



# ECFG15

ROME • ITALY 2020



Czech Academy  
of Sciences

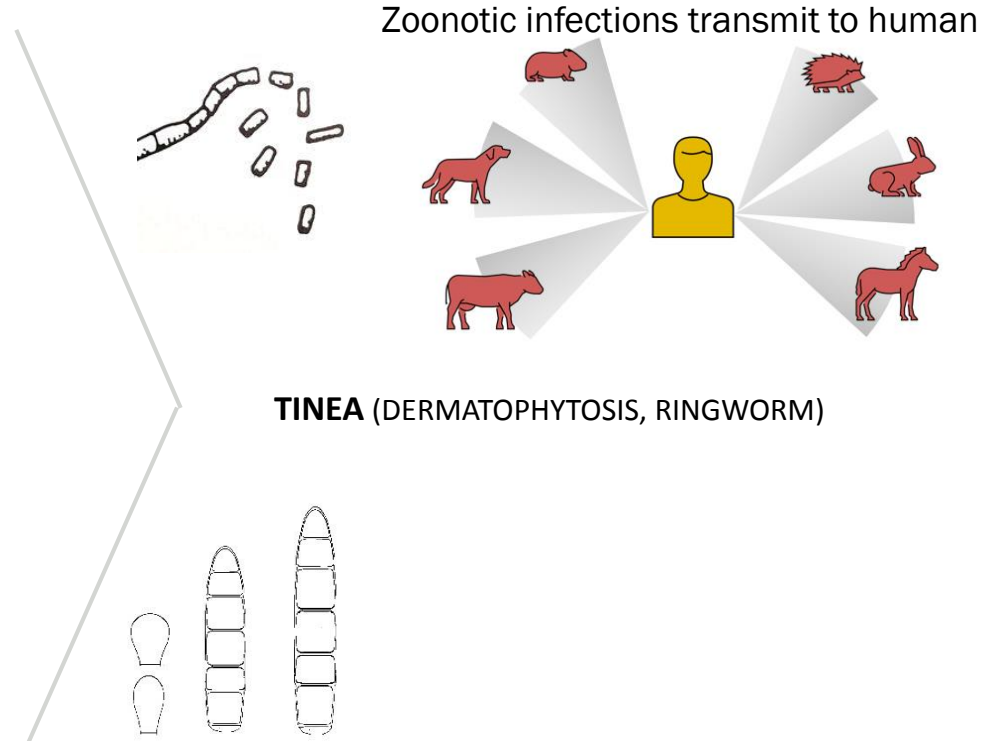
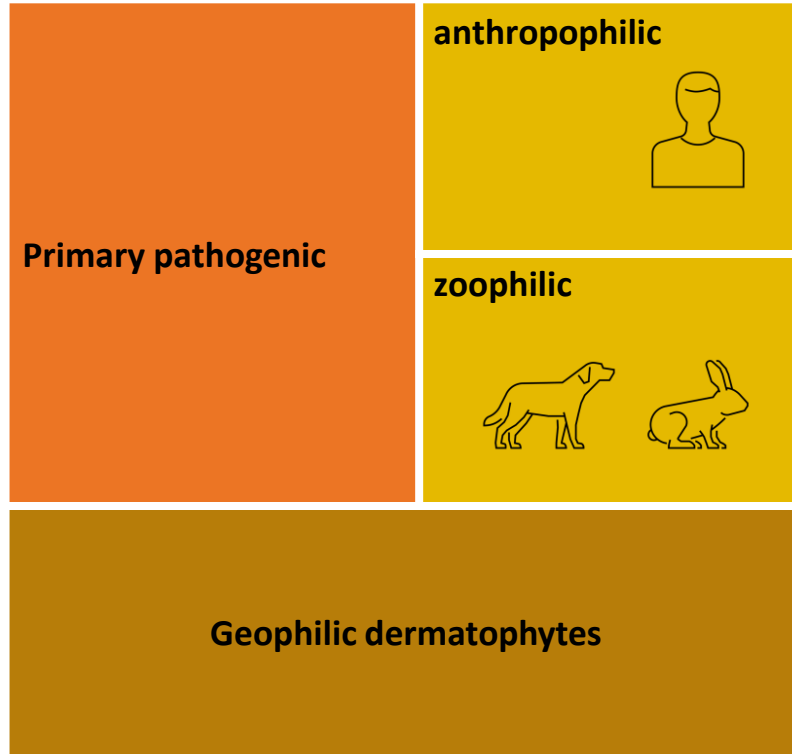
Elucidating species  
boundaries between  
agents of superficial  
mycoses *Trichophyton  
interdigitale* and *T.  
mentagrophytes*

