

The first species of *Lentinula* described from Africa: patterns of genetic divergence and historical biogeography in *Lentinula*

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Abstract

The genus *Lentinula* (Agaricales) is a small lineage in Omphalotaceae with seven described species, including the shiitake mushroom (*L. edodes*), which is the most widely cultivated mushroom in the world. Species of *Lentinula* are distributed throughout Australasia, the neotropics, and the Gulf Coast and Caribbean regions of the Americas, but none have been described from Africa. Here, we describe the first species of *Lentinula* from Africa, *Lentinula madagasikarensis* sp. nov., from central Madagascar. This report constitutes a 4000-mile, trans-oceanic range extension for *Lentinula*. The new taxon is strikingly similar to *L. edodes*, but a multi-locus phylogenetic analysis places it as sister to the neotropical *L. aciculospora*. A combination of macro- and micromorphological characters clearly distinguish *L. madagasikarensis* from all other species of the genus. We will discuss the implications of this discovery for the geographic origin of *Lentinula*, as well as a peculiarly high rate of interspecific sequence divergence in the ITS region detected in the group.

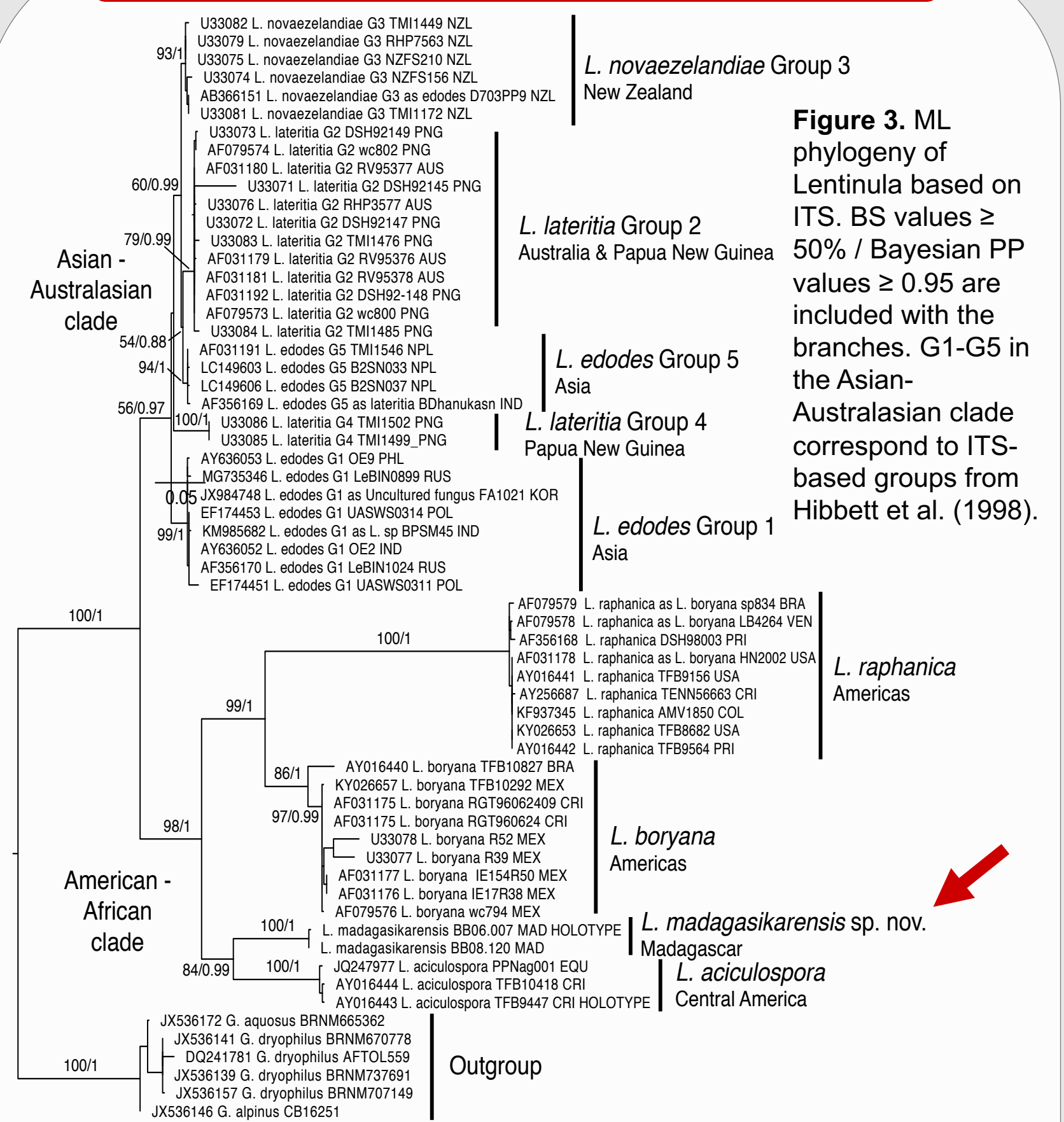
L. madagasikarensis sp. nov.



