

ARISE: An Infrastructure for Dutch Biodiversity – A Fungal Contribution

Dr. Hazal Kandemir

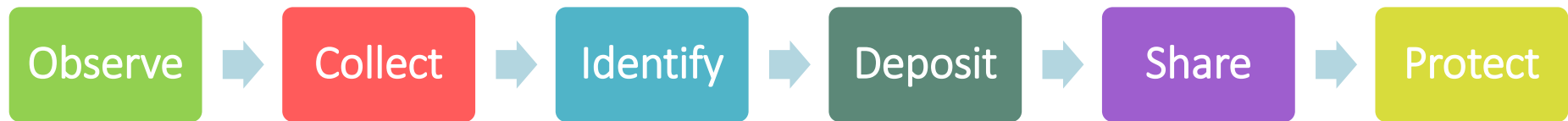


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What is ARISE?

Authorative and Rapid Identification System for Essential Biodiversity Information

Aims to build an infrastructure to identify and monitor all multicellular biodiversity in the Netherlands.



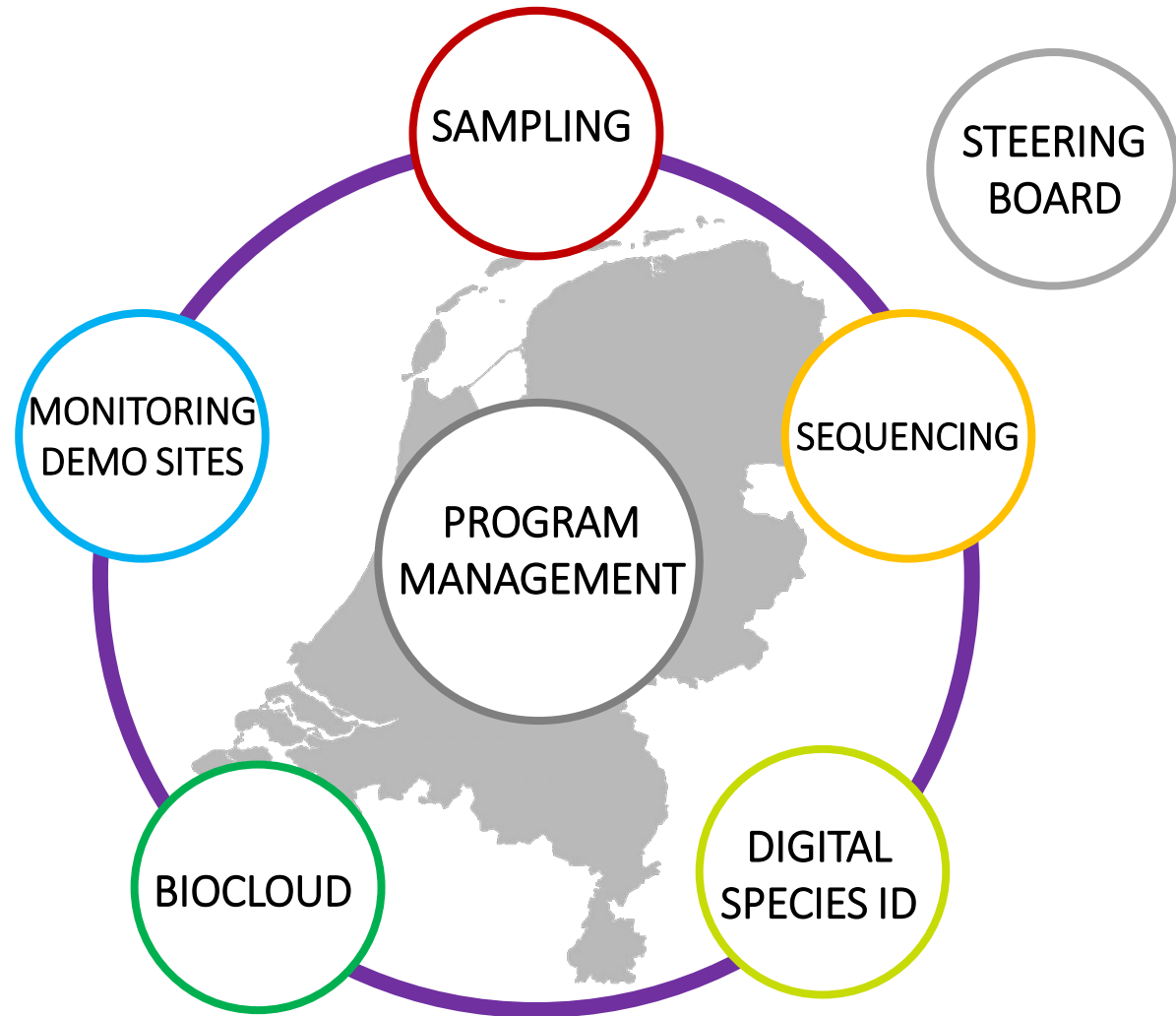
Organization



UNIVERSITEIT
TWENTE.