Michaela Švarcová



# Dermatophytes = agents causing superficial mycosis

- ecologically and phylogenetically related fungi, pathogens with high prevalence
- order Onygenales, family *Arthrodermataceae*





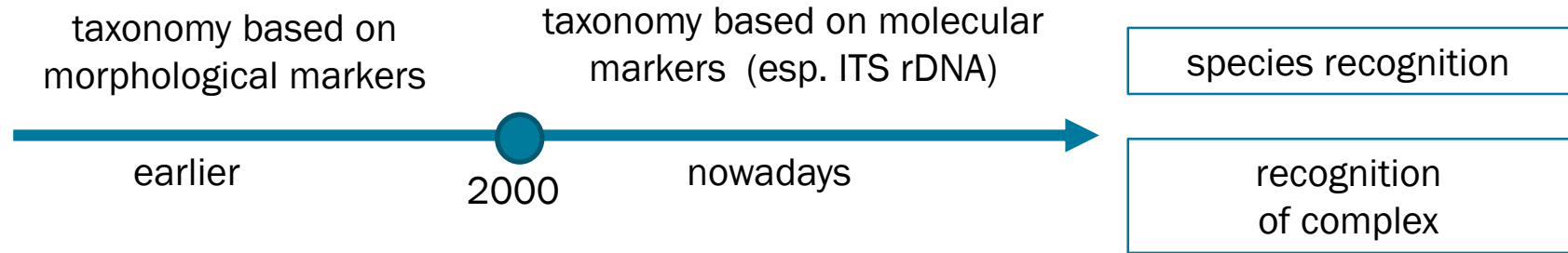
# Clinical manifestation





# Taxonomy of dermatophytes

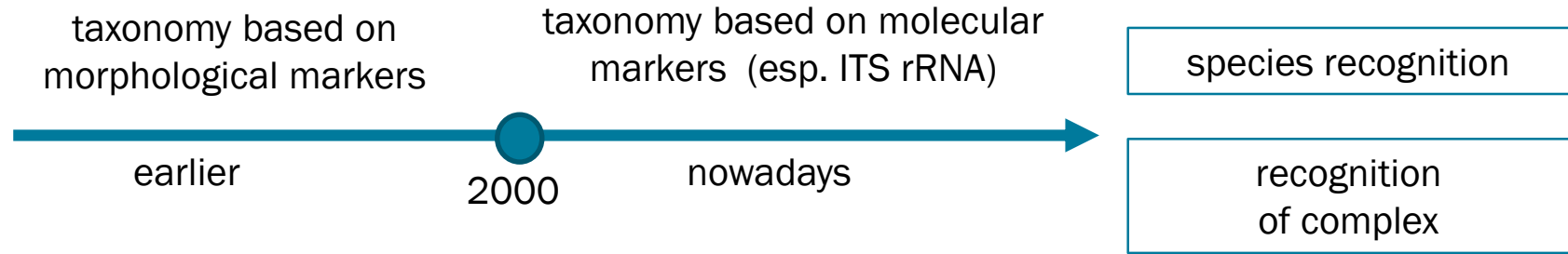
- Taxonomy of dermatophytes = still developing and adjusting





