Species delimitations in taxonomically difficult fungi: the case of *Hymenogaster*

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Acknowledgment

Ert (Engelbert) Soehner, around 1940

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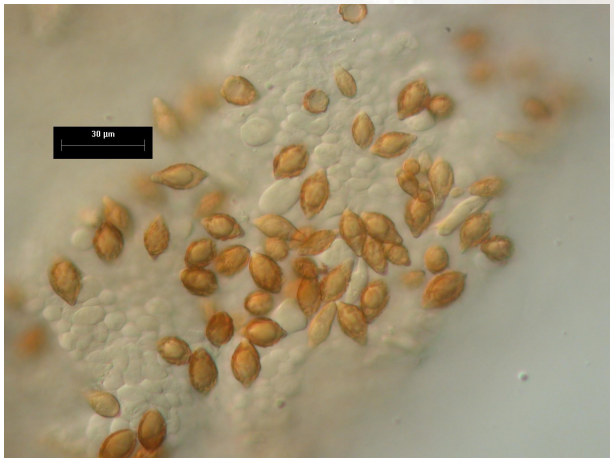
Introduction

General challenges:

- Macromorphological variability of basidiomata
- Micromorphological variability of basidospores
- Combination of both
- Different interpretations of morphological characters



Hymenogaster arenarius basidiospores and basidiomata

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Introduction

Great variety of species concepts

- Vittadini 1831
- Tulasne brothers 1843
- Hesse 1890
- Zeller & Dodge 1934
- Soehner 1960 (**narrow: 94 species**)
- Gross 1980
- Montecchi & Sarasini 2000 (**broad: 17 species**)

- How useful are these species concepts?

- **Question 1:** How to objectively compare different species concepts?

- **Question 2:** Once the best species concept is identified, how to revise the classification?

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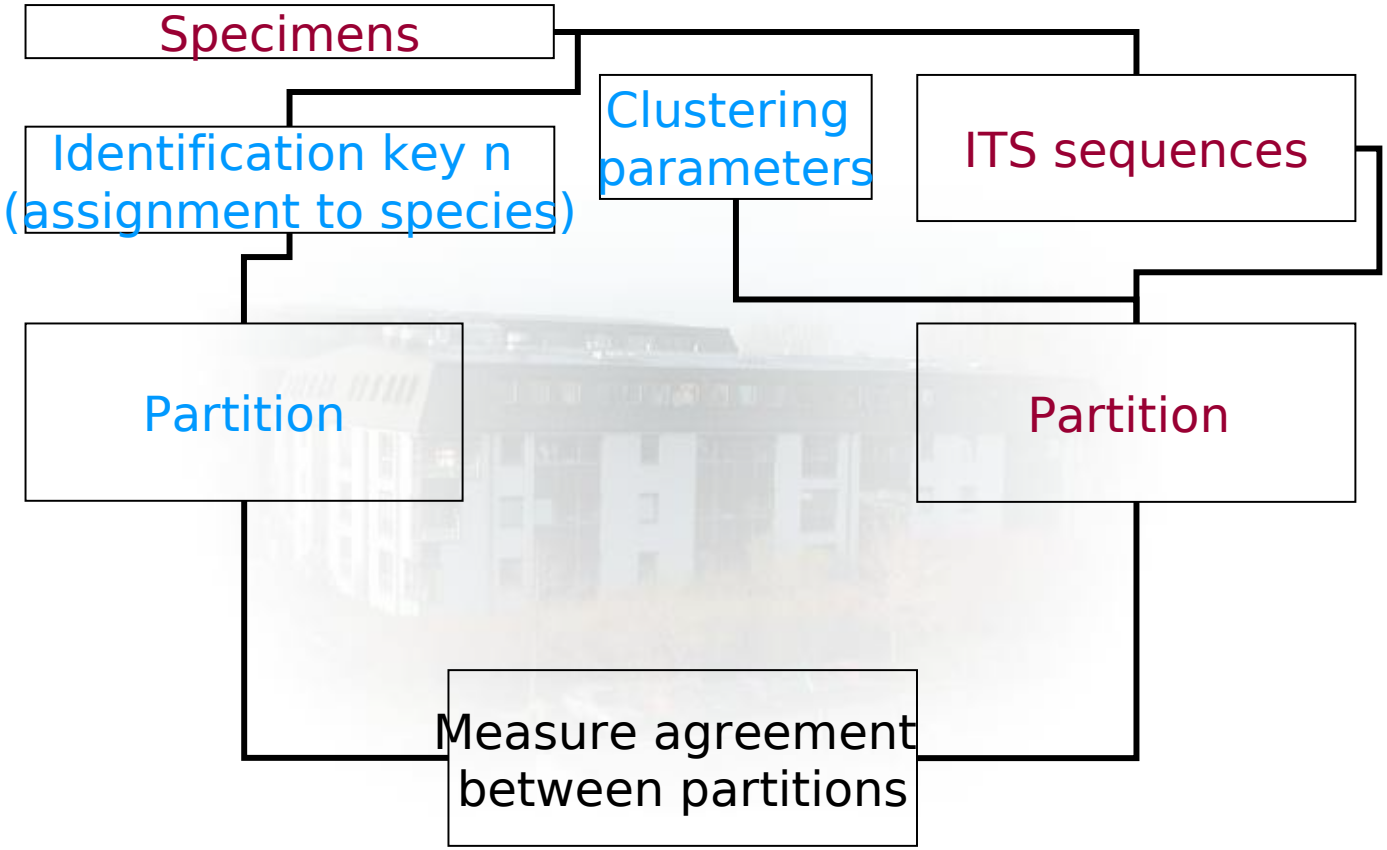
Clustering optimization to improve the congruency between traditional taxonomy and molecular systematics



