grevillei</i>	Green	Green	Green	Green	Orange	Green
<i>Laccaria amethystina</i>	Green	Green	Green	Green	Orange	Green
<i>Laccaria proxima</i>	Green	Green	Green	Green	Green	Orange
<i>Russula amoenolens</i>	Green	Green	Green	Green	Green	Orange
TAXA RICHNESS	4	7	7	3	7	5

Relative abundance of ectomycorrhizal fungal taxa in the chronosequence of *L. decidua* at „L” stand



Pairwise analysis of similarities (ANOSIM) of ECM fungal communities structure in a chronosequence of *L. decidua* at „L” stand.

Global R = 0.26, p = 0.0001

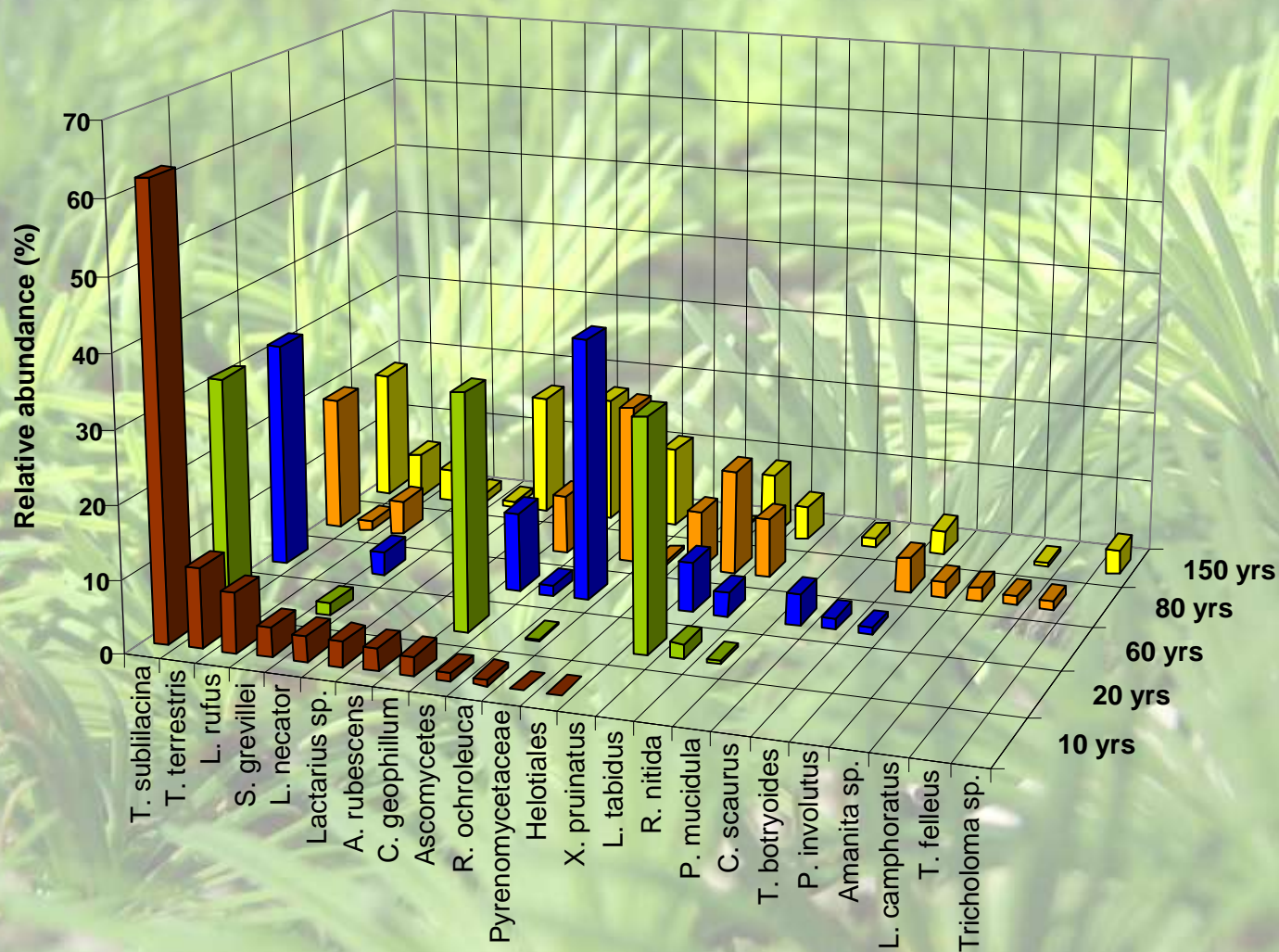
	15 yrs	30 yrs	60 yrs	80 yrs	110 yrs	200 yrs
15 yrs		0,001	0,014	0,0533	0,0442	0,0033
30 yrs	0,39		0,0001	0,0001	0,0001	0,0001
60 yrs	0,15	0,37		0,0001	0,0170	0,0047
80 yrs	0,08	0,41	0,3039		0,0011	0,0169
110 yrs	0,11	0,46	0,1205	0,2745		0,0001
200 yrs	0,22	0,27	0,1709	0,1566	0,3488	

Ectomycorrhizal fungal taxa in
the chronosequence of *Larix
decidua* at „H1”stand

Total taxa richness = 23

	10 years	20 years	60 years	80 years	150 years
T. sublilacina					
T. terrestris					
L. rufus					
S. grevillei					
L. necator					
Lactarius sp.					
A. rubescens					
C. geophillum					
Ascomycetes					
R. ochroleuca					
Pyrenomycetaceae					
Helotiales					
X. pruinatus					
L. tabidus					
R. nitida					
P. mucidula					
C. scaurus					
T. botryoides					
P. involutus					
Amanita sp.					
L. camphoratus					
T. felleus					
Tricholoma sp.					
TAXA RICHNESS	12	7	10	15	16

Relative abundance of ectomycorrhizal fungal taxa in the chronosequence of *L. decidua* at „H1” stand



