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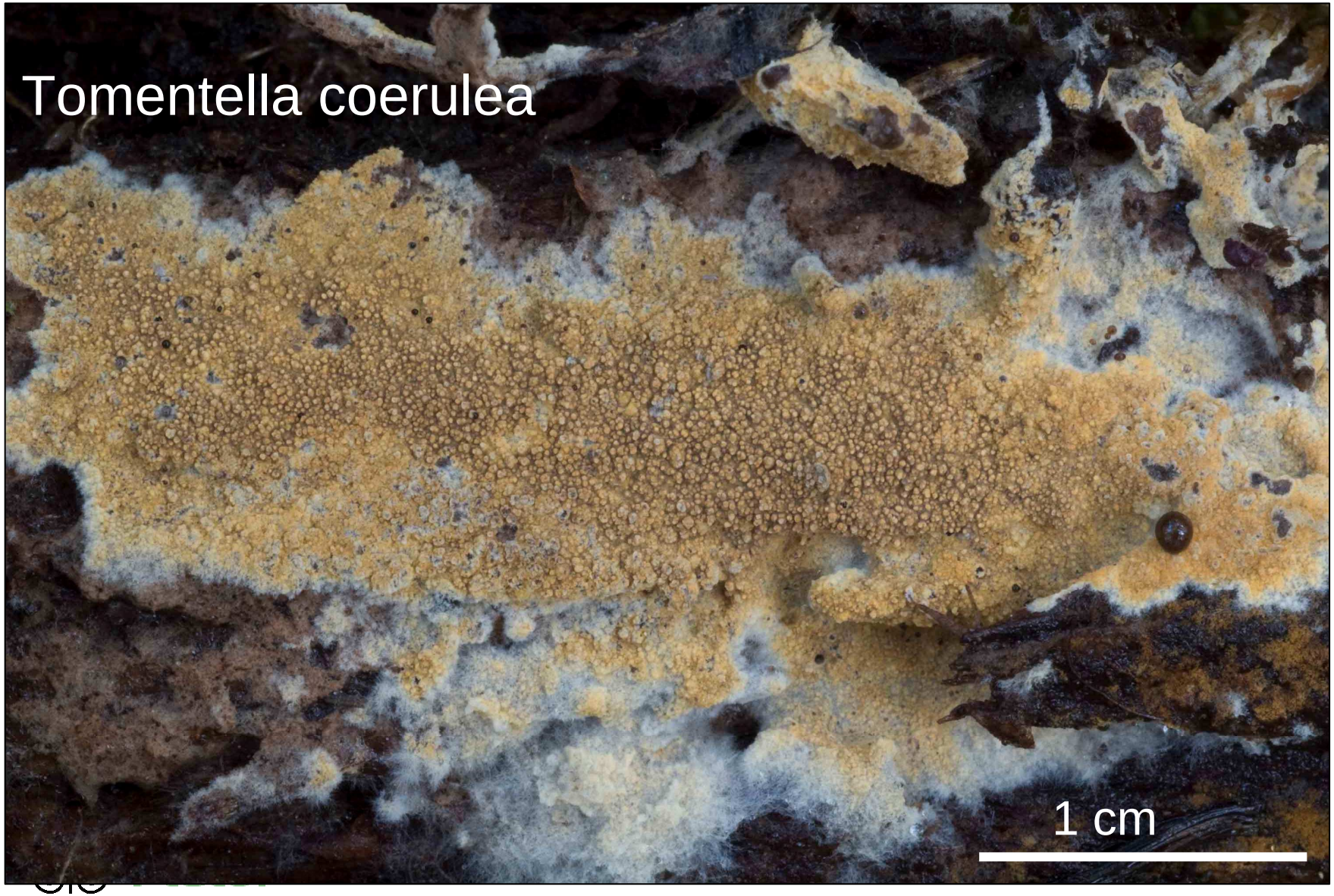
Database management and bioinformatics

Urmas Kõljalg
University of Tartu, Estonia

Launch of the Global Soil Biodiversity Atlas in France,
28th November 2016


FJÄLLRÄVEN
EQUIPMENT



NATARC


Tomentella punicea


Ectomycorrhiza

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Study/Database	Tomentella	Thelephora
Stalpers 1993	64	45
UNITE DNA species	>1500	