# Taxonomy of dermatophytes

- Taxonomy of fungi, especially dermatophytes = still developing and adjusting



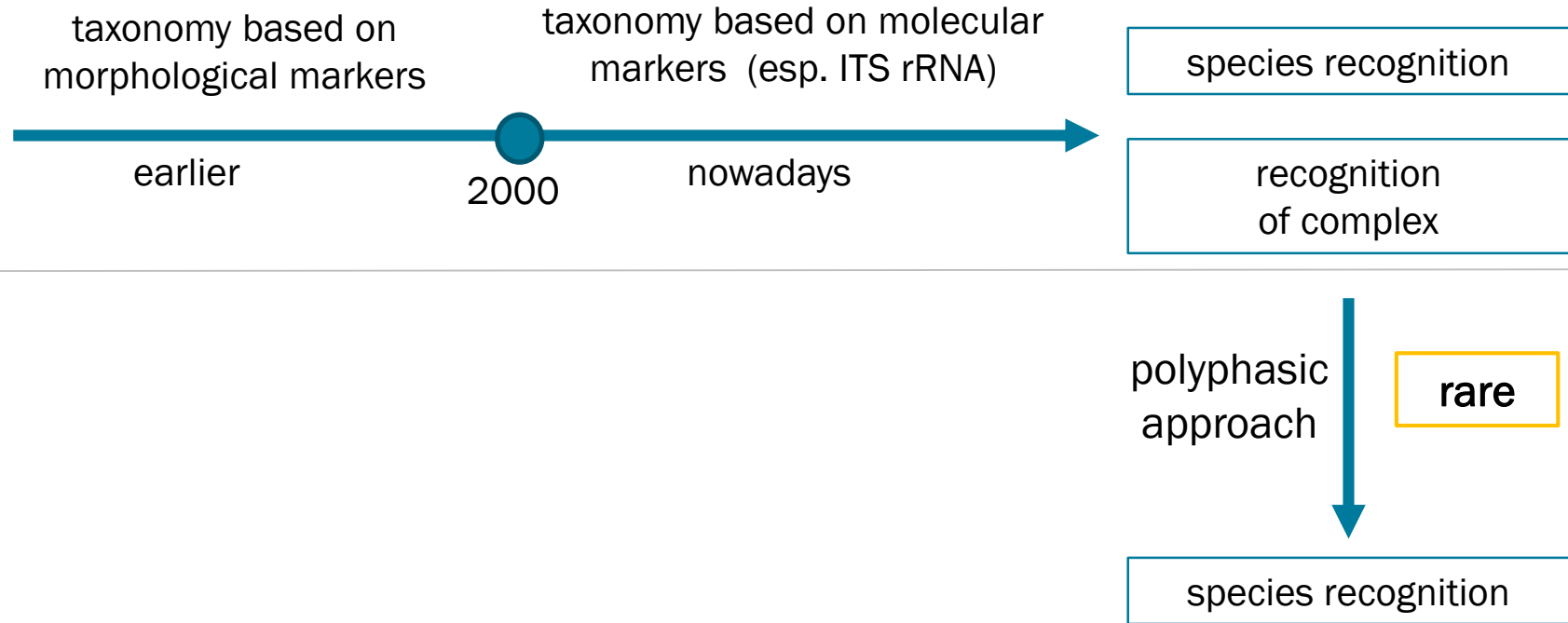
- Species recognition in case of *Trichophyton interdigitale*/*T. mentagrophytes*

- 2017 de Hoog = *Trichophyton interdigitale* and *T. mentagrophytes*
  - ecological differences
  - not so clear



# Taxonomy of dermatophytes

- Taxonomy of fungi, especially dermatophytes = still developing and adjusting



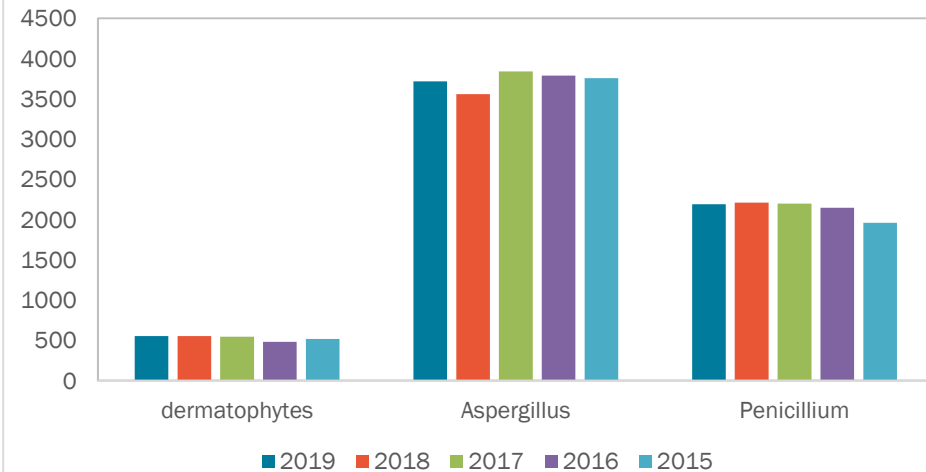


# Phylogenetic approaches 2015-2019

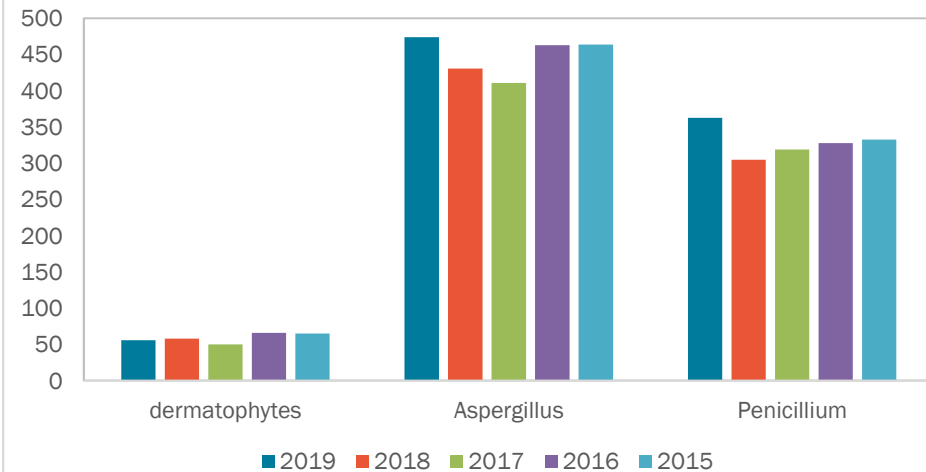
Google Scholar



Number of hits "taxonomy of..."