Ectomycorrhizal fungal taxa in the chronosequence of *Larix decidua* at „H2” stand

Total taxa richness = 20

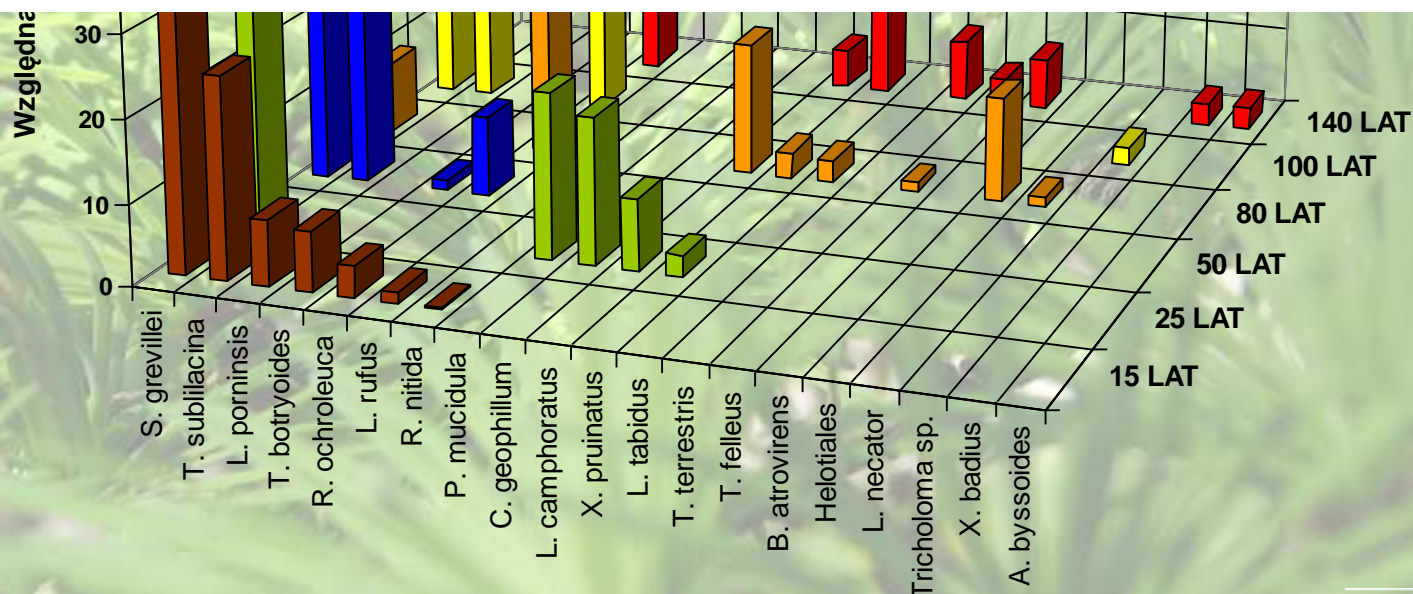
	CHRONOSEQUENCE					
	15 years	25 years	50 years	80 years	100 years	140 years
<i>S. grevillei</i>	Orange	Orange	Orange	Orange	Orange	Grey
<i>T. sublilacina</i>	Orange	Grey	Orange	Grey	Orange	Orange
<i>L. porninsis</i>	Orange	Grey	Grey	Grey	Grey	Grey
<i>T. botryoides</i>	Orange	Grey	Orange	Grey	Grey	Grey
<i>R. ochroleuca</i>	Orange	Grey	Orange	Orange	Orange	Orange
<i>L. rufus</i>	Orange	Grey	Grey	Orange	Grey	Grey
<i>R. nitida</i>	Orange	Grey	Grey	Grey	Grey	Grey
<i>P. mucidula</i>	Grey	Orange	Grey	Grey	Grey	Grey
<i>C. geophillum</i>	Grey	Orange	Grey	Grey	Grey	Grey
<i>L. camphoratus</i>	Grey	Orange	Grey	Orange	Grey	Orange
<i>X. pruinatus</i>	Grey	Orange	Grey	Orange	Grey	Orange
<i>L. tabidus</i>	Grey	Grey	Grey	Orange	Grey	Grey
<i>T. terrestris</i>	Grey	Grey	Grey	Grey	Grey	Orange
<i>T. felleus</i>	Grey	Grey	Grey	Orange	Grey	Orange
<i>B. atrovirens</i>	Grey	Grey	Grey	Grey	Grey	Orange
Helotiales	Grey	Grey	Grey	Orange	Grey	Grey
<i>L. necator</i>	Grey	Grey	Grey	Orange	Grey	Grey
<i>Tricholoma sp.</i>	Grey	Grey	Grey	Grey	Orange	Grey
<i>X. badius</i>	Grey	Grey	Grey	Grey	Grey	Orange
<i>A. byssoides</i>	Grey	Grey	Grey	Grey	Grey	Orange
TAXA RICHNESS	7	5	4	9	4	9

Relative abundance of ectomycorrhizal fungal taxa in the chronosequence of *L. decidua* at „H2” stand

No effect of chronosequence on ectomycorrhizal fungal communities.