Ca 500 DNA based species include sequence from the sporocarp/living culture

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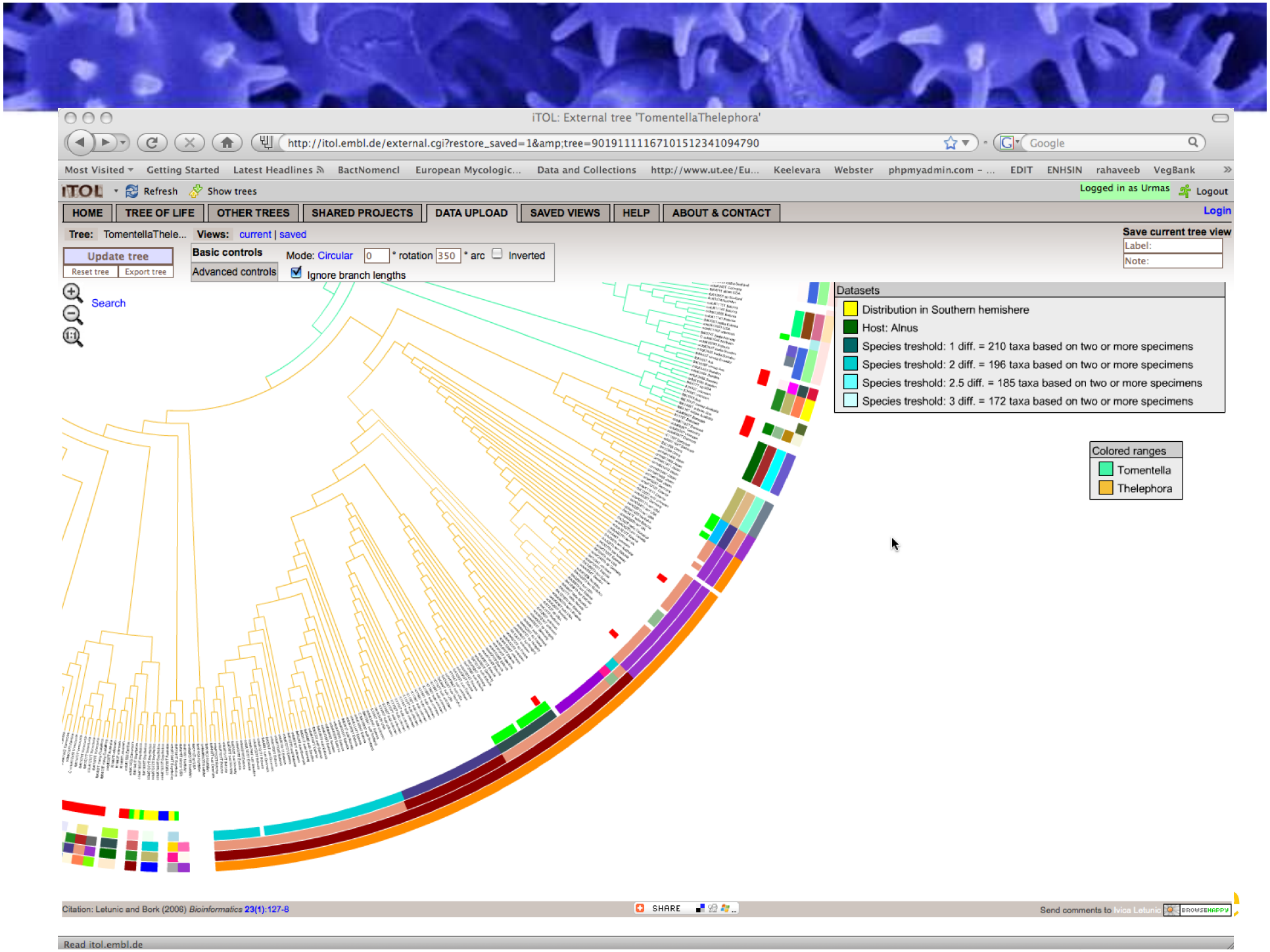
iTOL: External tree 'TomentellaThelephora'
http://itol.embl.de/external.cgi?restore_saved=1&tree=901911111671015123410947 90
Most Visited
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BactNomencl
European Mycologic...
Data and Collections
http://www.ut.ee/Eu...
Keelevara
Webster
phpmyadmin.com - ...
EDIT
ENHSIN
rahaveeb
VegBank
iTOL
Refresh
Show trees
Logged in as Urmas
Logout
HOME
TREE OF LIFE
OTHER TREES
SHARED PROJECTS
DATA UPLOAD
SAVED VIEWS
HELP
ABOUT & CONTACT
Login
Tree: TomentellaThele...
Views: current | saved
Save current tree view
Label:
Note:
Update tree
Reset tree
Export tree
Basic controls
Advanced controls
Mode: Circular
0
° rotation
350
° arc
Inverted
Ignore branch lengths
Search
Datasets
Distribution in Southern hemishere
Host: Alnus
Species treshold: 1 diff. = 210 taxa based on two or more specimens
Species treshold: 2 diff. = 196 taxa based on two or more specimens
Species treshold: 2.5 diff. = 185 taxa based on two or more specimens
Species treshold: 3 diff. = 172 taxa based on two or more specimens
Colored ranges
Tomentella
Thelephora
Citation: Letunic and Bork (2006) Bioinformatics 23(1):127-8
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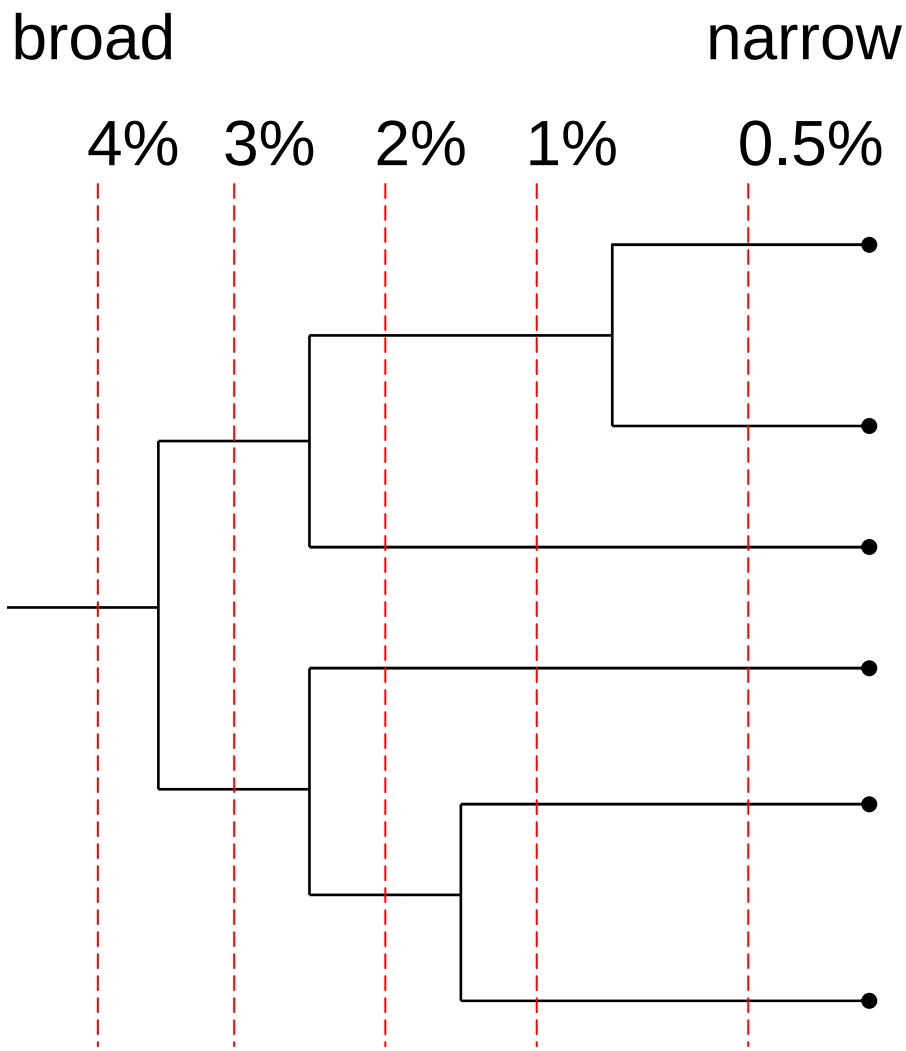
Read itol.embl.de