Number of hits "polyphasic..."



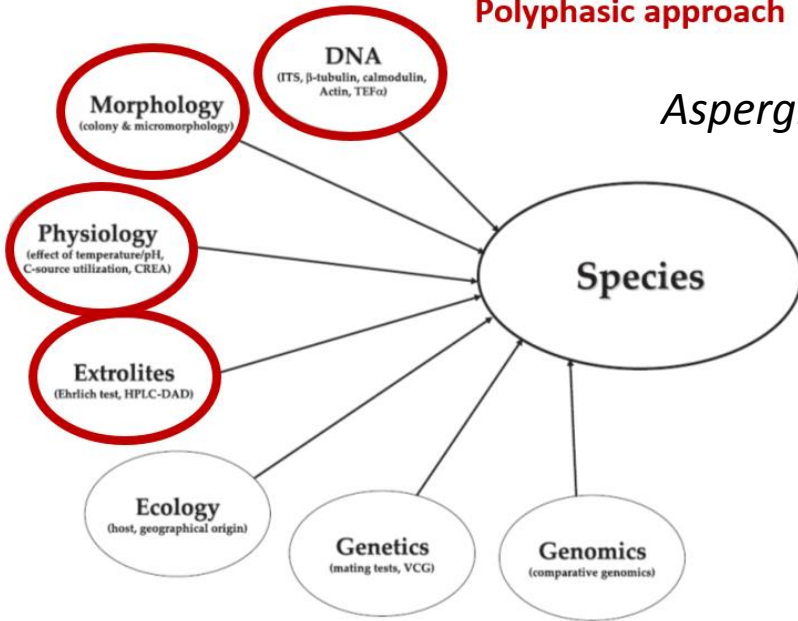
- Dermatophytes are mainly studied by clinicians
- Often identified by morphology or ITS rDNA



# Polyphasic approach

## Polyphasic approach

*Aspergillus, Penicillium, Cryptococcus* and others show the way



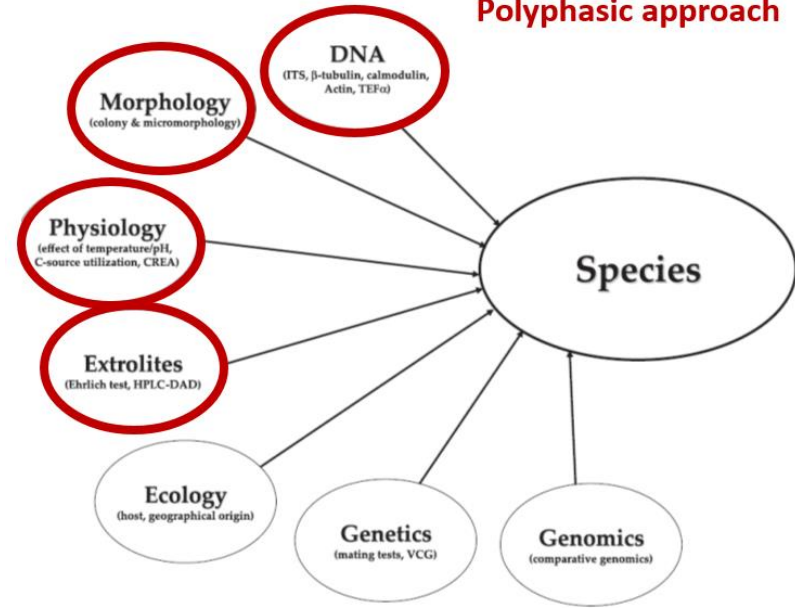
## DNA sequence markers

- sufficiently variable (**ITS**,  $\beta$ -tubulin, calmodulin, RPB2, mcm7, tsr1)
- available for majority of species
- relatively **well-known level of intraspecific variability** and minimal genetic distances between species



# Polyphasic approach

## Polyphasic approach



## Dermatophytes

- DNA sequence markers (ITS,  $\beta$ -tubulin, tef-1 $\alpha$ )
- morphology
- physiological and biochemical tests
- mating experiments
- secondary metabolism
- ecology – host spectrum, distribution
- clinical manifestation



# Current approach



## *T. interdigitale*

- tinea pedis and onychomycosis in humans
- ITS barcode sequence
- clonal, only MAT1-2 isolates



## *T. mentagrophytes*

- infection in rabbit, dogs, cats, rodents
- ITS barcode sequence
- sexual, both MAT genes