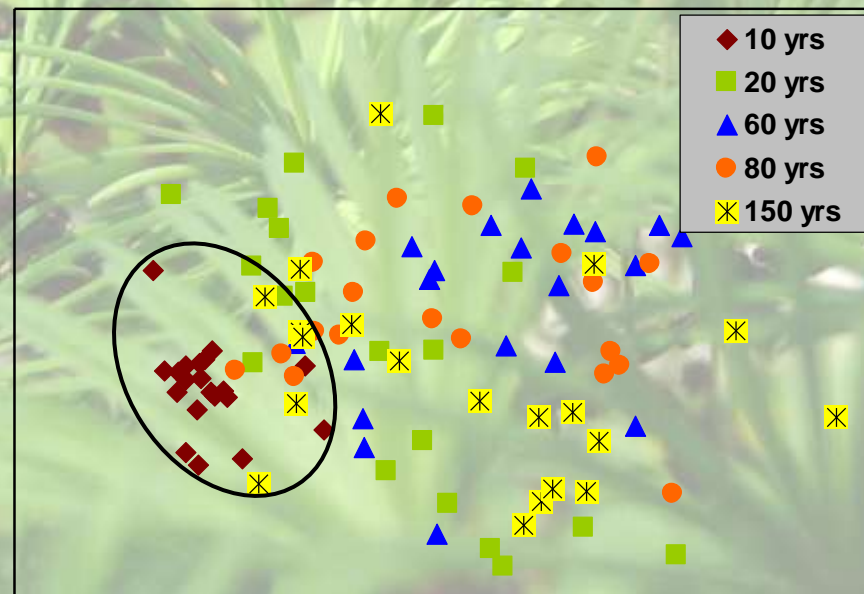
Analysis of similarities – ANOSIM:
„H1” – $R=0.11$, $p=0.29$

„H2” - global $R = 0.14$, $p = 0.11$



Pairwise analysis of similarities (ANOSIM) and Nonmetric Multidimensional Scaling (NMDS) ordination of ECM fungal communities structure in a chronosequence of *L. decidua* at „H1” stands

R \ p	10 yrs	20 yrs	60 yrs	80 yrs	150 yrs
10 yrs		0.000	0.000	0.000	0.001
20 yrs	0.55		0.141	0.101	0.078
60 yrs	0.58	0.12		0.675	0.141
80 yrs	0.58	0.13	-0.06		0.565
150 yrs	0.50	0.19	0.12	-0.04	



Tuber sp.