- Key 1: Soehner **(narrow)**
- Key 2: Montecchi & Sarasini **(broad)**
- Key 3: Modified Montecchi & Sarasini

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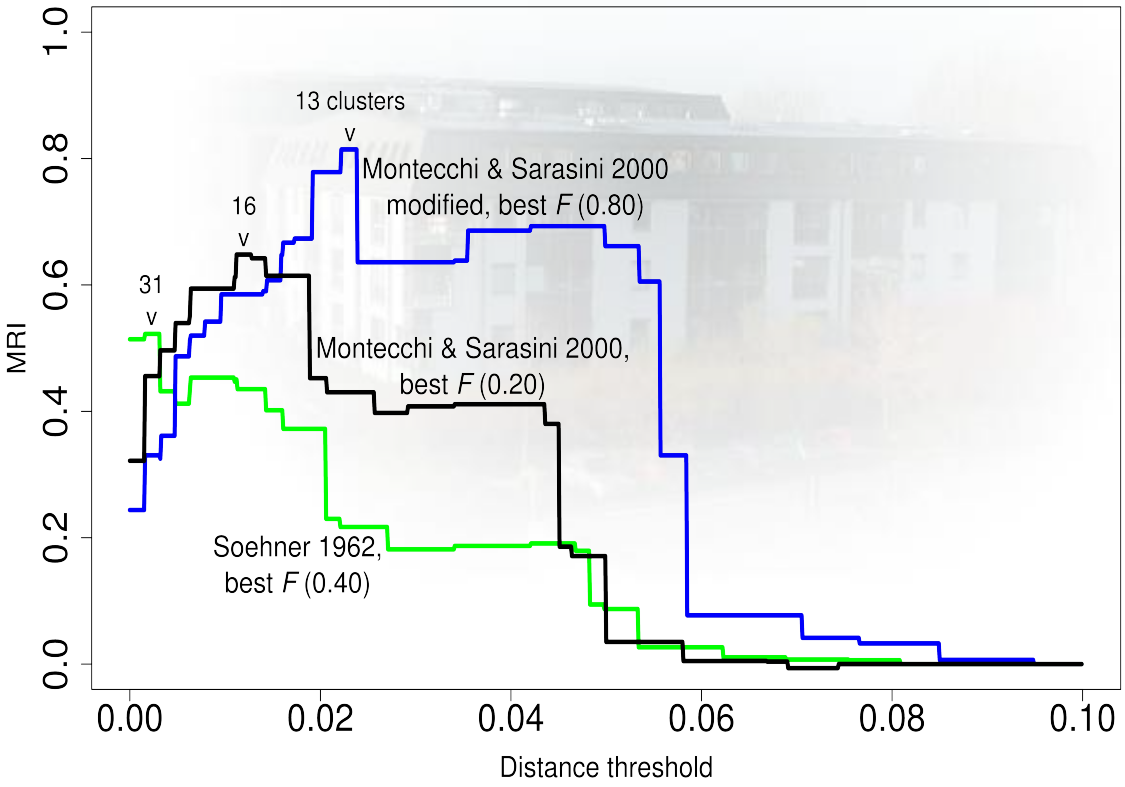
Clustering optimization plot