Delimitation of species



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Operational Taxonomic Units (OTU)

"the thing(s) being studied”

Sokal, PHA and Sneath, RR (1963), Principles of Numerical Taxonomy, San Francisco: W.H. Freeman.

Species Hypotheses (SH)

OTUs on species level

Kõljalg, U et al. (2013), Towards a unified paradigm for sequence-based identification of fungi. Molecular Ecology 22(21): 5271-5277.

UNITE

https unite.ut.ee

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unite

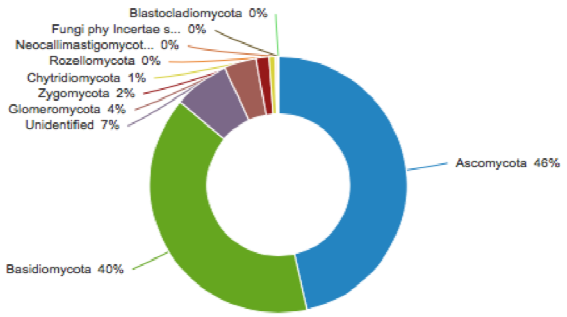
Unified system for the DNA based fungal species linked to the classification Ver. 7.0

Current version: **7.0**; Release date: 2015-08-01 (**read more**); Number of UNITE fungal Species Hypotheses: **53 891**

Threshold 1.5 % | Include All SH-s | Start typing taxon name here ... | Go | Reset

- Ascomycota (24,553)
- Basidiomycota (21,036)
- Unidentified (3,716)
- Glomeromycota (2,138)
- Zygomycota (840)
- Chytridiomycota (402)
- Rozellomycota (114)
- Neocallimastigomycota (83)
- Fungi phy Incertae sedis (23)
- Blastocladiomycota (3)

SH graph: Fungi



What is Species Hypothesis?

Species Hypothesis – any species level group of individuals that share a

What are Reference and Representative sequences?

Reference sequence (RefS) – serves as a name anchor for the Species

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UNITE

Curated rDNA ITS datasets from any biological sample (specimen, living specimen, **SOIL**, water, air, medical, etc.)