UNIVERSITEIT VAN AMSTERDAM



Monitoring demo sites team



Amsterdam city and ARTIS Royal Zoo



Nieuw Land National Park



Loobos and De Hoge Veluwe National Park



Enschede, University of Twente campus

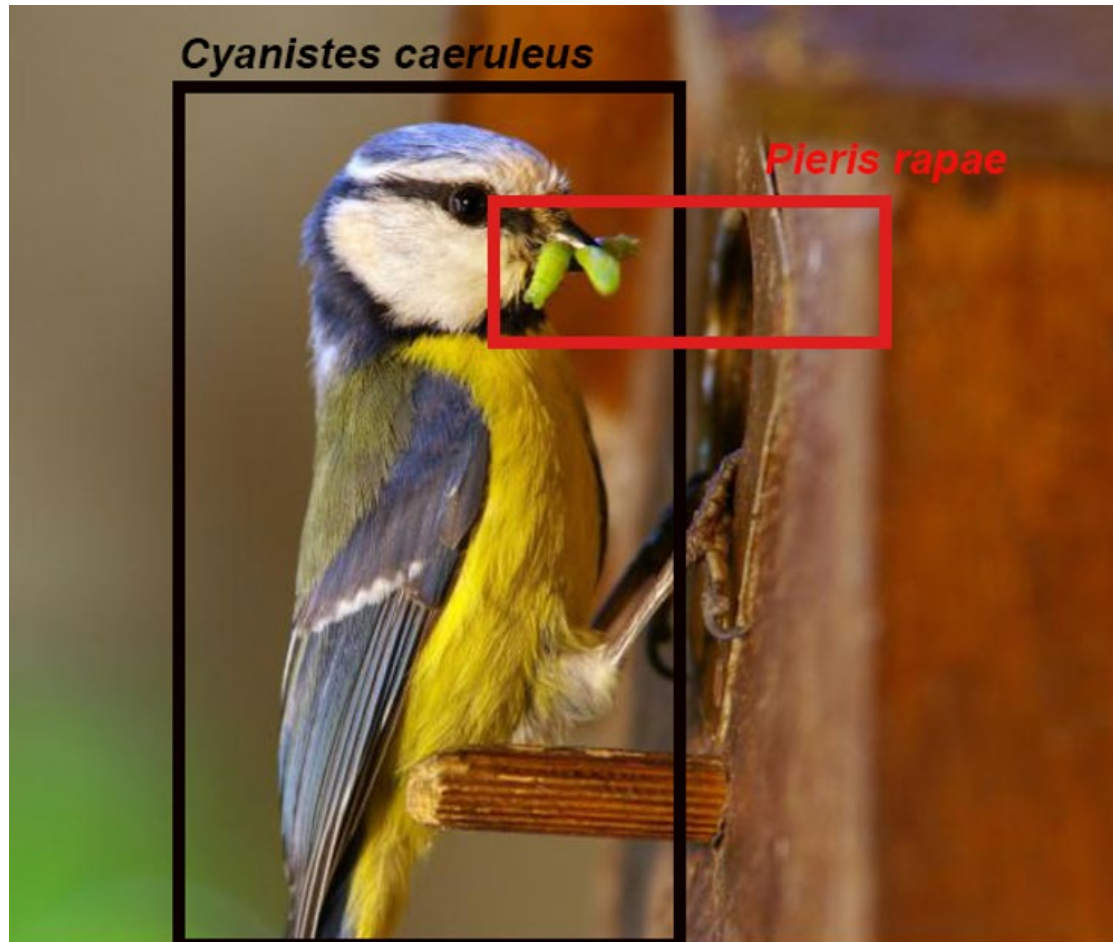
...establishes various digital sensors to be able to monitor biodiversity, biomass and movement of the species across space and time

Sampling team



...provides the samples from the field to the laboratories and into the collections

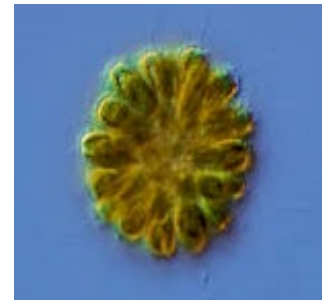
Digital species ID team



...builds tools and services to support development and deployment of AI algorithms to detect, identify and track the animals in diverse environments