- 140 specimens from seven countries, mainly from Hungary and Germany
- Three keys examined (narrow vs. broad)
- Clustering optimization plot



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Phylogenetic inference

- Maximum likelihood tree (RAxML)

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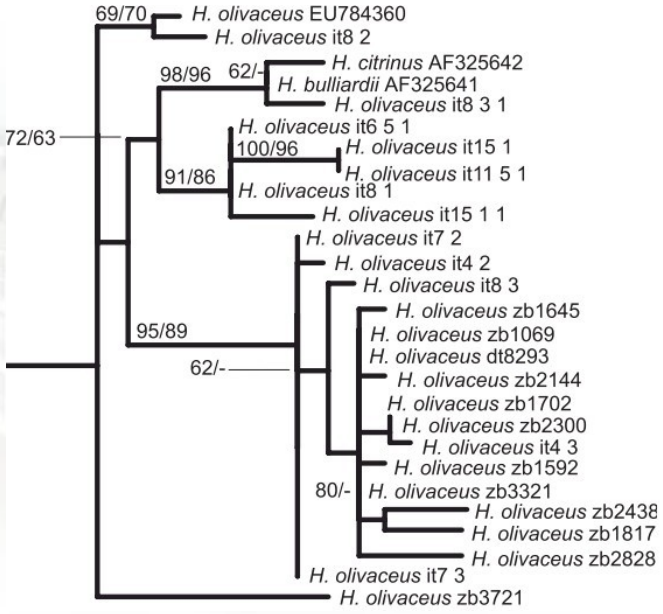
Example 1: Taxa merging

- Cluster 17, *Hymenogaster citrinus*
- Soehner: 4 species
- Montecchi & Sarasini: 2 species
- Modified Montecchi: 1 species



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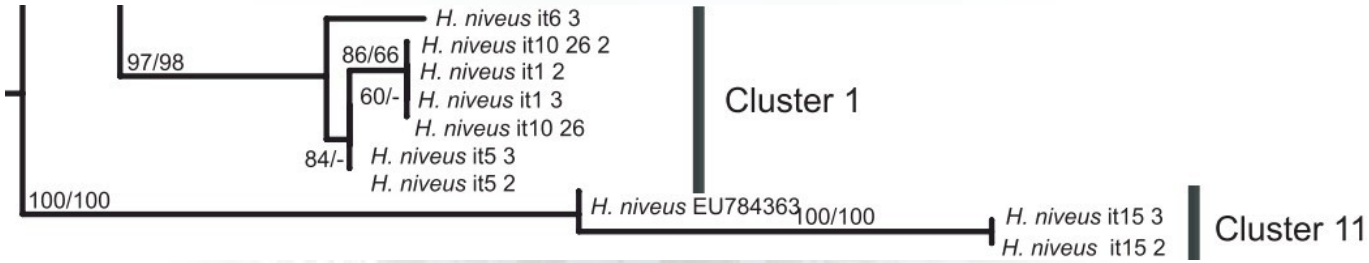
Example 2: Taxa splitting

- *H. arenarius* (Cluster 1) and *H. tener* (Cluster 11) must be separated from *H. niveus*
- Soehner: 3 species
- Montecchi & Sarasini: 1 species
- Modified Montecchi: 1 species