ITS sequences connected to the (type) specimen data, locality, traits, multimedia, etc.

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UNITE SH taxonomy tree

https://unite.ut.ee/sh_taxonomy_tree.php?threshold=5&is_singleton=&kingdom=k__Fungi&phylum=&class=&order=&fa...

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Unified system for the DNA based fungal species linked to the classification
Ver. 7.0

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Log in to PlutoF

1.5% cut off value

UNITE *Species Hypotheses* ver. 7 taxonomy browser

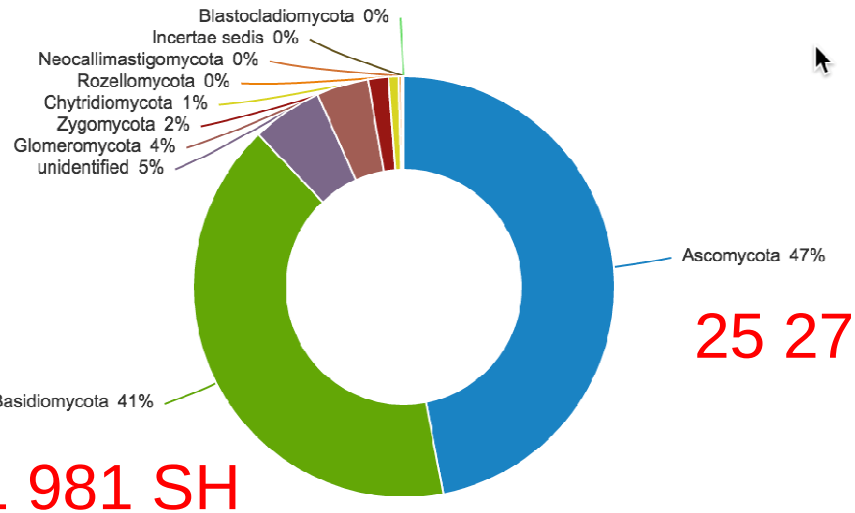
Select distance and dataset to browse:

1.5% (default) | All SH-s | Go

Fungi

Ascomycota (25273)
Basidiomycota (21981)
Blastocladiomycota (3)
Chytridiomycota (402)
Glomeromycota (2139)
Incertae sedis (23)
Neocallimastigomycota (83)
Rozellomycota (114)
unidentified (2911)
Zygomycota (841)

SH graph: kgd Fungi



25 273 SH

21 981 SH

Open in a new window

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UNITE SH taxonomy tree

https://unite.ut.ee/sh_taxonomy_tree.php?threshold=6&is_singleton=&kingdom=k__Fungi&phylum=&class=&order=&fa...

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0.5% cut off value

UNITE *Species Hypotheses* ver. 7 taxonomy browser

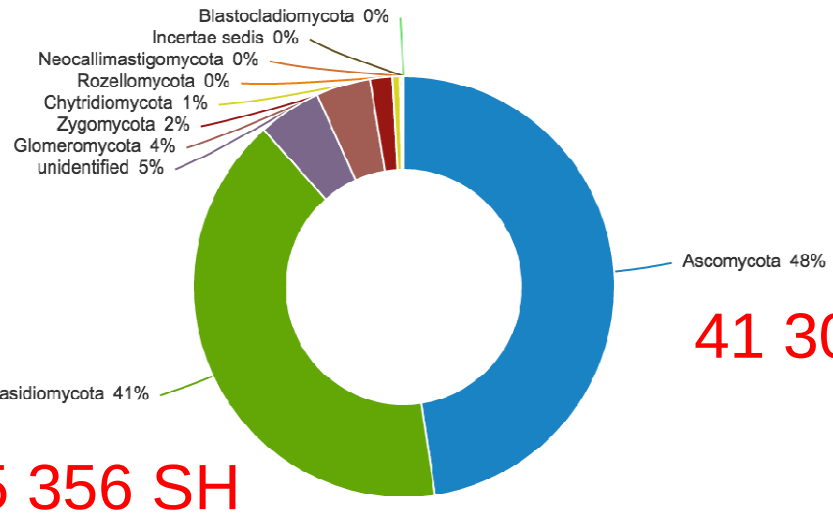
Select distance and dataset to browse:

0.5% | All SH-s | Go

Fungi

Ascomycota (41302)
Basidiomycota (35356)
Blastocladiomycota (3)
Chytridiomycota (479)
Glomeromycota (3614)
Incertae sedis (30)
Neocallimastigomycota (110)
Rozellomycota (127)
unidentified (4195)
Zygomycota (1485)

SH graph: kgd Fungi



41 302 SH

35 356 SH

Open in a new window

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Chrome Fail Muuda Kuva Ajalugu Järjehoidjad Inimesed Aken Abi 56% P 14:12 Urmas Koljalg

