

# Taxonomic re-examination of *Macrolepiota olivascens*, a European taxon showing high similarity to parasol mushroom *M. procera* (Agaricaceae, Basidiomycota)

The genus *Macrolepiota* – the saprotrophic fungal genus *Macrolepiota* Singer contains ca. 40 species worldwide, characterized by large agaricoid basidiomata with a loose ring and squamules covering the pileus. The type species of the genus is *M. procera* (Scop.) Singer, a popular edible mushroom due to its delicious taste and faint nutty aroma of the cap. It also has a good medicinal value, as it contains proteins, minerals, vitamins, carbohydrates, and high amounts of dietary fibres.



Figure 3. *M. olivascens*. Typical greenish discoloration on the pileus and stem. Photos: Gy. Vrba.

## INTRODUCTION

*Macrolepiota procera* species complex (Figure 1, 2) includes taxa previously separated as species on morphological ground (e.g., *M. permixta* (Barla) Pacioni, *M. fuliginosa* (Barla) Bon). *Macrolepiota olivascens* Singer & M.M. Moser also shares similar micro- and macromorphological characteristics like *M. procera*, but its distinguishing feature is that the pileus and stem show a greenish discoloration (Figure 3). *Macrolepiota olivascens* was described from Austria and considered as a rare species throughout Europe (Figure 4).



Figure 1. Basidiocarps of *Macrolepiota procera* (A) and *M. olivascens* (B) in Hungary. Photos: A) Angelina Nagy; B) György Vrba.



Figure 4. Georeferenced records of *Macrolepiota olivascens* in the GBIF database ([www.gbif.org](http://www.gbif.org)).

## MATERIALS & METHODS

The studied *Macrolepiota* samples were collected in the past few years in Hungary and Denmark. Primer pair ITS1F/ITS4 was used for the Phire® Direct PCR method as well as for Sanger-sequencing. Chromatograms were checked by Staden package. Our dataset was complemented with sequences downloaded from GenBank. Alignments were made in SeaView 4. Phylogenetic reconstruction was inferred using RAxML in raxmlGUI with 1000 rapid bootstrap and GTRGAMMA substitution model. Phylogenetic tree (Figure 5) was visualized in MEGA 7.

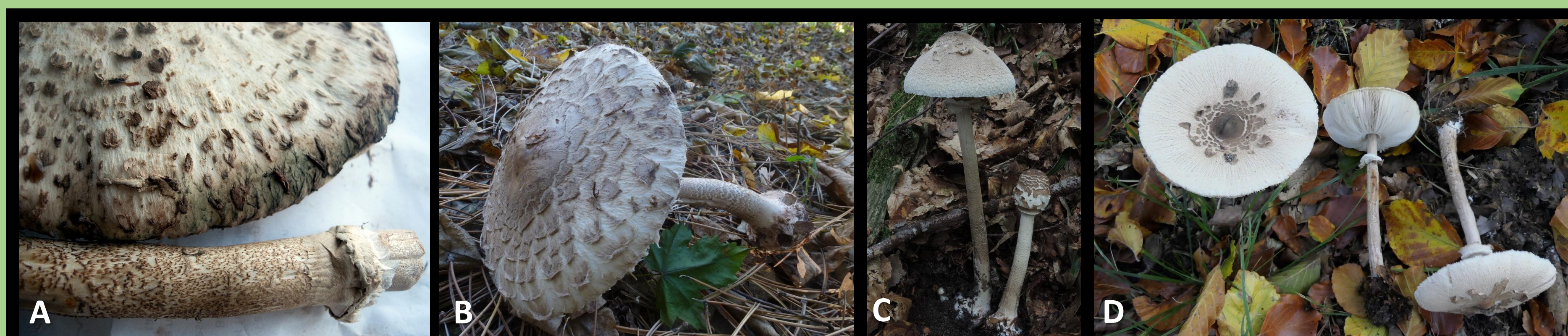


Figure 2. Basidiocarps of *Macrolepiota procera* species complex. A) *M. olivascens* (DMS9203956); B) *M. procera* (A2429); C–D) *M. rhodosperma* (= *M. fuliginosa* s. Vellinga) (DMS9332434, DMS9344048). Photos: A,C) Thomas Læssøe, B) Lajos Boros; D) Margot Nielsen.