# Morphology



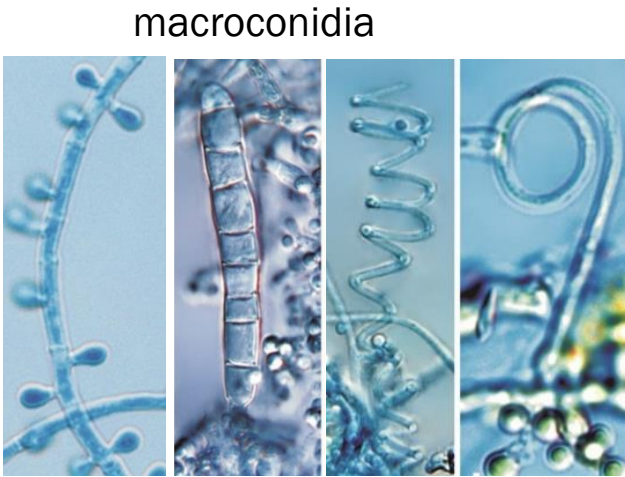
*T. interdigitale*



microconidia



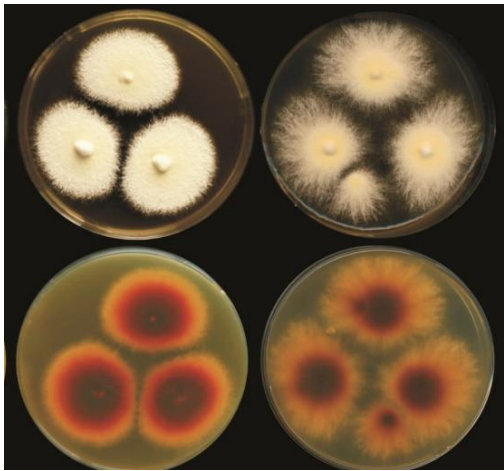
*T. mentagrophytes*



macroconidia

microconidia

spiral hyphae





# Does the fungi know how to behave?

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# Does the fungi know how to behave? No!

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ONE STRAIN



# Does the fungi know how to behave? No!

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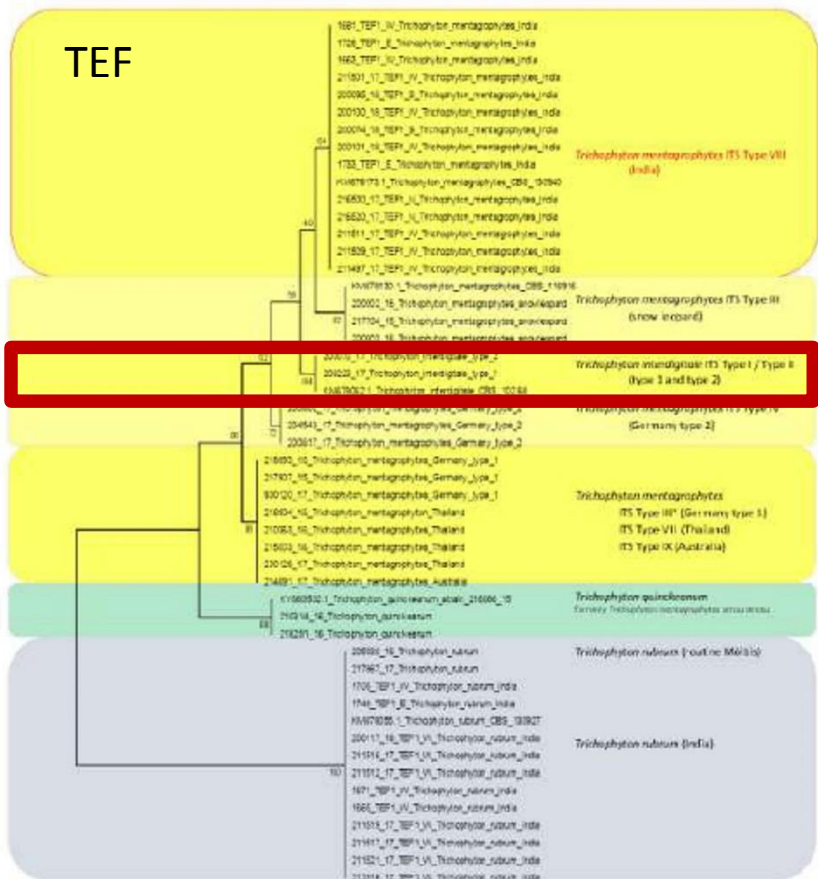
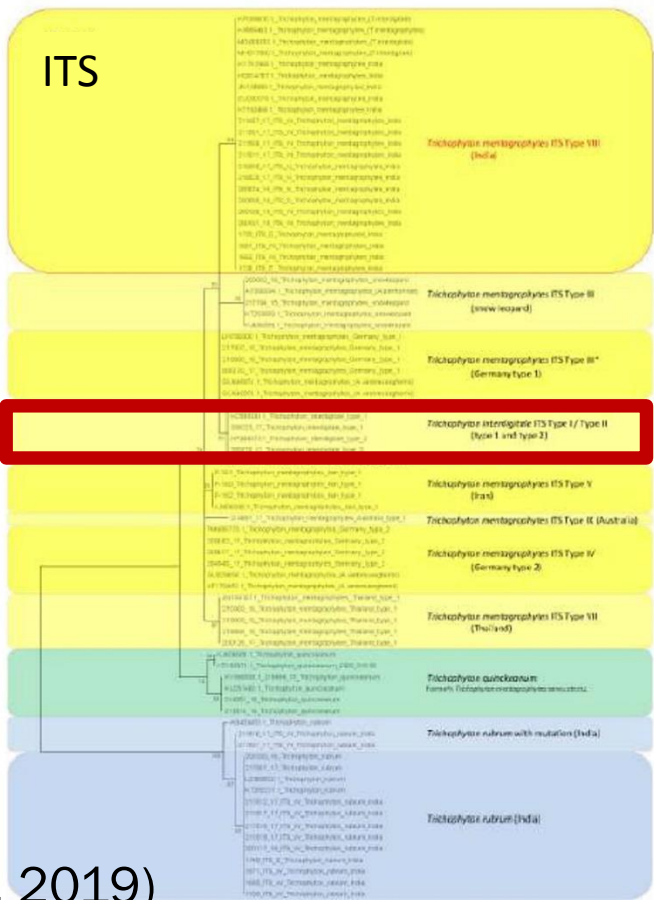
What about  
molecular data?