UNITE SH taxonomy tree | UNITE – Species Hypothese

https://unite.ut.ee/sh/SH188487.07FU

Google Kasutustingimused Teatage veast kaardil

1.5% 1% 0.5% 2% 2.5% 3%

Sequence ID	UNITE taxon name	INSD taxon name	Country	DNA source	Interacting taxa	Clustering based on: Full ITS
more | FJ158047	Cortinarius	Cortinariaceae (uncultured Cortinar...	Poland	Ectomycorrhiza	Pinus sylvestris	
more | UDB011349	Cortinarius alboviolaceus		Estonia	Fruitbody		
more | HQ285366	Cortinarius	Cortinariaceae (uncultured Cortinar...	United States	Ectomycorrhiza		
more | HQ022045	Cortinarius	Cortinariaceae (uncultured Cortinar...	United States	Soil fungal DNA		
more | KJ705149		Cortinarius (Cortinarius alboviolac...				
more | FJ266726	Cortinarius	Cortinariaceae (uncultured Cortinar...	United States	Ectomycorrhiza	Picea	
more | JX316781		Cortinariaceae (uncultured Cortinar...	United States			
more | KJ705148		Cortinarius (Cortinarius alboviolac...				
more | UDB001122	Cortinarius alboviolaceus		Sweden	Fruitbody		
more | AJ549965	Cortinarius	Cortinariaceae (uncultured Cortinar...	Germany	Ectomycorrhiza	Betula pendula	
more | AY669657		Cortinarius (Cortinarius alboviolac...	Germany	Fruitbody		
more | JF907875		Cortinarius (Cortinarius alboviolac...	Italy			
more | UDB011739	Cortinarius alboviolaceus		Estonia	Fruitbody		
more | UDB011755	Cortinarius alboviolaceus		Estonia	Fruitbody		
mo			Canada	Fruitbody	Tsuga heterophylla	
mo			Norway	Fruitbody		
mo			Estonia	Fruitbody		
mo			Estonia	Fruitbody		
mo			United States	Fruitbody		
mo			Sweden	Fruitbody		RefSeq
mo			Austria	Fruitbody		
mo			Canada	Fruitbody		
mo			Sweden	Fruitbody		
mo			Canada	Fruitbody		
mo			Canada	Fruitbody		
mo			Canada	Fruitbody		
mo			Canada	Fruitbody		
mo			Canada	Fruitbody		
mo			Canada	Fruitbody		
mo			Norway	Fruitbody		
mo			Finland	Fruitbody		Locked sequence
mo						
mo						
mo			Estonia	Fruitbody		
mo			Estonia	Fruitbody		
mo			Estonia	Fruitbody		
mo			Estonia	Fruitbody		
			Estonia	Fruitbody		

Author: Vello Liv

iris.ut.ee/plutof/thumbs_medium/thumb_medium_SP001152.JPG

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Communication of the species

Accession code of the Cortinarius xanthodryophilus SH:

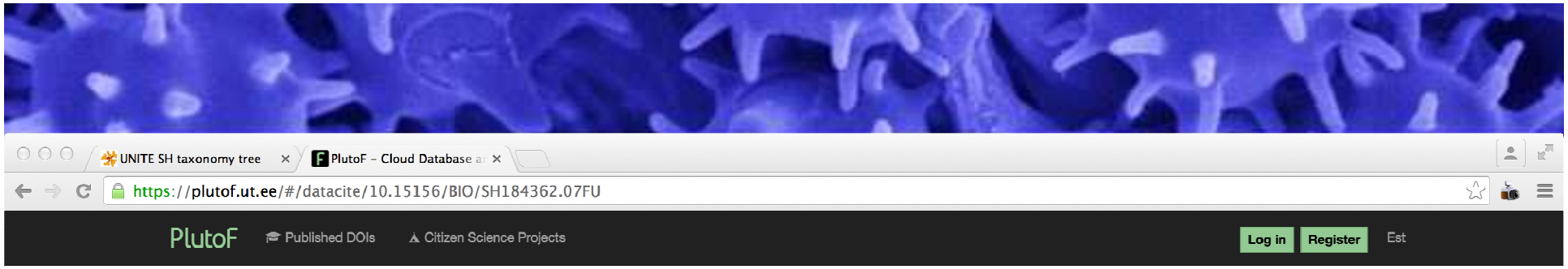
SH184362.07FU

is resolved with unique DOI (digital object identifier):

dx.doi.org/10.15156/BIO/SH184362.07FU

Version 7 includes 487 435 SHs and each of them have unique DOI

PlutoF unite



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Display Settings: GenBank

Send to:

Uncultured ectomycorrhiza (Boletus) isolate 26 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA gene, partial sequence