Cenococcum geophilum



Xerocomus pruinatus



*Tomentella
sublilacina*



Pseuotomentella tristis



Paxillus involutus



Lactarius porninsis



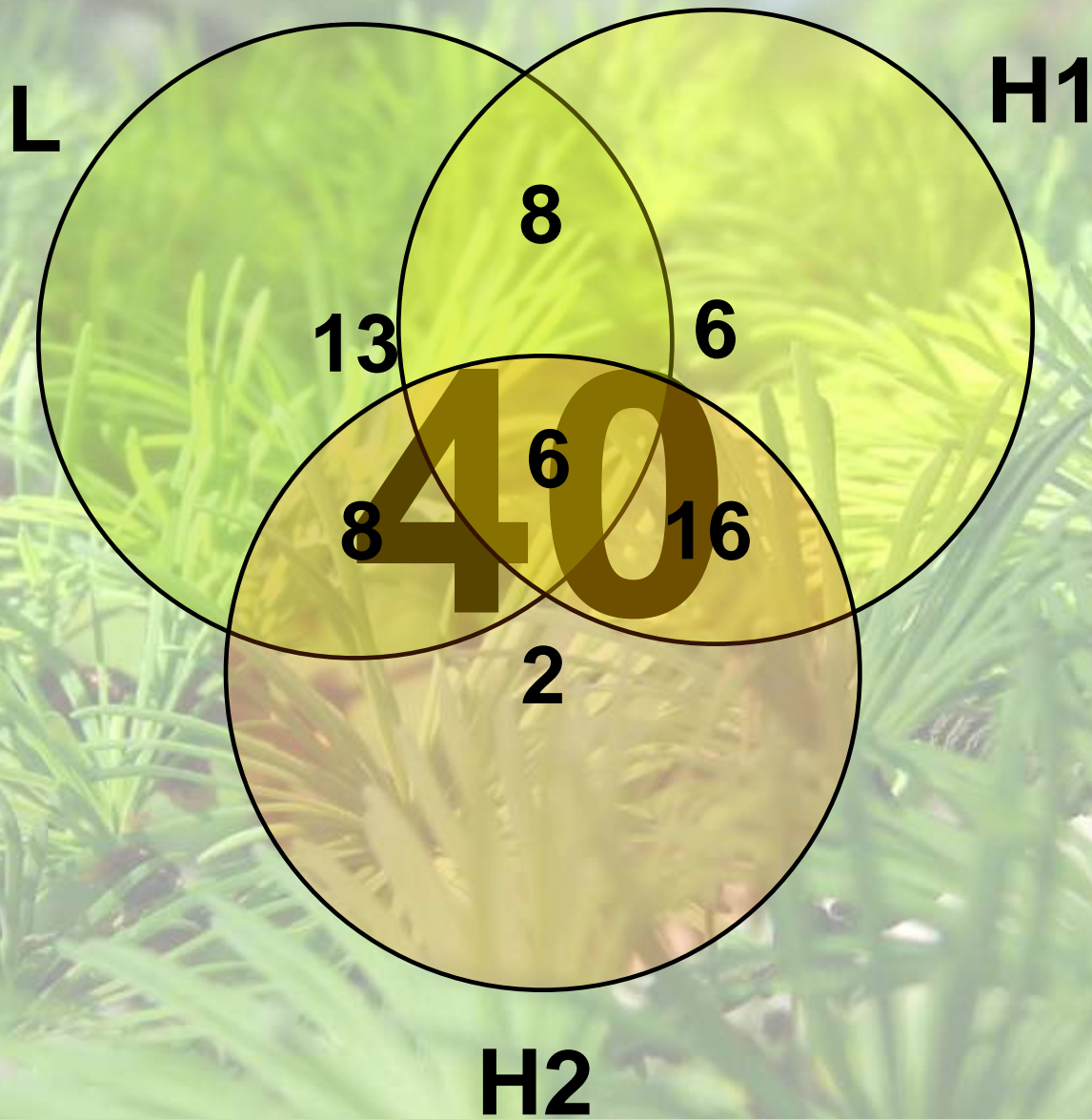
Russula ochroleuca



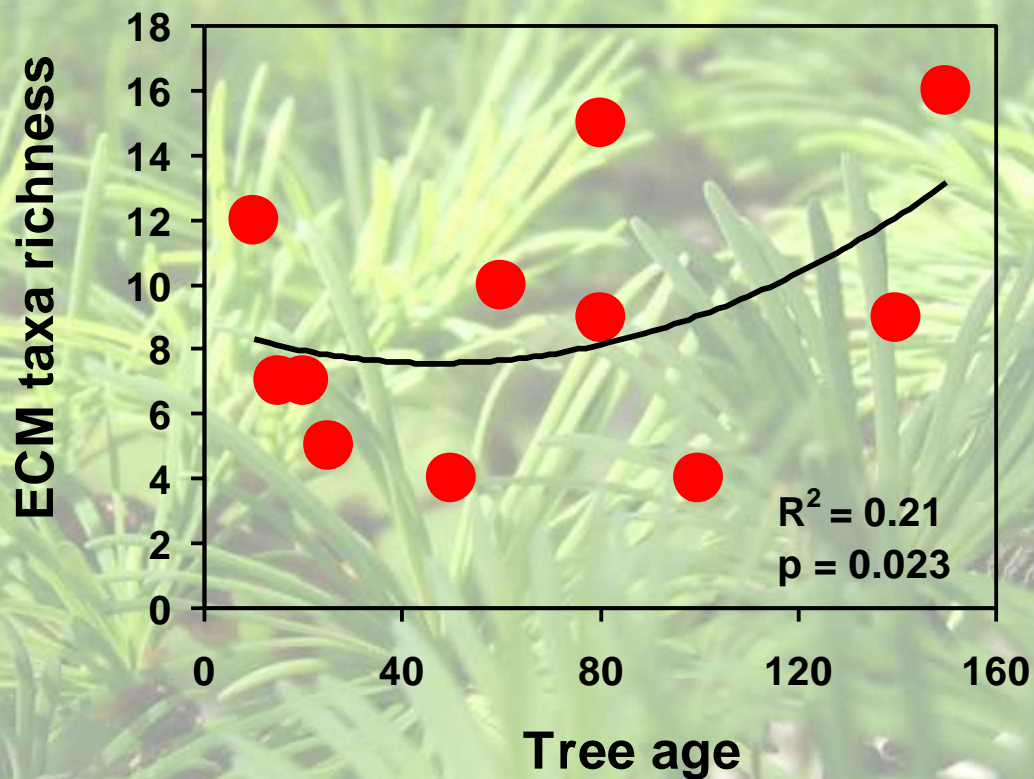
Laccaria amethystina



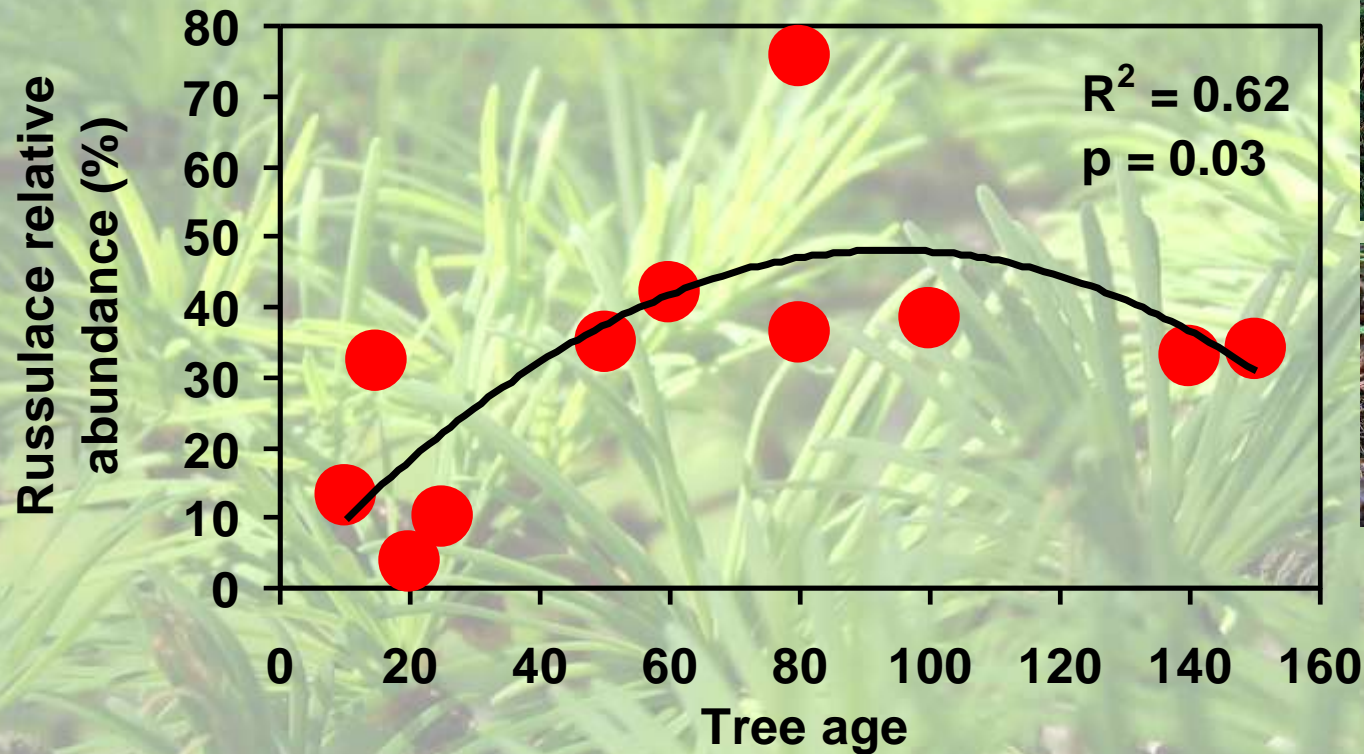
VENN DIAGRAM OF ECM FUNGAL TAXA RICHNESS