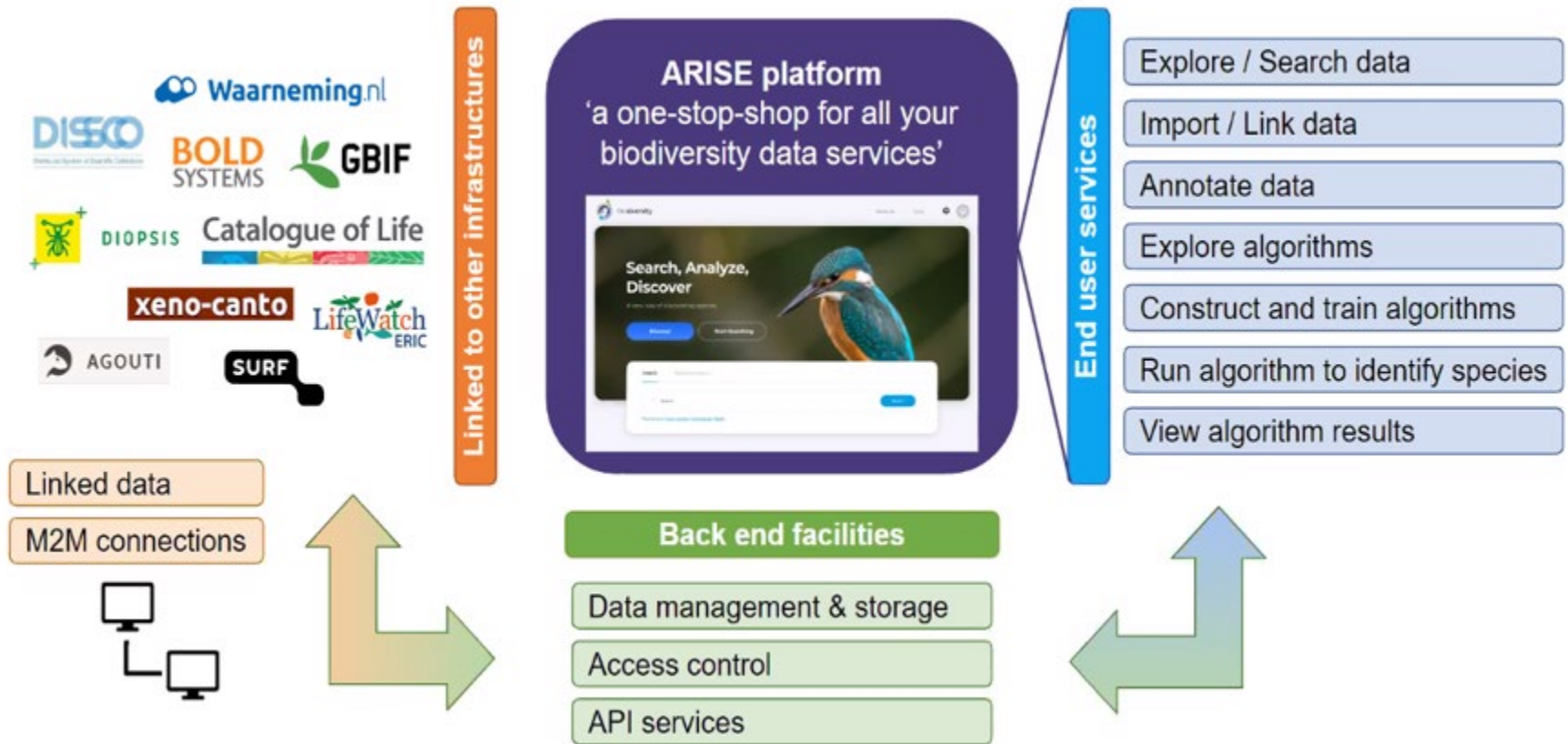
Sequencing team

- Aims to sequence 350,000 specimens
- to cover at least 95% of all Dutch species
- ✓ Efficient
- ✓ Fast
- ✓ Low-cost
- ✓ Standardized
- ✓ (semi) automatic
- ✓ Transparent methods
- ✓ Less plastic



...extracts and sequence DNA for all the specimens and processes the bioinformatic analyses of the sequence data

