

The lentinoid fungi (*Lentinus* and *Panus*) from Western Ghats, India

Gunasekaran Senthilarasu

SRM Research Institute, SRM University, Kattankulathur 603203, Tamil Nadu, India; corresponding author e-mail: senthilarasug28@gmail.com

Abstract: *Panus natarajanus* sp. nov. from the Western Ghats of Karnataka, India, is described, illustrated and discussed along with *P. velutinus*, *P. tephroleucus*, *P. ciliatus*, *P. hookerianus*, *Lentinus fasciatus*, *L. concentricus*, and *L. megacystidiatus*. *Lentinus alpacus* is re-allocated to *Panus* as *P. alpacus* comb. nov., and contrasted with *P. parvus*. A short description with illustrations is provided of *L. concinnus*, which is also newly reported from the Western Ghats. A synoptic key for all species of lentinoid fungi of the Western Ghats is provided.

Key words:

Agaricales
Gloeophyllales
Pleurotus
Polyporales
taxonomy

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INTRODUCTION

The generic demarcation and phylogenetic relationships between *Lentinus* and *Panus* and their putative allies *Neolentinus*, *Heliocybe*, and *Pleurotus* has been controversial (Kühner 1980, Corner 1981, Pegler 1983a, Redhead & Ginns 1985, Singer 1975, 1986, Hibbett & Vilgalys 1991, 1993, Rune 1994, Thorn *et al.* 2000, Garcia-Sandoval *et al.* 2011). Corner (1981) considered *Lentinus* and *Panus* as separate genera on the basis of their hyphal system and included some species placed in *Pleurotus* by Singer (1975), whereas, Pegler (1983a) treated *Panus* as a subgenus of *Lentinus* and included several species of Singer's *Pleurotus* in *Panus*. Singer (1986) included *Lentinus crinitus* (the widely accepted lectotype species of *Lentinus*) and *Panus conchatus* (the conserved type species of *Panus*) in *Panus*, and *Lentinus* was used for *Neolentinus lepideus* and *Lentinula edodes*. However, Pegler (1975) separated *Lentinula edodes* from *Lentinus* in the basis of the non-decurrent lamellae and a monomitic hyphal system with inflated, sclerified generative hyphae. Many subsequent authors have accepted that *Lentinus* and *Panus* are separate genera (Corner 1981, Moser 1978, Singer 1975, 1986, Thorn *et al.* 2000). Recent studies using RFLP, and cladistic analyses of rDNA sequence data along with morphological characters, support *Lentinus* subgen. *Lentinus sensu* Pegler as equivalent to *Lentinus sensu* Corner. In addition, a large part of the subgenus *Lentinus sensu* Pegler, *Neolentinus* and *Panus s. str.* is monophyletic whereas, the *Lentinus sensu* Pegler is polyphyletic (Redhead & Ginns 1985, Hibbett & Vilgalys 1991, 1993, Hibbett & Thorn 1994, Hibbett *et al.* 1993, Grand *et al.* 2011, Seelan *et al.* 2015). Further, in a phylogenetic and phylogenomic overview of *Polyporales*, *Lentinus* was nested within the core polyporoid clade, while *Panus* was nested within the residual polyporoid clade (Binder *et al.* 2013). *Lentinus s. str.* is characterized by species with radiate, descending, or intermediate tramas