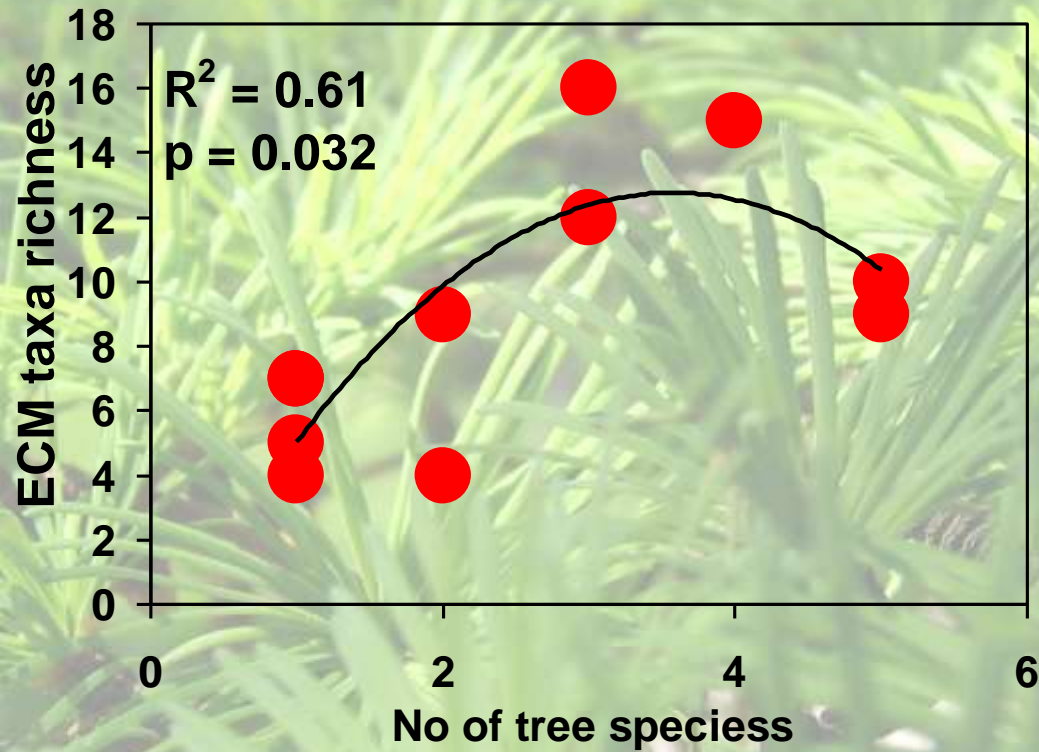
Relationship between tree age and ECM fungal taxa richness in a chronosequence of *L. decidua*



Relationship between tree age and abundance of ECM fungal taxa from Russulaceae family in a chronosequence of *L. decidua*



Relationship between number of tree species and ECM fungal taxa richness in a chronosequence of *L. decidua*



NEW FUNGAL SPECIES/TAXA ON THE LIST OF MYCORRHIZAL PARTNERS OF LARIX DECIDUA

Wilcoxina mikolae, Tuber sp. 1, Tuber sp. 2, Pezizales 1, Pezizales 2, Pezizales 3, Hydnotrya tulasnei, Tomentella sublilacina, Tomentella ellisii, Tomentella sp. 1, Tomentella sp. 2, Pseudotomentella tristis, Russula puellaris, Russula ochroleuca, Russula sp. 1, Thelephora terrestris, Heyderia abietis Trichophea gregaria, Lactarius tabidus, Xerocomus badius, Xerocomus pruinatus, Cadophora finlandica, **Sistotrema alboluteum, Tomentella stuposa, Phialocephala fortini, Inocybe lacera, Tylospora asterophora, Xerocomus sp. 1., Laccaria amethystina, Laccaria proxima, Russula amoenolens, Lactarius necator, Lactarius sp. 1, Amanita rubescens, Pyrenomycetaceae, Helotiales, Russula nitida, Pseudotomentella mucidula, Cortinarius scaurus, Tomentella botryoides, Amanita sp. 1, Lactarius camphoratus, Tylopilus felleus, Tricholoma sp., Byssocorticium atrovirens, Amphinema byssoides ...**

24 new taxa



4. EFFECT OF ALTITUDE (m a.s.l.) (IZERSKIE MOUNTAINS)



610 m a.s.l.



860 m a.s.l.



1100 m a.s.l.