Hymenogaster tener arenarius

Hymenogaster niveus

Hymenogaster

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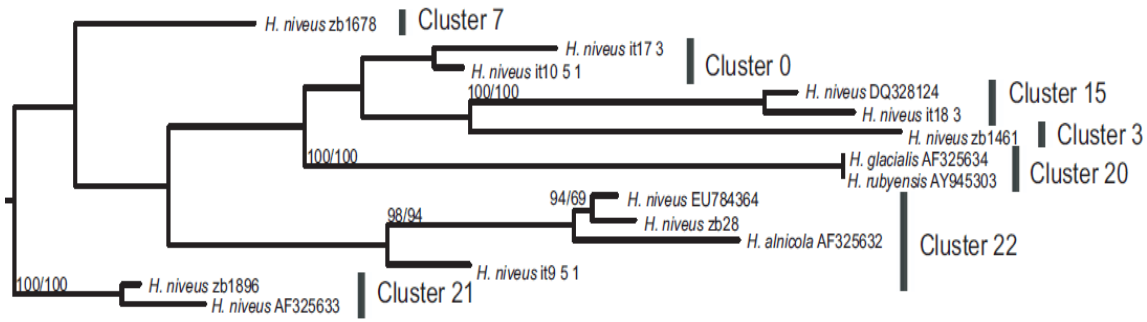
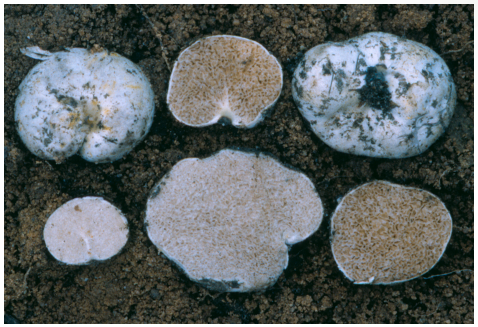
Example 3: Cryptic taxa

- Cryptic taxa remain
- *H. niveus*, 7 clusters
- Soehner: 2 species
- Montecchi & Sarasini: 1 species*
- Modified Montecchi: 1 species*

(*including *H. tener* and *H. arenarius*)





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Conclusion

- Considerably macro- and micromorphological variability of *Hymenogaster* does not directly coincide with a large number of clusters
- The narrow species concept of Soehner does not adequately reflect the true number of species
- The modified broad species concept of Montecchi & Sarasini that combines conspecific taxa does more accurately reflect the number of species in the genus *Hymenogaster* (but we have considered some of Soehners taxa)
- Central European taxa with well distinguishable morphological characters are reduced from 25 (Soehner: 94) to 12 (including two novel species and 2 cryptic species complexes)
- Clustering optimization using OPTSIL is useful for complex and taxonomically difficult groups of fungi in general