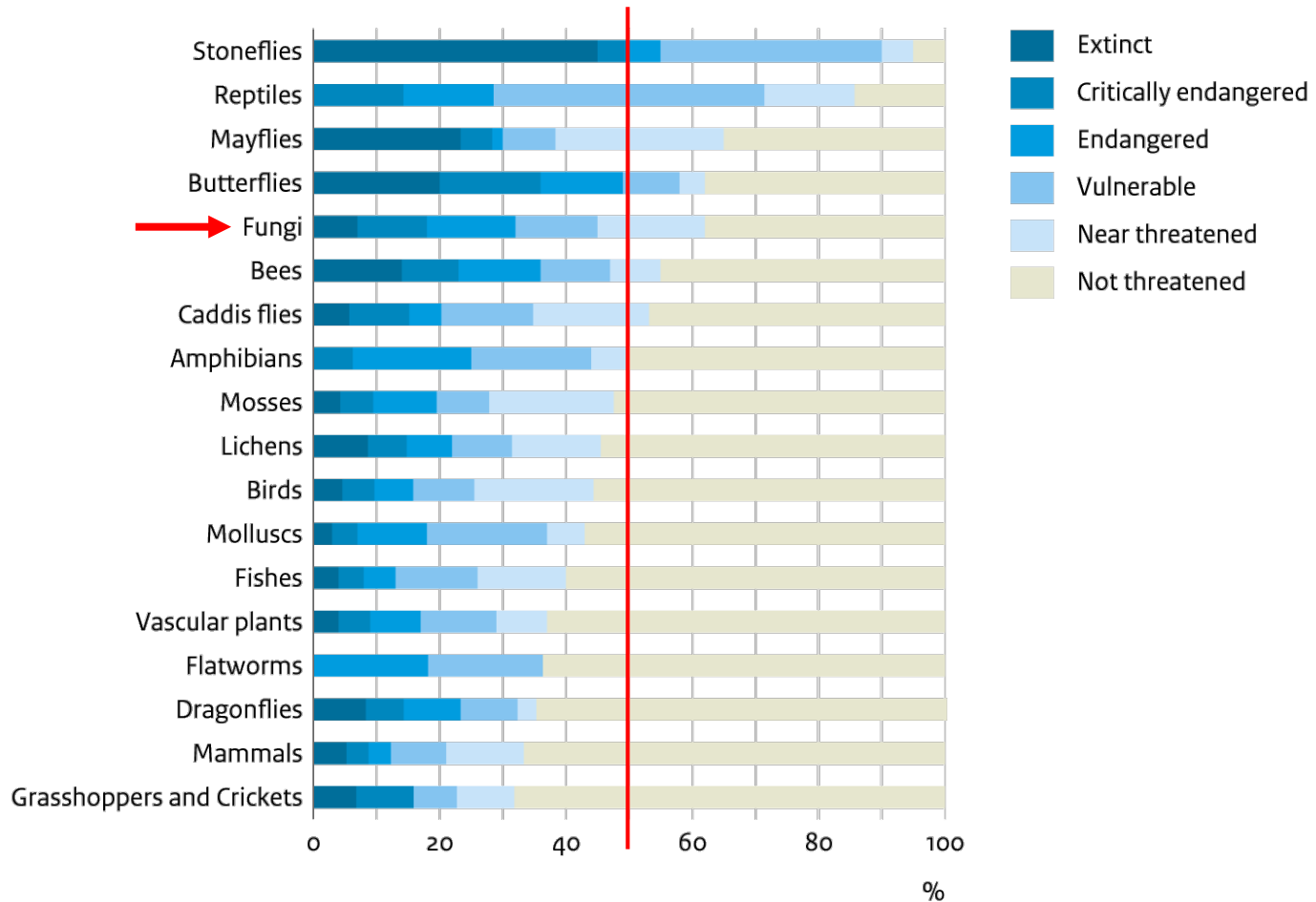
Biocloud



“...builds an infrastructure of the entire ARISE program including facilities for data management, storage, digital object identification and integration services between the ARISE and the outside world.”

Dutch Biodiversity

Percentage of threatened and extinct species per species group in The Netherlands, 2019