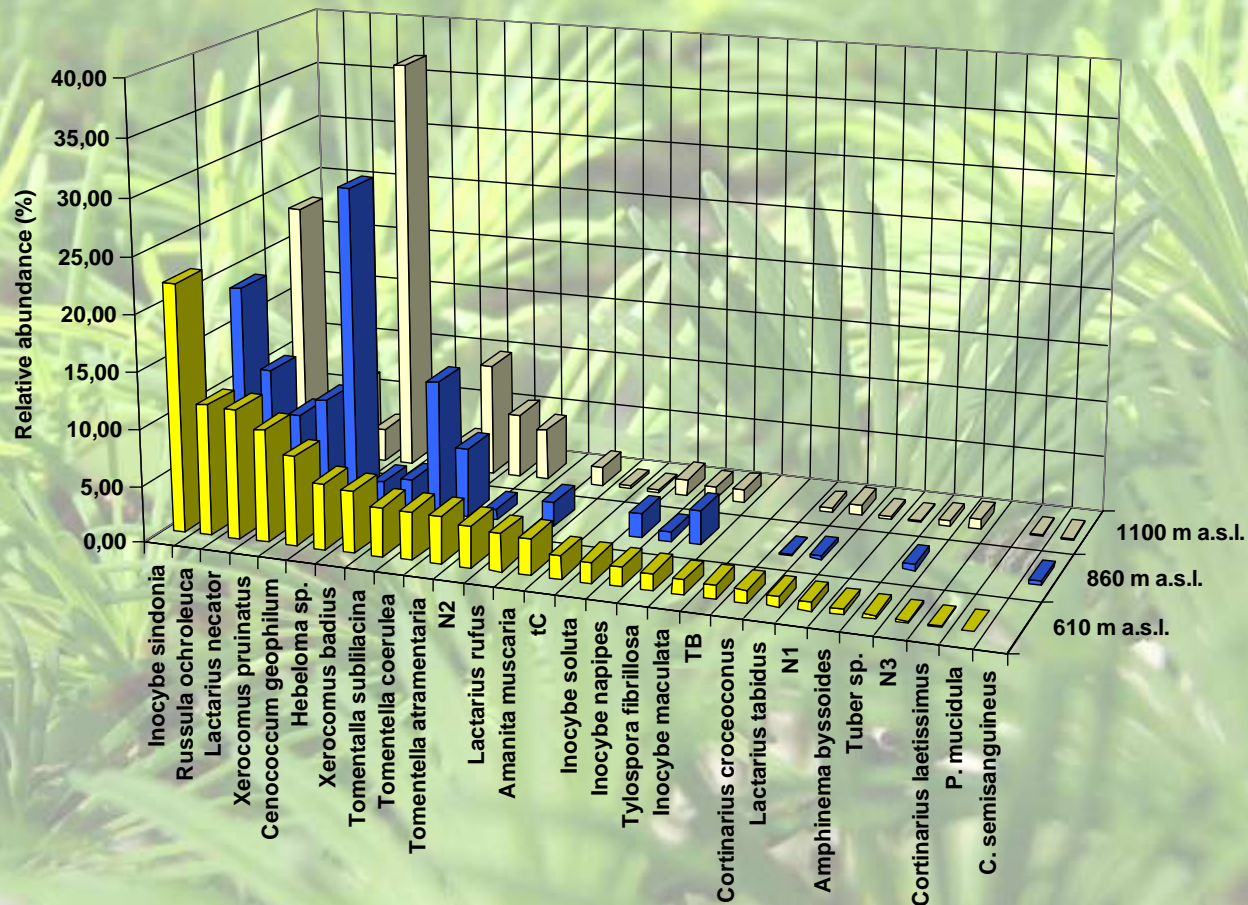


**Ectomycorrhizal fungal taxa from
Larix decidua stands located at
610, 860 and 1100 m a.s.l. in the
Izerskie Mountains**

Total taxa richness = 28

	610 m a.s.l.	860 m a.s.l.	1100 m a.s.l.
<i>Cenococcum geophilum</i>			
<i>Inocybe sindonia</i>			
<i>Tomentella coerulea</i>			
<i>Tomentella atramentaria</i>			
<i>Lactarius necator</i>			
<i>Xerocomus pruinatus</i>			
<i>Lactarius rufus</i>			
<i>Tylospora fibrillosa</i>			
<i>Inocybe napipes</i>			
<i>Lactarius tabidus</i>			
<i>Xerocomus badius</i>			
N1			
<i>Amanita muscaria</i>			
<i>Tomentella sublilacina</i>			
<i>Amphinema byssoides</i>			
<i>Cortinarius sp.</i>			
<i>Inocybe soluta</i>			
<i>Pseudotomentella mucidula</i>			
<i>Tuber sp.</i>			
<i>Hebeloma sp.</i>			
N3			
<i>Cortinarius croceoconus</i>			
<i>Cortinarius semisanguineus</i>			
<i>Russula ochroleuca</i>			
N2			
TB			
<i>Inocybe maculata</i>			
<i>Cortinarius laetissimus</i>			
TAXA RICHNESS	27	18	23

Effect of altitude on relative abundance of ectomycorrhizal fungal taxa on the roots of *L. decidua* trees in Izerskie Mountains



Statistical analysis (ANOSIM) did not show significant effect of altitude on ECM fungal communities

Lactarius tabidus



Lactarius necator



Xerocomus badius



Inocybe sindonia



Inocybe soluta



Inocybe napipes



Cortinarius laetissimus



Hebeloma sp.



Dermocybe semisanguinea



NEW FUNGAL SPECIES/TAXA ON THE LIST OF MYCORRHIZAL PARTNERS OF LARIX DECIDUA

Wilcoxina mikolae, Tuber sp. 1, Tuber sp. 2, Pezizales 1, Pezizales 2, Pezizales 3, Hydnotrya tulasnei, Tomentella sublilacina, Tomentella ellisii, Tomentella sp. 1, Tomentella sp. 2, Pseudotomentella tristis, Russula puellaris, Russula ochroleuca, Russula sp. 1, Thelephora terrestris, Heyderia abietis Trichophea gregaria, Lactarius tabidus, Xerocomus badius, X. pruinatus, Cadophora finlandica, Sistotrema alboluteum, Tomentella stipitata, Phialocephala fortini, Inocybe lacera, Tylospora asterophora, Xerocomus sp. 1., Laccaria amethystina, Laccaria proxima, Russula amoenolens, Lactarius necator, Lactarius sp. 1, Amanita rubescens, Pyrenomycetaceae, Helotiales, Russula nitida, Pseudotomentella mucidula, Cortinarius scaurus, Tomentella botryoides, Amanita sp. 1, Lactarius camphoratus, Tylopilus felleus, Tricholoma sp., Byssocorticium atrovirens, Amphinema byssoides, **Inocybe sindonia, Inocybe napipes, Inocybe soluta, Inocybe maculata, Tomentella coerulea, Tomentella atramentaria, Tylospora fibrilosa, Amanita muscaria, Hebeloma sp., Cortinarius croceoconus, Cortinarius semisanguineus, Cortinarius leatissimus ...**

12 new taxa



5. TREE GENOTYPE EFFECT (PROVENANCE TRIAL)

LP1 - *L. decidua* subsp. *polonica* - Bliżyn

LP2 - *L. decidua* subsp. *polonica* - Świątokrzyski N.P.