Figure 1. Lab and field photographs of *Lentinula madagasikarensis*; Chilocystidia; Basidiospores; and Basidia; G) Cheilocystidia. Scale bar for drawings equals 20 µm.

During a survey on edible mushrooms of Madagascar, B. Buyck and V. Hofstetter reported the finding of a species of *Lentinula*. This species was found on both native wood as well as introduced *Eucalyptus*. The new species closely resembles *L. edodes* but differs in having thick velar material on the cap margin as well as narrower spores and sphaeropedunculate cheilocystidia that forms florets. *L. madagasikarensis* is morphologically distinct from its sister species, *L. aciculospora*, with its vinaceous cap color, larger basidiospores, and cheilocystidia without lobes. The epithet is derived from the Malagasy term for Madagascar.

Species phylogeny of *Lentinula*



After confirming placement in *Lentinula*, an ITS phylogeny resolves the new species placement as sister to *L. aciculospora*, an America species restricted to Central America and northern South America.

Placement in *Omphalotaceae*

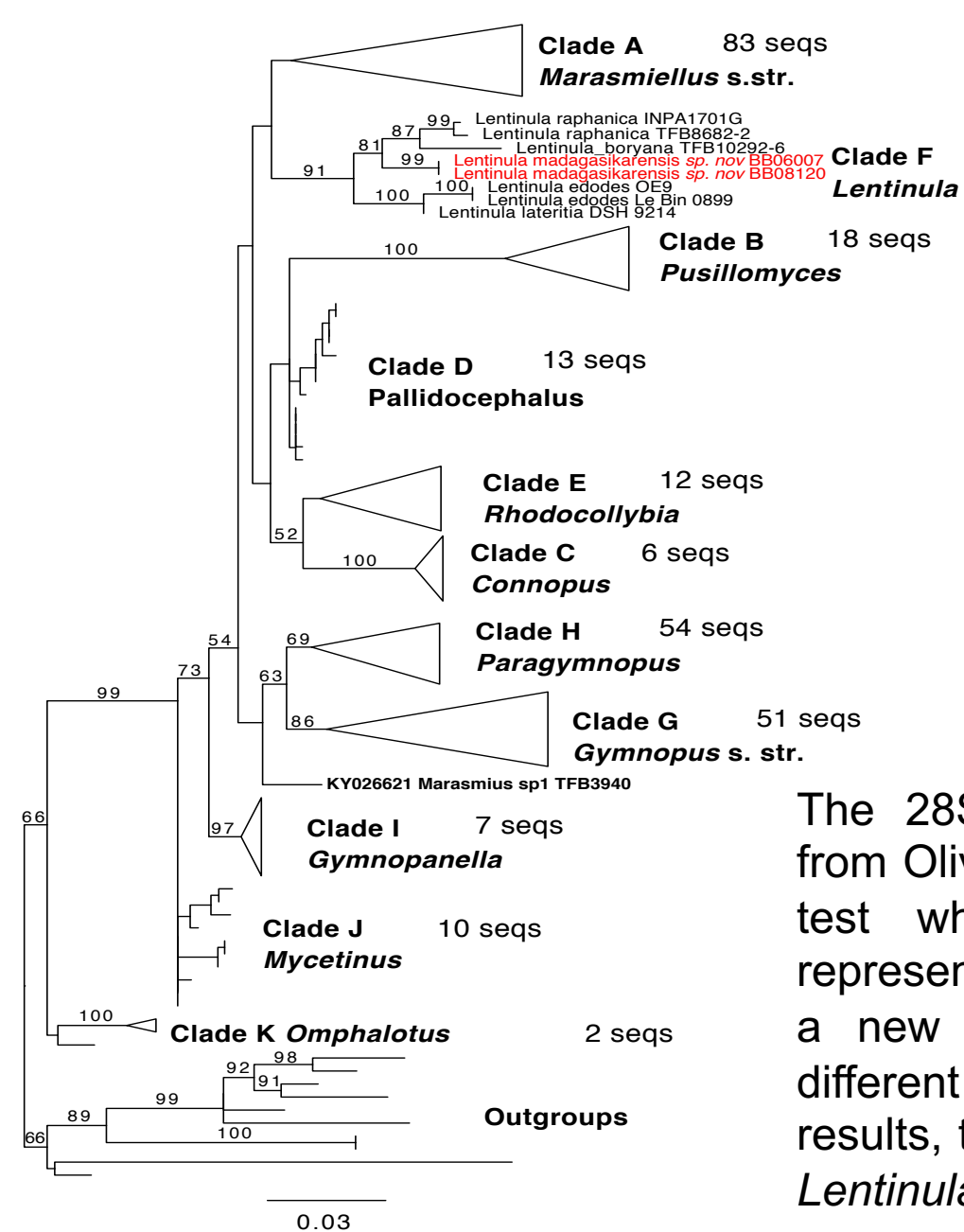


Figure 2. Maximum-likelihood phylogeny of *Omphalotaceae* based on the 28S sequence dataset of Oliveira et al. (2019). Major clades from the original study are labeled and collapsed with number of samples included in each clade. BS values \geq 50% are included with the branches.