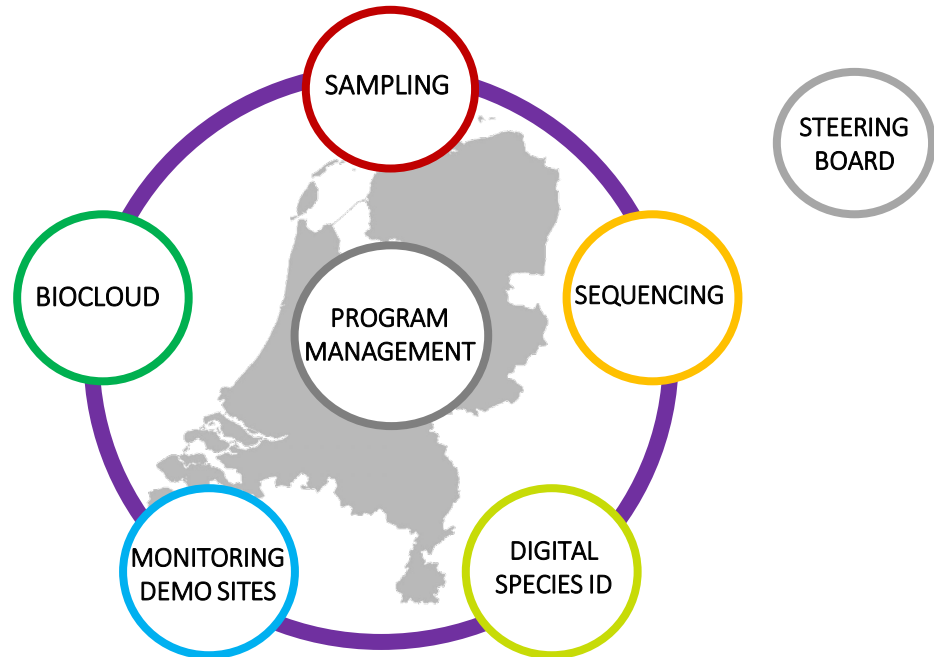


Source: Species organizations, WUR

CBS/nov20
www.clo.nl/en105217

Westerdijk Institute (WI) & ARISE

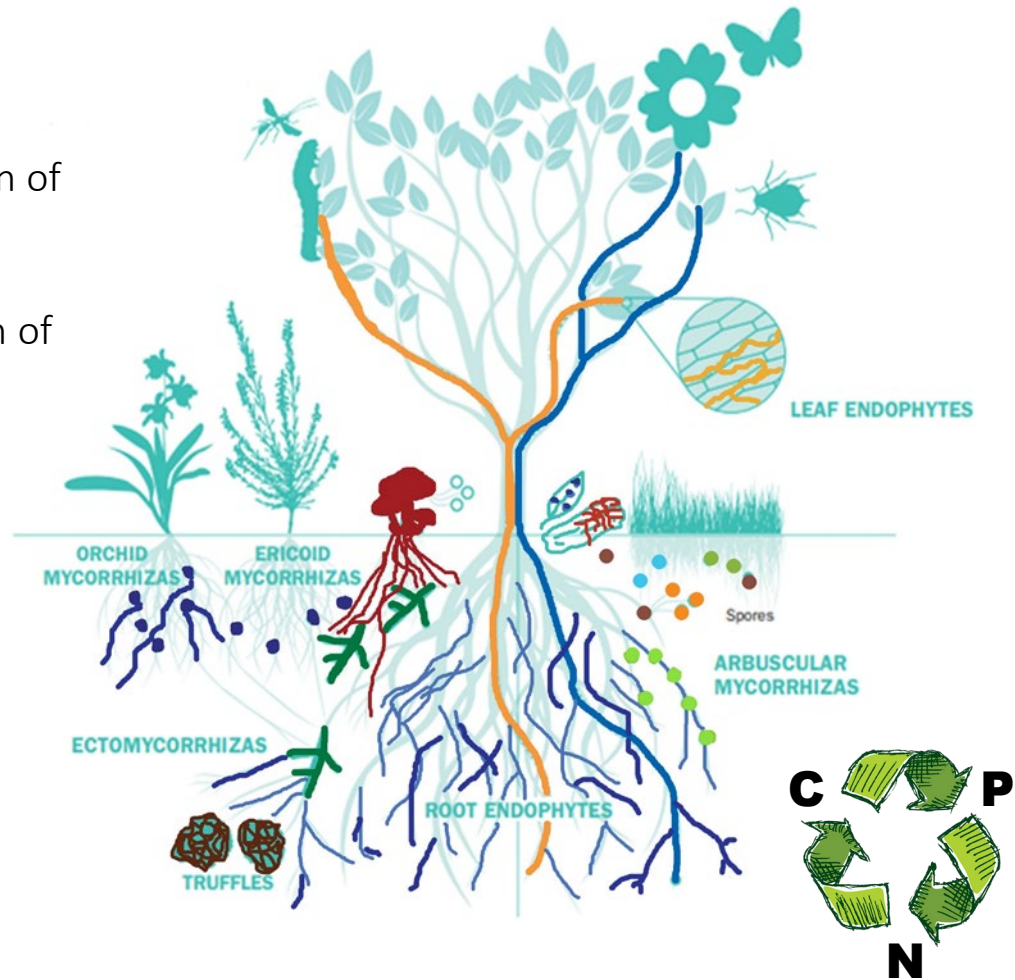
- Pedro Crous
- Ewald Groenewald
- Gerard Verkleij
- Duong Vu
- Hazal Kandemir
- Margarita Hernández
- Marjan Vermaas
- Noa van Dam



- Main aim is to provide an up-to-date reference database and tools for fast and reliable species identification
- Main interest is Dutch soil fungal biodiversity

Why soil fungi?

- ✓ Soil structure formation and modification of habitats
- ✓ Regulation of diseases, pests and growth of other microorganisms
- ✓ Regulating of the balance of carbon and nutrients
- ✓ Protection against root pathogens
- ✓ Stabilization of soil organic matter and decomposition of residues



! **<2% of the global fungal species are described**
<5% of soil fungi are culturable