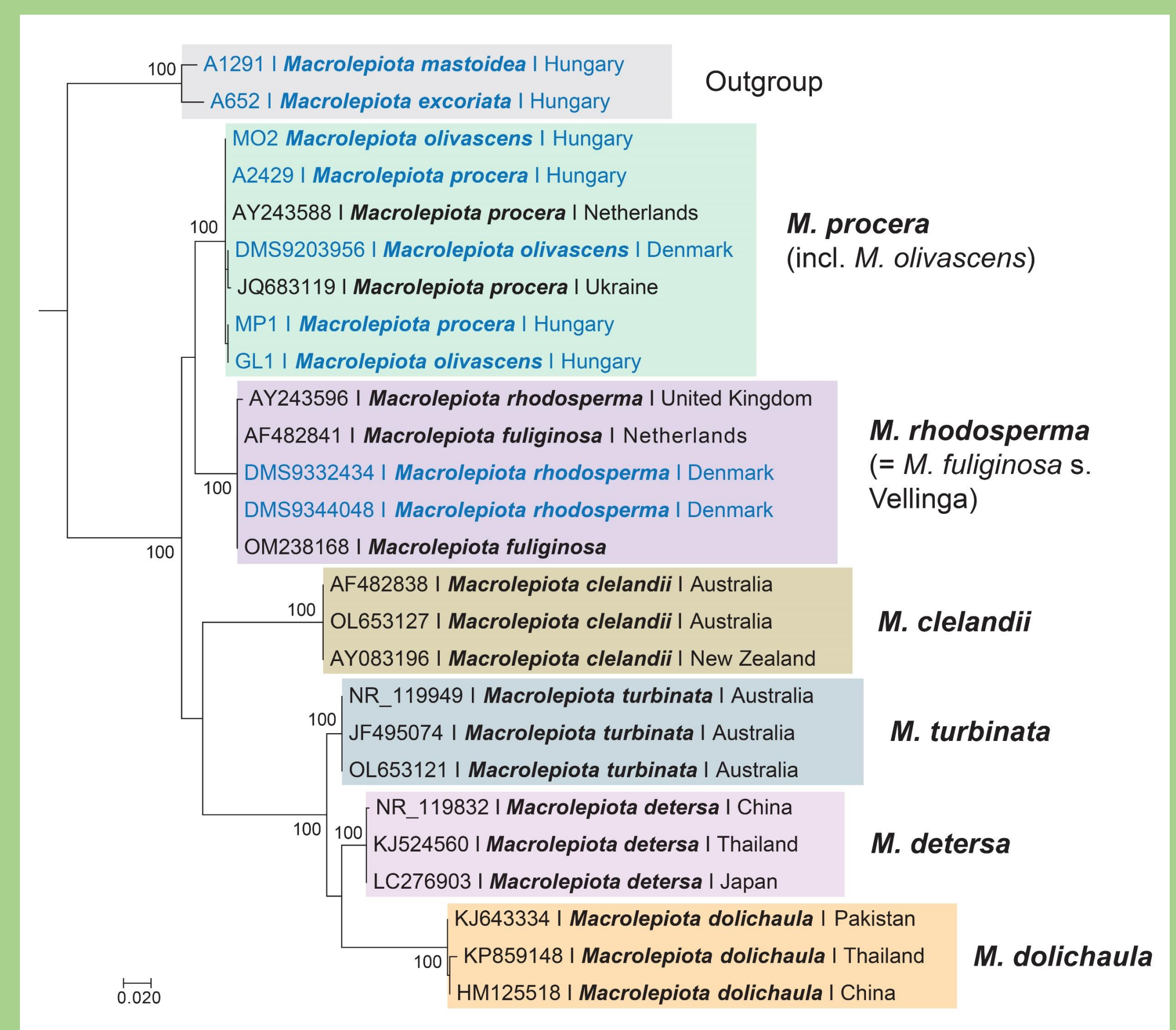


Figure 5. Maximum Likelihood (ML) phylogenetic tree derived from ITS-sequences of *Macrolepiota olivascens* and its relatives. ML bootstrap values > 70% are shown above or below branches. The bar indicates 0.02 expected change per site per branch. New sequences marked with blue.

## RESULTS & DISCUSSION

An examination of recent *Macrolepiota* collections from Hungary has failed to show reliable micromorphological differences between specimens identified as both *M. olivascens* and *M. procera*. As far as we know, the separation of *M. olivascens* at the species level has not been studied and confirmed by molecular genetic studies. For this purpose, examination of the nrDNA ITS region of *M. olivascens* materials from Hungary and Denmark were carried out in this study. Based on our results the ITS sequences do not separate this taxon from *M. procera* on species level (Figure 5). Therefore, our preliminary phylogenetic study suggests that the two species are conspecific, with *M. olivascens* being only a synonym or a form of the earlier described *M. procera*. In order to support this preliminary result and clarify the taxonomic position, ecological and evolutionary background of the *M. procera* species complex, it is necessary to study additional samples (incl. type materials). Furthermore, we are planning further investigations to chemically explore and identify the compounds responsible for the greenish discoloration, which was previously considered a taxonomically relevant feature.