ONE STRAIN





# *Trichophyton interdigitale* and *T. mentagrophytes* are not monophyletic



(Nenoff et al., 2019)



prevention of reinfection and spread of infection by identifying source of mycotic infection

## Anthropophilic infection

- sanitary conditions
- treatment of roommates
- prevention of risky hobbies

## Zoophilic infection

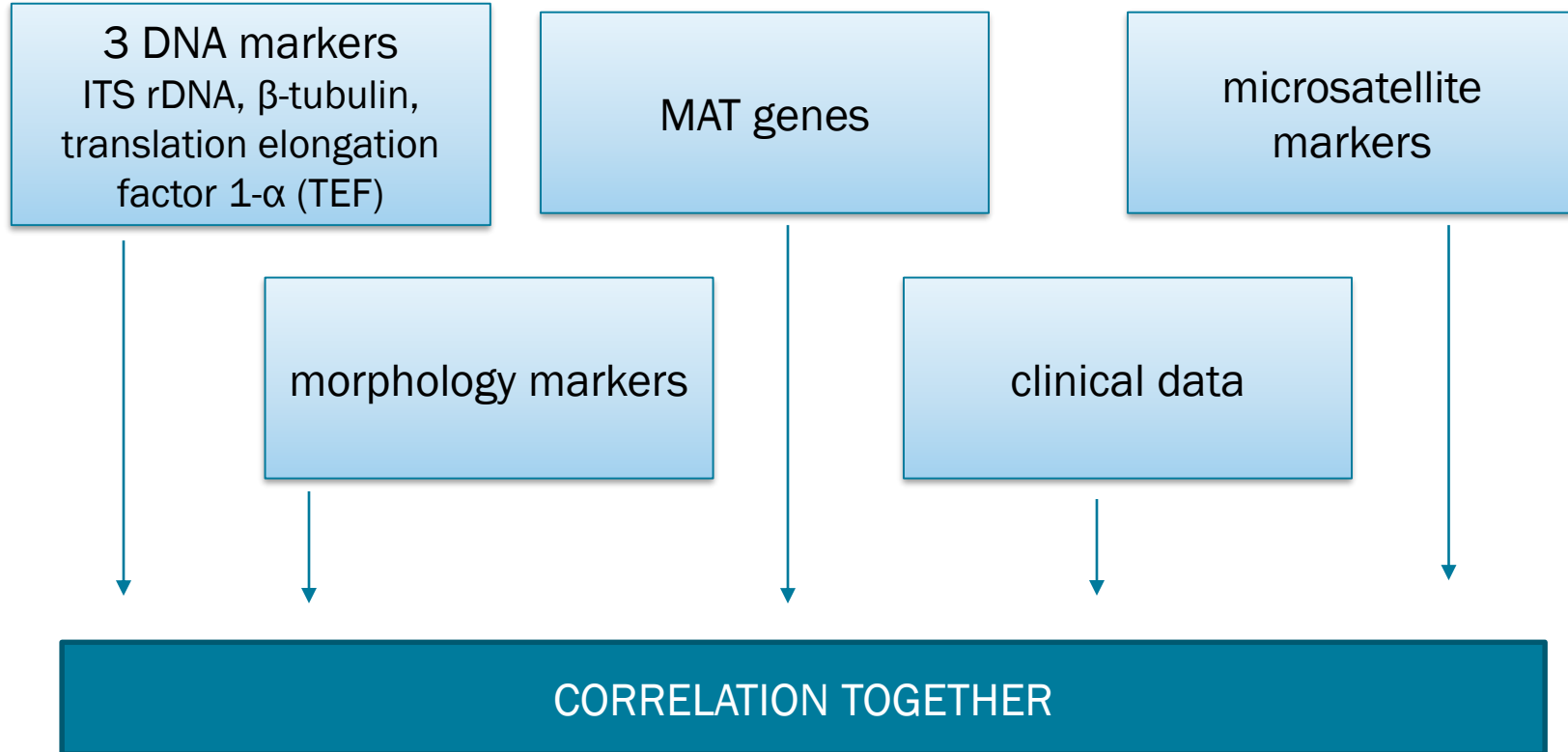
- finding of infected animal and animal treatment