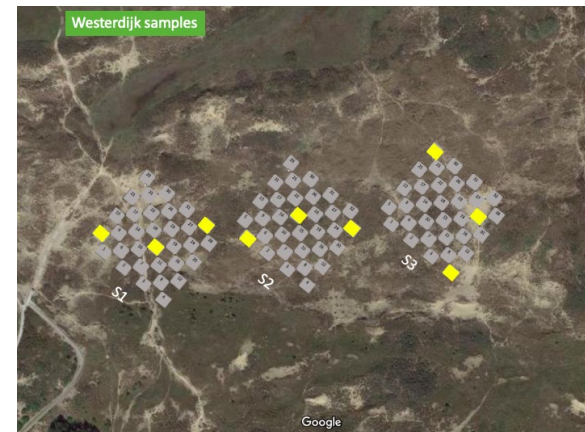
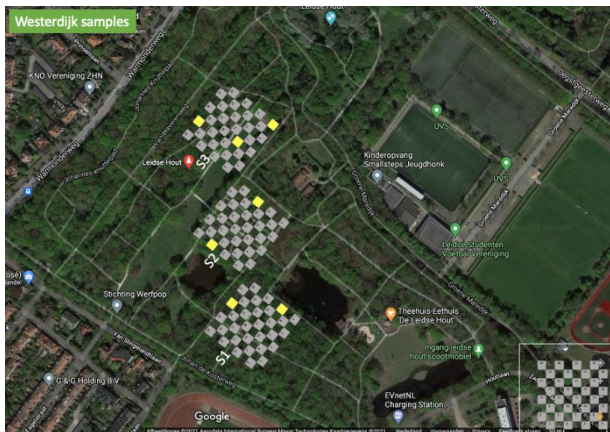
Sampling team - ARISE

Pilot project: Metabarcoding vs. Barcoding cultures

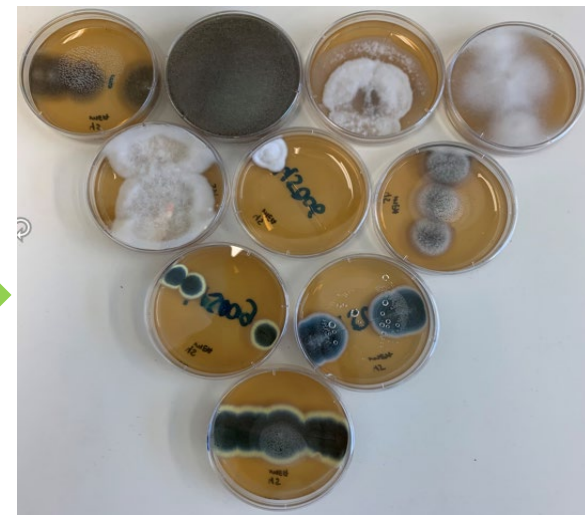
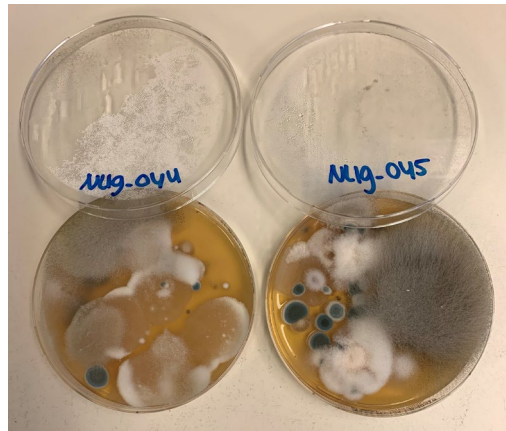
- Soil-DNA extraction protocol: BOMB Beads
- Detect all species from one sample
- Standard database: UNITE
- Useful for ecological studies
- Different taxonomic units e.g. OTU, BIN, and ESV.
- Short(er) run time

- Not applicable for taxonomic studies
- Not applicable for further analyses such as bioactive compound search

Sampling - WI



Lab process



496
Fungal strains

Citizen Science

FUNGI FOR THE FUTURE - SOIL



What does the Westerdijk Institute do with soil samples?



STEP 4

Place the samples in the envelope and send them to the postal address specified on the form.

You need a kit



STEP 3

Register yourself on the website. Enter a new soil sample, complete all fields and upload a nice and good quality picture of the sample location.



STEP 5

The envelope arrives. We take a bit of soil from the first tube. The second tube we place in our big fridge.



STEP 6

We place the gram of soil in a tube together with 9 ml sterilized water.



STEP 7

Now we shake the tube firmly, so that the water and soil mix well. Now we have a mix of 10 ml fluid with soil (a 'slurry').



STEP 8

From the 'slurry' soil sample we take 1 ml fluid and we mix this with 9 ml water again. We repeat this process up to 6 times.

We select the last 2 tubes for the next steps.



STEP 9

Now we take petri dishes with a layer of agar (food for the fungi). From the selected tubes we take a bit of fluid which we pour on the dishes. Then we put the lids on, and were ready for the next step.



From soil sample to new fungus!



Winners!

STEP 10

And now the fungi will do what fungi do best: eat and grow. We place them in a special room at 20-25 degrees Celsius. And every day we check to see how they grow and grow.



STEP 2

Fill the tubes, but leave 1 centimeter open. Take both samples from the same spot!



STEP 1

Take some soil (from 2-5 cm depth) with a clean teaspoon.



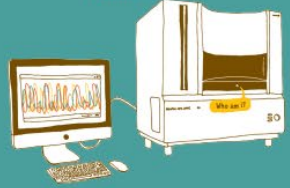
STEP 16

We change the graph to written out DNA code. We check the DNA with the fungi we already have in the genbank. Do they look alike? Even if a fungus differs only 2%, it could be a new species!