GenBank: EF644121.1

FASTA Graphics PopSet

Go to:

```
LOCUS       EF644121                 582 bp    DNA     linear   ENV 01-OCT-2008
DEFINITION  Uncultured ectomycorrhiza (Boletus) isolate 26 18S ribosomal RNA
            gene, partial sequence; internal transcribed spacer 1, 5.8S
            ribosomal RNA gene, and internal transcribed spacer 2, complete
            sequence; and 28S ribosomal RNA gene, partial sequence.
ACCESSION   EF644121
VERSION     EF644121.1  GI:157284042
KEYWORDS    ENV.
SOURCE      uncultured Boletus
  ORGANISM  uncultured Boletus
            Eukaryota; Fungi; Dikarya; Basidiomycota; Agaricomycotina;
            Agaricomycetes; Agaricomycetidae; Boletales; Boletineae;
            Boletaceae; environmental samples.
REFERENCE   1  (bases 1 to 582)
  AUTHORS   Krpata,D., Peintner,U., Langer,I., Fitz,W.J. and Schweiger,P.
  TITLE     Ectomycorrhizal communities associated with Populus tremula growing
            on a heavy metal contaminated site
  JOURNAL   Mycol. Res. 112 (PT 9), 1069-1079 (2008)
   PUBMED   18692376
REFERENCE   2  (bases 1 to 582)
  AUTHORS   Krpata,D., Peintner,U., Langer,I., Fitz,W. and Schweiger,P.
  TITLE     Direct Submission
  JOURNAL   Submitted (01-JUN-2007) Institute of Microbiology, University
            Innsbruck, Technikerstrasse 25, Innsbruck 6020, Austria
FEATURES             Location/Qualifiers
     source          1..582
                     /organism="uncultured Boletus"
                     /mol_type="genomic DNA"
                     /isolate="26"
                     /isolation_source="ectomycorrhizal root tips of Populus
                     tremula growing in heavy metal contaminated site near
```

Change region shown

Customize view

Analyze this sequence

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Highlight Sequence Features

Find in this Sequence

LinkOut to external resources

SILVA LSU Database [SILVA]

SH326509.06FU [UNITE]

related identifed ITS sequences [emerencia]

Related information

Related Sequences

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Recent activity

Turn Off Clear

Uncultured ectomycorrhiza (Boletus) isolate 26 18S ribosomal RNA gene, partial Nucleotide

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Identification and communication

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LETTERS

Digital identifiers for fungal species

U. Kõljalg[1,*], L. Tedersoo[2], R. H. Nilsson[3], K. Abarenkov[2]

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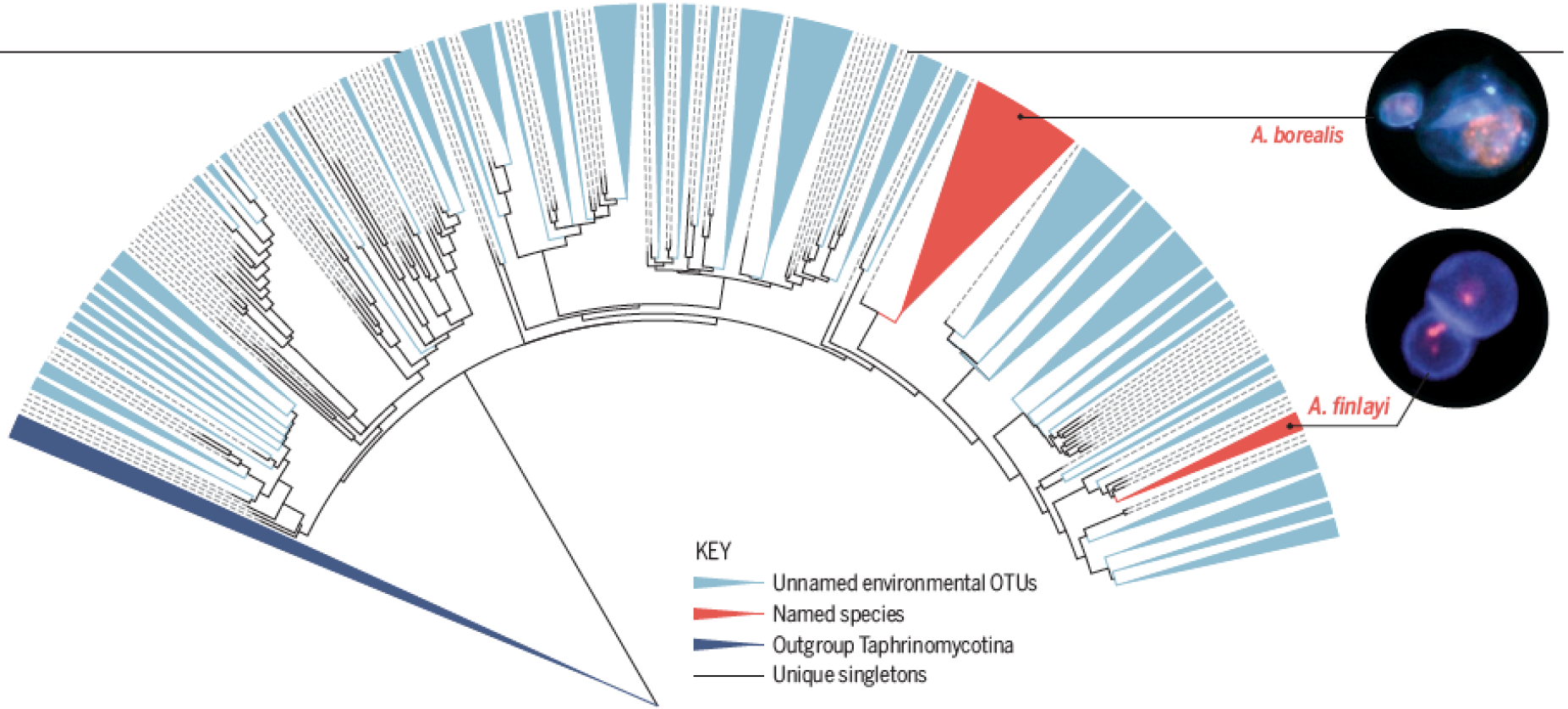
Unnamed environmental OTUs of Archaeorhizomycetes
Menkis et al 2014; Hibbett 2016