LS1 - *L. decidua* subsp. *decidua* var. *sudetica* - Szczytna

LS2 - *L. decidua* subsp. *decidua* var. *sudetica* - Kowary



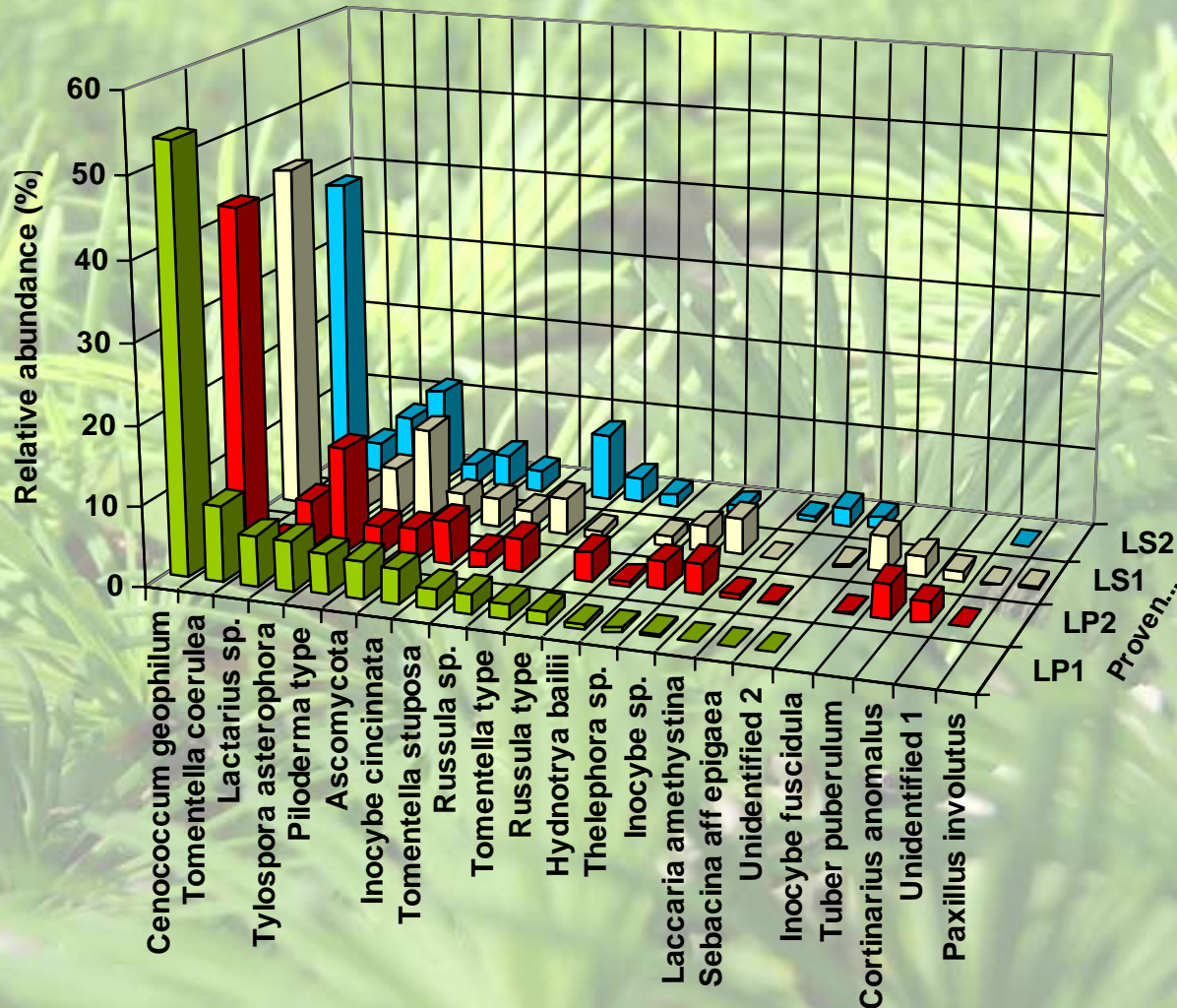
PROVENANCE TRIAL
(BESKID SADECKI MOUNTAINS)

**Ectomycorrhizal fungal taxa
hosted by different
provenances of *Larix decidua*
grown in provenances trial in
the Beskid Sądecki Mountains**

Total taxa richness = 22

	LP1	LP2	LS1	LS2
<i>Cenococcum geophilum</i>				
<i>Tomentella coerulea</i>				
<i>Lactarius sp.</i>				
<i>Tylospora asterophora</i>				
<i>Piloderma type</i>				
<i>Ascomycota</i>				
<i>Inocybe cincinnata</i>				
<i>Russula sp.</i>				
<i>Thelephora sp.</i>				
<i>Laccaria amethystina</i>				
<i>Tomentella stuposia</i>				
<i>Hydnotrya bailii</i>				
<i>Inocybe sp.</i>				
<i>Russula type</i>				
<i>Sebacina aff epigaea</i>				
<i>Tomentella type</i>				
<i>Unidentified 2</i>				
<i>Inocybe fuscidula</i>				
<i>Tuber puberulum</i>				
<i>Cortinarius anomalus</i>				
<i>Unidentified 1</i>				
<i>Paxillus involutus</i>				
TAXA RICHNESS	17	19	20	15

Relative abundance of ectomycorrhizal fungal taxa on the roots of *L. decidua* trees from provenance trial in the Beskid Sadecki Mountains



Statistical analysis (ANOSIM) did not show significant effect of larch genotype on ECM fungal communities