STEP 15

We place the DNA of the fungus in a DNA-Analyzer that uses a laser to 'read' the DNA. DNA consists of 4 building blocks (A, C, T, and G). In this graph each building block has its own colour.



STEP 14

To find out which fungus it is, we need DNA. We amplify (copy) this DNA many times, to make sure we have enough for the next step.



STEP 12

A week later the fungus has grown (again)! We scrape a bit off the fungus and place this in an 'Eppendorf' tube.



STEP 11

After a week we can see if there are any interesting fungi growing. With a flat needle we carefully take a bit of each fungus. We place this on a new petri dish with some food to grow.



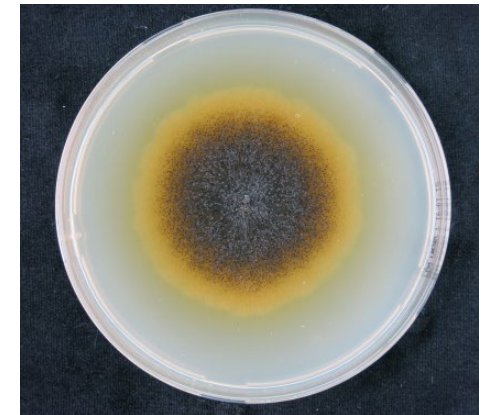
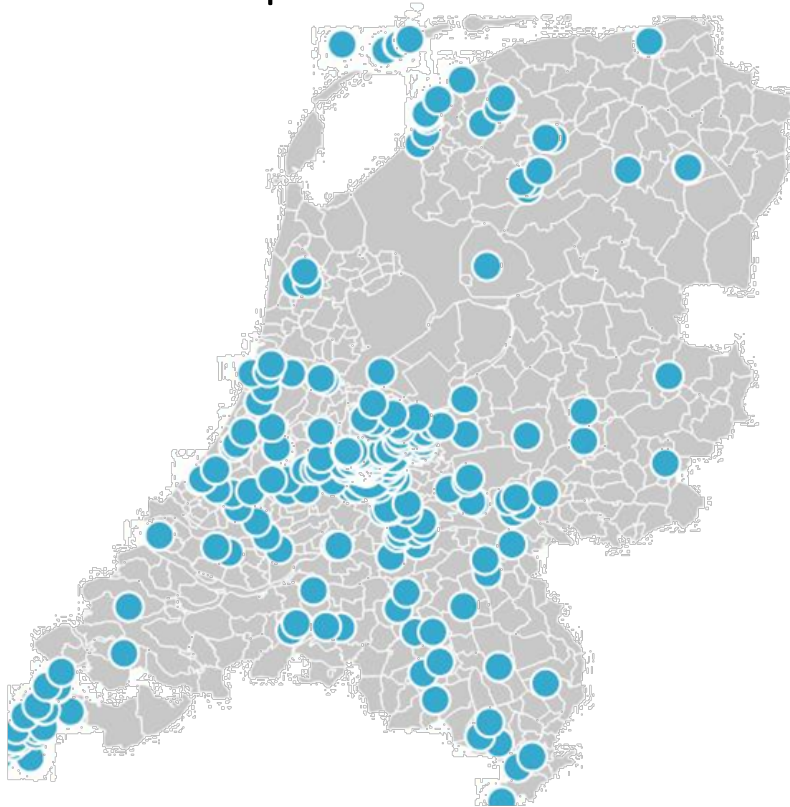
STEP 13

We make another tube and send it to the CBS Collection where we store it for future research.



Citizen Science (2017-2019)

390 soil sample



3850 Fungal strains

Fungal Planet description sheets - Persoonia

Acaulium pannemaniae

Lasionectria hilhorstii

Collariella hilkhuijsenii

RESEARCH ARTICLE

Diversity of yeast species from Dutch garden soil and the description of six novel Ascomycetes

Marizeth Groenewald^{1,*}, Lorenzo Lombard¹, Michel de Vries¹,
Alejandra Giraldo Lopez^{1,2}, Maudy Smith¹ and Pedro W. Crous^{1,2,3}

FEMS Yeast Research, 18, 2018, foy076

doi: 10.1093/femsyt/foy076


Advance Access Publication Date: 17 July 2018

Research Article

Mycological Progress (2019) 18:1135–1154
<https://doi.org/10.1007/s11557-019-01511-4>

ORIGINAL ARTICLE

New plectosphaerellaceous species from Dutch garden soil

Alejandra Giraldo^{1,2}  • Margarita Hernández-Restrepo¹  • Pedro W. Crous^{1,2,3}

MycKeys 65: 49–99 (2020)
doi: 10.3897/mycokeys.65.47704
<http://mycokeys.pensoft.net>

RESEARCH ARTICLE

 **MycoKeys**
A peer-reviewed open-access journal
Launched to accelerate biodiversity research

Citizen science project reveals high diversity in Didymellaceae (Pleosporales, Dothideomycetes)

Lingwei Hou^{1,2*}, Margarita Hernández-Restrepo^{3*}, Johannes Zacharias Groenewald³, Lei Cai^{1,2}, Pedro W. Crous^{3,4}

DNAbarcoder

available online at www.studiesinmycology.org STUDIES IN MYCOLOGY 92: 1–20 (2019).