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Communication of unnamed species

2013		2014	2016		
UNITE SH (vers 6)	Seq. count	Menkis et al	UNITE SH (vers 7)	Seq. count	Taxon name (ver 7)
SH024357.06FU	60	DQ497955	SH019951.07FU	63	Archaeorhizomyces
SH024363.06FU	1		same SH	63	Archaeorhizomycetes
SH024364.06FU	1		same SH	63	Archaeorhizomyces
SH024366.06FU	1	*FJ440883	same SH	63	Archaeorhizomyces
SH024359.06FU	3	EF434112	SH019954.07FU	4	Archaeorhizomyces
SH024358.06FU	6	GQ160036	SH019953.07FU	4	Archaeorhizomyces
SH028573.06FU	2	AF461602	SH000652.07FU	2	Archaeorhizomyces
SH005365.06FU	2	EU292507	SH019950.07FU	77	Archaeorhizomyces
SH005360.06FU	3	HM069471	same SH	77	Archaeorhizomyces
SH005354.06FU	74	HQ212088	same SH	77	Archaeorhizomyces
same SH	74	GQ160052	same SH	77	Archaeorhizomyces
same SH	74	AY394903	same SH	77	Archaeorhizomyces
same SH	74	DQ481983	same SH	77	Archaeorhizomyces
SH037685.06FU	4	GU174301	SH032873.07FU	4	Archaeorhizomyces
SH037797.06FU	2	HM239707	SH019935.07FU	3	Archaeorhizomyces
SH037690.06FU	1	GU174346	SH032853.07FU	2	Archaeorhizomycetes
SH037692.06FU	1	*AY970243	same SH	1	Archaeorhizomyces
SH037686.06FU	7	AY969872	SH032850.07FU	7	Archaeorhizomyces
SH006449.06FU	5	HM239996	SH004896.07FU	13	Archaeorhizomyces

High-Throughput Seguencing projects

HTS sequences included in UNITE SH version 7

FJ152528		Leotiomycetes (uncultured...	Canada	Ectomycorrhiza
JX857198		Fungi (uncultured fungus)	United States	
JX857214		Fungi (uncultured fungus)	United States	
KC514890		Sordariomycetes (Sordario...		
HQ611285		Fungi (uncultured fungus)	Sweden	
KF274409		Fungi (uncultured fungus)	Finland	
AM260917	**Helotiales**	Fungi (uncultured fungus)	United Kingdom	Soil fungal DNA
HF947879		Helotiales (uncultured He...	Ireland	
HF947876		Helotiales (uncultured He...	Ireland	
KC965984		Fungi (uncultured fungus)	United States	
KF617245		Fungi (uncultured fungus)	United States	
AB476482	**Helotiales**	Fungi (uncultured fungus)	Sweden	Ericoid mycorrhiza
UDB020841			Sweden	Soil fungal DNA
KF879483		Pezizomycotina (unculture...	United States	
GU180254	**Helotiales**	Ascomycota (uncultured As...	United States	Ectomycorrhiza
DQ273331	**Helotiales**	Pezizomycotina (unculture...	United States	Ectomycorrhiza
FJ152527		Leotiomycetes (uncultured...	Canada	Ectomycorrhiza
HF947867		Helotiales (uncultured He...	Ireland	
FN565266	**Helotiales**	Helotiales (uncultured He...	United Kingdom	Ectomycorrhiza
FN565265	**Helotiales**	Helotiales (uncultured He...	United Kingdom	Ectomycorrhiza
EF445405	**Helotiales**	Fungi (uncultured fungus)	United Kingdom	Ericoid mycorrhiza
AM260813		Fungi (uncultured fungus)	United Kingdom	Soil fungal DNA
AM292203		Ascomycota (ascomycete sp...	United Kingdom	Soil fungal DNA
AM260927		Fungi (uncultured fungus)	United Kingdom	Soil fungal DNA