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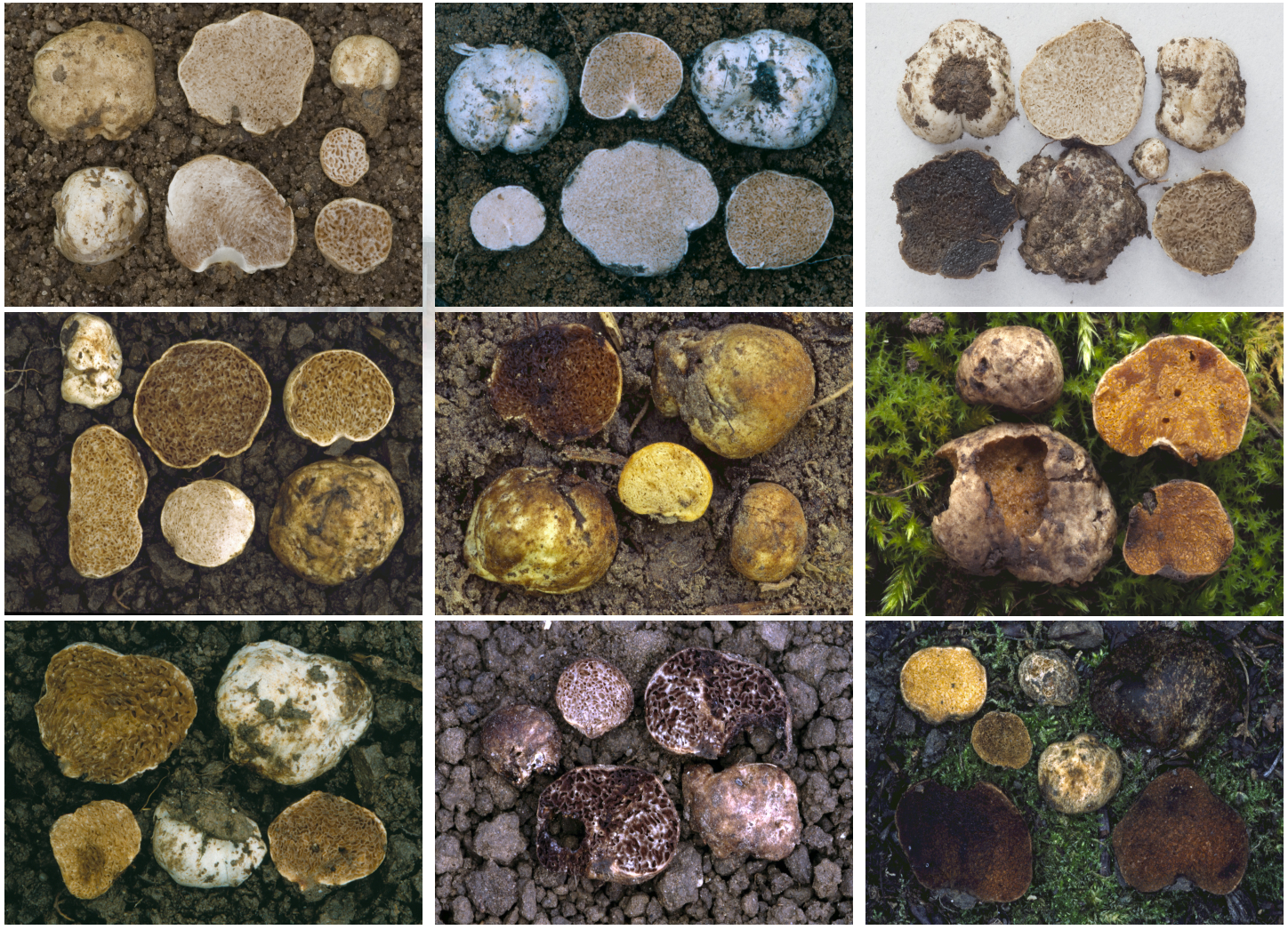
More *Hymenogaster*



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Example: Conspecific / cryptic taxa

- *H.niveus*, *H. arenarius*, *H. tener* (*H. pussilus*, *H. mutabilis* ?)

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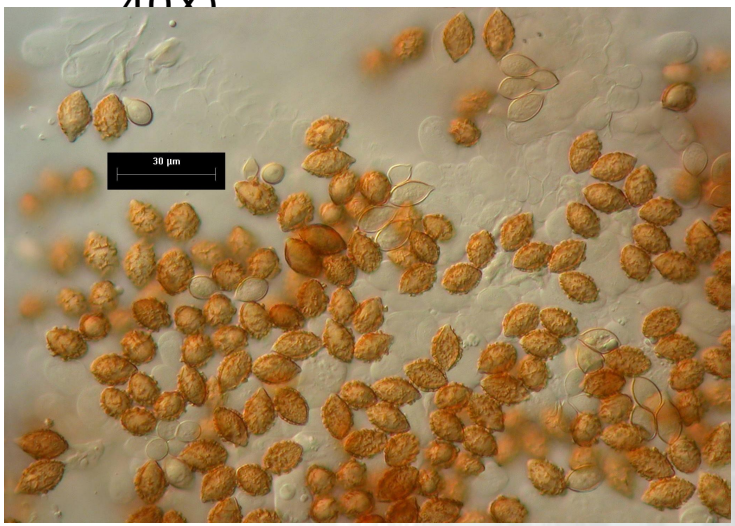
Example

Hymenogaster tener (DIC 40X)



Hymenogaster arenarius (DIC 40X)

Hymenogaster niveus sensu lato (DIC 40X)

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Example

Hymenogaster tener (DIC 40X)

Hymenogaster arenarius (DIC 40X)

Hymenogaster niveus sensu lato (DIC 40X)

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