Large-scale generation and analysis of filamentous fungal DNA barcodes boosts coverage for kingdom fungi and reveals thresholds for fungal species and higher taxon delimitation

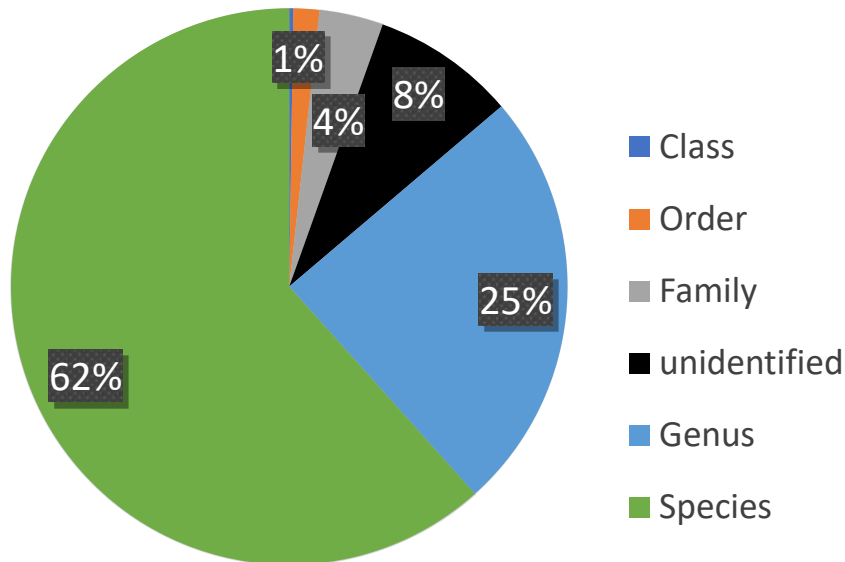
D. Vu^{1*}, M. Groenewald¹, M. de Vries¹, T. Gehrman¹, B. Stielow¹, U. Eberhardt², A. Al-Hatmi¹, J.Z. Groenewald¹, G. Cardinali³, J. Houbraken¹, T. Boekhout^{1,4}, P.W. Crous^{1,5,6}, V. Robert¹, and G.J.M. Verkley^{1,7}

RESOURCE ARTICLE MOLECULAR ECOLOGY RESOURCES WILEY

Dnabarcoder: An open-source software package for analysing and predicting DNA sequence similarity cutoffs for fungal sequence identification

Duong Vu¹ | R. Henrik Nilsson² | Gerard J. M. Verkley¹

Classification of the CS sequences



ID level	# sequences
Class	9
Order	58
Family	143
unidentified	321
Genus	946
Species	2372
Grand Total	3849

Sequencing - WI



Collections



Search the CBS strains database

Criteria	Operation	Type of organism
Q0 Type of organism	=	Filamentous fungi
Q1 And Country	Target record name starts with	netherlands
Q2 And Substrate (including host)	Starts with ...	soil

Reset Search

~277 genera related to soil published

~34.000 strains from these genera

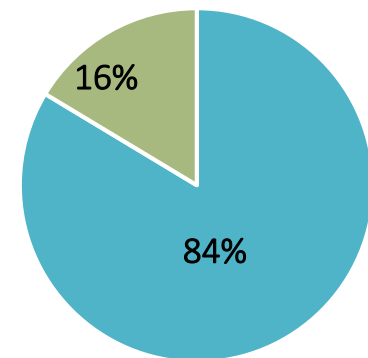
are in the CBS collection

~10.000 strains from soil

~1500 strains from Dutch soil

~8000 Dutch strains (filamentous fungi)

CBS strains



■ NL strains ■ NL soil strains

Future directions - WI

- Releasing barcode data for more species
- Providing an up-to-date reference database for (soil) fungi
- Overview of biodiversity in soil fungi in the NL
- Contribution to filling the gaps in the fungal taxonomy by describing new taxa
- “What is in there?” “What is its role?”
- Provoke an awareness on the importance of soil fungi



Thanks!

Westerdijk Institute ARISE team



Pedro Crous



Ewald
Groenewald



Gerard
Verkleij



Duong Vu



Margarita
Hernández



Marjan
Vermaas



Noa van Dam



WESTERDIJK
FUNGAL BIO
DIVERSITY
INSTITUTE



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TWENTE.



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Marie
Skłodowska-Curie
Actions

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Funded by
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