The 28S dataset of *Omphalotaceae* from Oliveira et al. (2019) was used to test whether the African material represents a new species of *Lentinula*, a new genus, or a member of a different genus. Based on these results, this is clearly a new species of *Lentinula*.

High interspecific variation in ITS

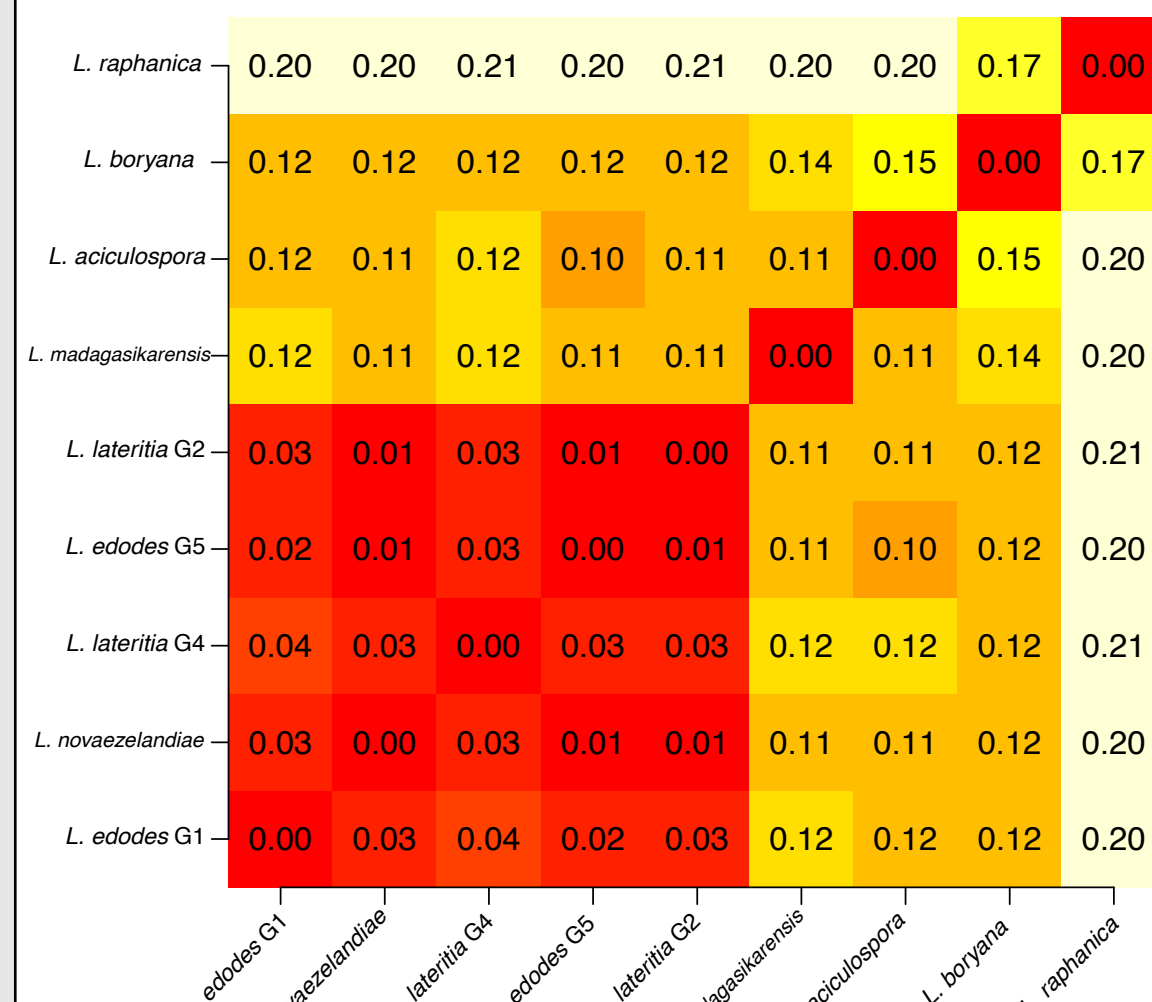


Figure 4. Distance-matrix heat map of representative sequences of *Lentinula* based on pairwise distances from an ITS multi-sequence alignment given as proportion of divergence.

Initial BLAST results of the new species of *Lentinula* resulted in ambiguous hits to various members of *Omphalotaceae*. Genetic distances between species of *Lentinula* outside of the Asian-Australasian clade are high.

Future directions

It will be important to include this new species in the ongoing *Lentinula* genome project. We plan to use the Oxford Nanopore MinION system to sequence the 2008 material. With this data we can use phylogenomics to resolve relationships in *Lentinula* and test for a biogeographic origin.



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