RepSeq

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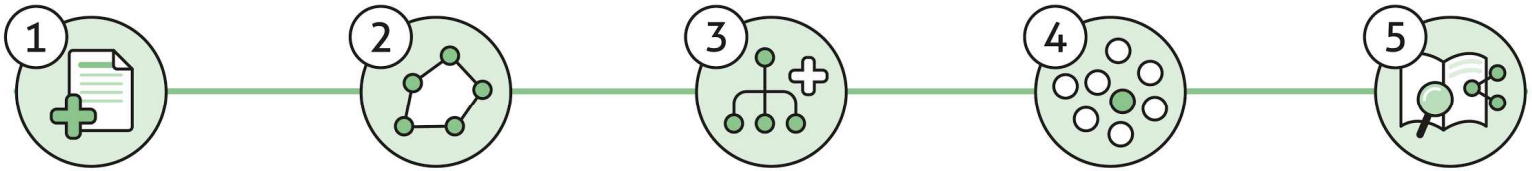
Metabarcoding Projects



1. Create Project
2. Create Sampling Areas
3. Create/Import Material Samples
4. Upload HTS Representatives
5. Search
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PlutoF – Cloud Database ar

https://plutof.ut.ee/#

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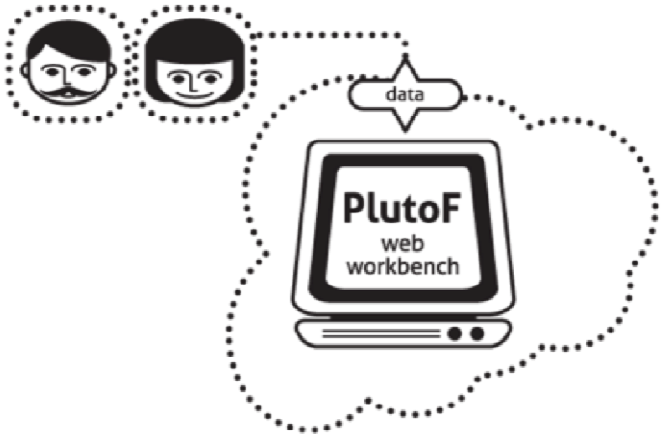

Create, manage, share, analyse and publish biology-related databases and projects

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News

PlutoF and Pensoft started to develop new publishing systems,

In November 9-12, PlutoF team visited academic publishing company Pensoft in Bulgaria. The aim was to develop prototype connecting the two systems - Pensoft's ARPHA writing tool and PlutoF Biodiversity Platform. This is multi-phase development project.

Estonian bird observations are published in global biodiversity portal GBIF

Regular bird observations and observations made with mobile application "Minu loodusheli" are now available through GBIF portal. Original source of data is PlutoF - information system for biodiversity developed by the Natural History Museum (University of Tartu).

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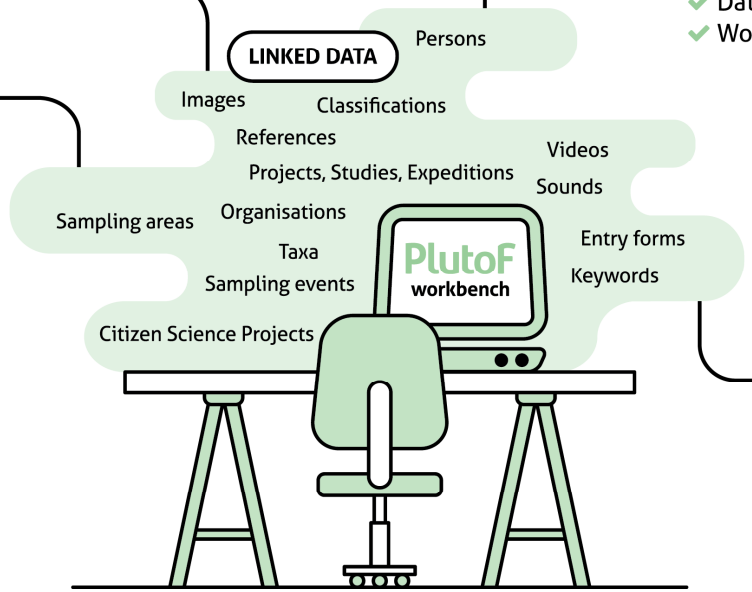
- Sequence



SERVICES
- Access rights/Workgroups
- File Repository
- Import/Export
- Sequence analysis
- Annotations
- Collection management (transactions, assessments, treatments)
- DOI publishing
- Taxonomy management editor

INTEGRATIONS
- GBIF
- DataCite
- Pensoft
- ODK Collect (mobile data gathering)
- INSD (GenBank, ENA, DDBJ)
- UNITE

PlutoF unite

Identification of species

Open Data / Open Access

All SHs are freely downloaded at unite.ut.ee
For the inhouse analyses or for the building identification pipelines

HTS pipelines: QIIME, mothur, SCATA, CREST, UCHIME, UTAX.

Identification of species

All UNITE SH accession codes are connected to the Fungal classification.

It means OTUs will receive accession codes and will be connected to the classification even when species names are not available.

Thank you!

Kessy Abarenkov

Allan Zirk