Tylospora asterophora



Cortinarius anomalus



Inocybe cincinata



Inocybe fuscidula



Hydnotrya bailii



Tuber puberulum



Sebacina epigea



Tomentella coerulea



Tomentella stuposa



NEW FUNGAL SPECIES/TAXA ON THE LIST OF MYCORRHIZAL PARTNERS OF LARIX DECIDUA

Wilcoxina mikolae, Tuber sp. 1, Tuber sp. 2, Pezizales 1, Pezizales 2, Pezizales 3, Hydnotrya tulasnei, Tomentella sublilacina, Tomentella ellisii, Tomentella sp. 1, Tomentella sp. 2, Pseudotomentella tristis, Russula puellaris, Russula ochroleuca, Russula sp. 1, Thelephora terrestris, Heyderia abietis Trichophea gregaria, Lactarius tabidus, Xerocomus badius, Xerocomus pruinosus, Cadophora finlandica, Sistotrema alboluteum, Tomentella stipitata, Phialocephala fortini, Inocybe lacera, Tylospora asterophora, Xerocomus sp. 1., Laccaria amethystina, Laccaria proxima, Russula amoenolens, Lactarius necator, Lactarius sp. 1, Amanita rubescens, Pyrenomycetaceae, Helotiales, Russula nitida, Pseudotomentella mucidula, Cortinarius scaurus, Tomentella botryoides, Amanita sp. 1, Lactarius camphoratus, Tylopilus felleus, Tricholoma sp., Byssocorticium atrovirens, Amphinema byssoides, Inocybe sindonia, Inocybe napipes, Inocybe soluta, Inocybe maculata, Tomentella coerulea, Tomentella atramentaria, Tylospora fibrilosa, Amanita muscaria, Hebeloma sp., Cortinarius croceoconus, Cortinarius semisanguineus, Cortinarius leatissimus, **Inocybe cincinata, Inocybe fuscidula, Inocybe sp. 1, Cortinarius anomalus, Sebacina epigea, Hydnotrya bailii, Tuber puberulum, Russula sp. 2, Lactarius sp. 2**

9 new taxa



SUMMARY

TAXA RICHNESS

FOREST NURSERIES - 7

NATURAL REGENERATION - 22

CHRONOSEQUENCE - 40

ALTITUDE – 28

PROVENANCE TRIAL - 22

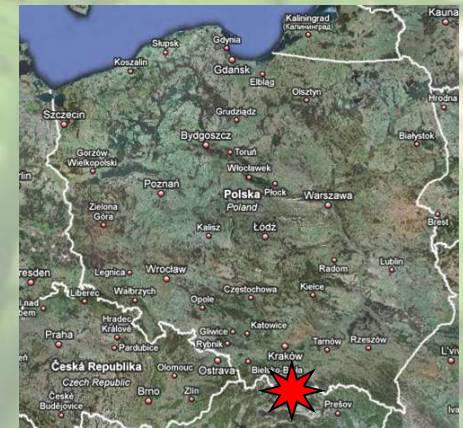


83 TAXA + 8 unidentified morphotypes



UNDER INVESTIGATION

ECM FUNGAL COMMUNITY OF EUROPEAN LARCH IN THE TATRA MOUNTAINS





Thanks for your attention

Greetings from Kórnik



ANOSIM (analysis of similarities) and NMDS (non-metric multidimensional scaling)

Comparison of taxonomic composition of the ectomycorrhizal community among both sites was also calculated using the Bray–Curtis dissimilarity coefficient which has been shown to be one of the most robust coefficients for the analysis of taxonomic composition data.

To test the significance of taxonomic differences due to location the Bray–Curtis matrix was subjected to the simple non-parametric permutation procedure - analysis of similarities (ANOSIM).

The R value in ANOSIM is equal to 1 if there is a complete separation of groups and 0 when groups are similar and has a measure of statistical significance (P) attached to it.

Non-metric multidimensional scaling (NMDS) is an effective method available for the ordination of taxonomic composition data and provided a visual summary of the pattern of Bray–Curtis values for the comparison of ectomycorrhizal fungal composition on tested sites.

PODSUMOWANIE

- ❖ Zbiorowiska grzybów ektomikoryzowych towarzyszących modrzewiowi zmieniają się w układzie chronosekwencji stanowisk
- ❖ Wysokość nad poziomem morza tylko w niewielkim stopniu kształtuje zbiorowiska grzybów ektomikoryzowych towarzyszących modrzewiowi
- ❖ Sezon w istotnym stopniu modyfikuje bogactwo gatunkowe grzybów mikoryzowych towarzyszących modrzewiowi (Góry Izerskie)
- ❖ Naturalnie odnawiające się siewki modrzewia mogą być traktowane jako „naturalne pułapki” na grzyby ektomikoryzowe

Research potential of Institute of Dendrology in forest ecosystem genomics



INSTITUTE OF DENDROLOGY

Polish Academy of Sciences

The Institute of Dendrology is a Polish unique centre of multidisciplinary research on trees and shrubs.



INSTITUTE OF DENDROLOGY

The history of the Institute goes back to the early 19th century. In 1829-1880 Tytus Działyński and his son, Jan Kanty Działyński, created a rich collection of woody plants, which later developed into the Kórnik Arboretum, closely associated with the Institute.



INSTITUTE OF DENDROLOGY

In 1933 the Department of Dendrology was established as a part of the Kórnik Gardens owned by the Foundation 'Zakłady Kórnickie'. In 1945, after the end of the 2nd World War, the research centre was restored as the Department of Dendrology and Pomology. It was affiliated to the Polish Academy of Sciences in 1952, and its name had changed several times by 1975, when it became the Institute of Dendrology.



INSTITUTE OF DENDROLOGY

LABORATORY OF MYCORRHIZAL RESEARCH

LABORATORY OF SEED BIOCHEMISTRY

LABORATORY OF PROTEOMICS

LABORATORY OF BIOINDICATION

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LABORATORY OF SEED BIOLOGY

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LABORATORY OF PHYSIOLOGY OF ABIOTIC STRESS

LABORATORY OF GROWTH AND DEVELOPMENT PHYSIOLOGY

LABORATORY OF BIOCHEMICAL GENETICS

LABORATORY OF POPULATION GENETICS

LABORATORY OF ROOT SYSTEM PATHOLOGY

LABORATORY OF VEGETATIVE REPRODUCTION

LABORATORY OF SYSTEMATICS AND GEOGRAPHY