- Confirmation of traditional classification = two species
- OR = one species with wide host range and variable phenotype and genotype



# Approach with dataset of 130 isolates





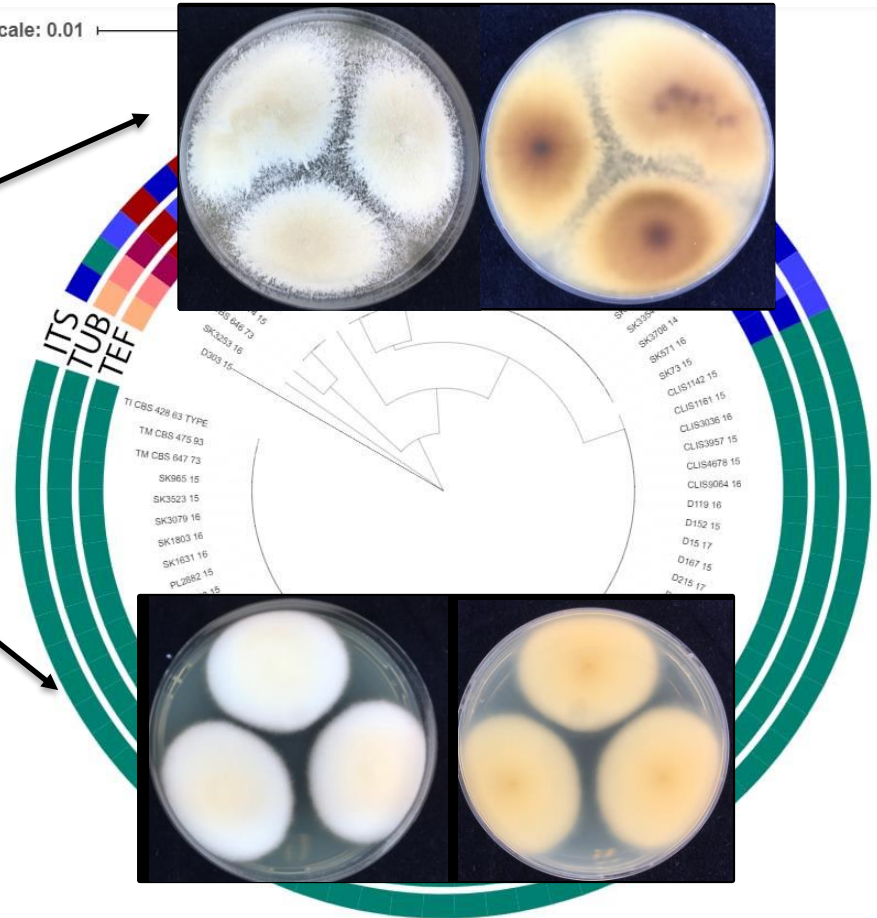




# Preliminary results

- Presumption of morphology
- “*T.mentagrophytes*”
- “*T.interdigitale*”
- many isolates are in transition state

Tree scale: 0.01





Tree scale: 0,01

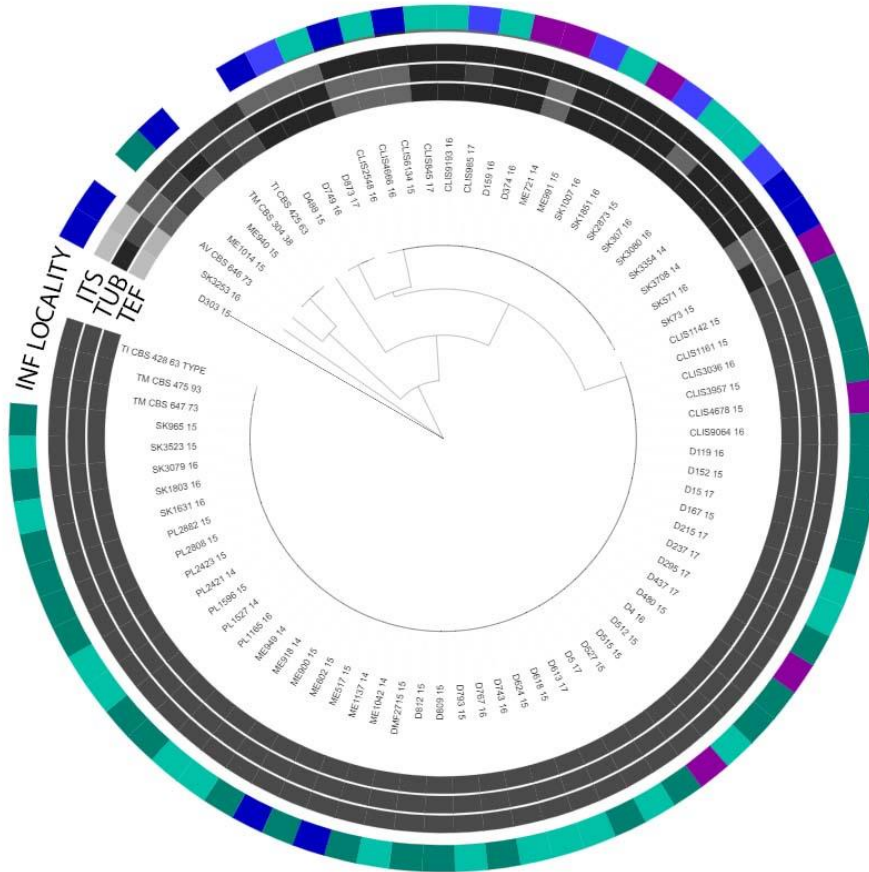


- violet = age of patient
  - average age
- “T.interdigitale”* > *“T.mentagrophytes”*



# Preliminary results

Tree scale: 0.01



## Clinical manifestation



Onychomycosis are specific for  
“*T.interdigitale*”



# Take home message

## 2 species

Low gene flow between populations

*T.interdigitale* and *T.mentagrophytes*  
separated by 3 gene markers

Onychomycoses specific for *T.interdigitale*

*Trichophyton mentagrophytes* ↑ gene  
diversity by mating

## 1 species

*T.interdigitale* is not monophyletic by  
ITS and TEF markers

overlapping morphology

overlapping clinical manifestation

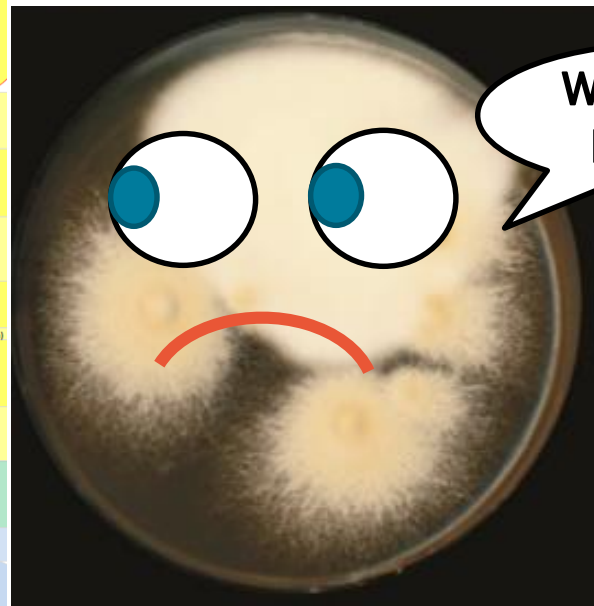
tinea infections are not specific for  
one or another species

## Future:

dataset scale up, MAT genes, morphology (micro-,  
macro), delimitation methods



# Thank you for your attention!



Where do I belong?





- [www.itol.embl.de](http://www.itol.embl.de)
- [www.scholar.google.com](http://www.scholar.google.com)
- NENOFF, Pietro, et al. The current Indian epidemic of superficial dermatophytosis due to *Trichophyton mentagrophytes*—A molecular study. *Mycoses*, 2019, 62.4: 336-356.
- SAMSON, Robert A., et al. The species concept in *Aspergillus*: recommendations of an international panel. *Studies in Mycology*, 2007, 59: 71.