with ligative hyphae and hyphal pegs in the hymenium, whereas *Panus s. str.* is distinguished by the strongly radiate hymenophoral trama with dimitic hyphae and lacking hyphal pegs. The brown rot fungi *Neolentinus* and *Heliocybe* were segregated from *Lentinus* sections *Pulverulenti*, *Cirrhosi*, and *Squamosi sensu* Pegler (1983a) based on the bipolar mating system and type of wood decay (Redhead & Ginns 1985, Hibbett & Vilgalys 1993, Garcia-Sandoval *et al.* 2011) and included in *Gloeophyllales* (Binder *et al.* 2005, Hibbett & Donoghue 2001, Thorn *et al.* 2000). Rune (1994) considered *Heliocybe* to be a synonym of *Neolentinus* and suggested the transfer of *Heliocybe* species to *Neolentinus*. However, in a phylogenetic study on *Gloeophyllales*, *Heliocybe sulcata* was placed as the sister group to the clade *Neolentinus* (Garcia-Sandoval *et al.* 2011), which supported the retention of *Heliocybe* and *Neolentinus* as separate genera. As a result of all these studies, *Neolentinus* and *Heliocybe* are now placed in *Gloeophyllales*, while *Lentinula* is in *Agaricales*, and both *Lentinus s. str.* and *Panus s. str.* are in *Polyporales*. *Lentinus sensu* Pegler is dispersed through at least three orders, *Agaricales*, *Polyporales*, and *Gloeophyllales*.

A review of the literature revealed that 15 species belonging to *Lentinus* and *Panus* have been reported from the Western Ghats (Sathe & Daniel 1980, Sathe & Deshpande 1980, Sathe & Kulkarni 1980, Manjula 1983, Pegler 1983a, Manimohan *et al.* 2004, Natarajan *et al.* 2005, Farook *et al.* 2013, Senthilarasu 2014). This group is well explored in the Western Ghats of Kerala where six species of *Lentinus* and five species of *Panus* are known: *L. bambusinus* (Kumar & Manimohan 2005), *L. patulus* (Mohanan 2011), *L. polychrous* (Manimohan *et al.* 2004, Mohanan 2011), *L. sajor-caju* (Natarajan 1978, Sathe & Daniel 1980, Florence 2004, Manimohan *et al.* 2004, Pradeep & Vrinda 2007, Varghese *et al.* 2010, Mohanan 2011; Florence 2004, as *Pleurotus sajor-caju*; Manimohan *et al.* 2004, Pradeep & Vrinda 2007, Varghese *et al.* 2010, Mohanan 2011, all as *L. dicholamellatus*), *L. squarrosulus* (Sharma *et al.* 1985,

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Florence & Yesodharan 2000, Florence 2004, Manimohan *et al.* 2004, Pradeep & Vrinda 2007, Varghese *et al.* 2010, Mohanan 2011), *L. tigrinus* (Mohanan 2011), *P. caespiticola* (Manimohan *et al.* 2004, as *L. caespiticola*; Manimohan & Leelavathy 1995, as *L. caespiticola* var. *asiaticus*), *P. neostrigosus* (Manimohan *et al.* 2004, Mohanan 2011, as *L. strigosus*), *P. hookerianus* (Manimohan *et al.* 2004, as *L. hookerianus*), *P. indicus* (Sathe & Daniel 1980, Florence 2004), and *P. similis* (Manimohan *et al.* 2004, as *L. similis*).

The diversity of lentinoid fungi from the Western Ghats of Tamil Nadu, Maharashtra, and Karnataka is meager. *Lentinus crinitus* (Natarajan & Raman 1981), *L. squarrosulus* (Natarajan & Manjula 1978), *P. neostrigosus* (Pegler 1983a, as *L. strigosus*), *P. velutinus* (Pegler 1983a, as *L. velutinus*), and *P. similis* (Pegler 1983a, as *L. similis*) have been reported from the Western Ghats of Tamil Nadu (Natarajan 1978, Natarajan & Manjula 1978, Natarajan & Raman 1981, Manjula 1983, Pegler 1983a). In the Western Ghats of Maharashtra, *L. alpacus* (Senthilarasu & Singh 2012), *L. connatus* (Léville 1846, as *L. javanicus*; Pegler 1983a), *L. sajor-caju* (Senthilarasu 2014), and *L. squarrosulus* (Theissen 1911, as *L. aff. subnudus*; Pegler 1983a) have been reported. Only one species, *P. similis* (Pegler 1983a, as *L. similis*) has been authentically reported from the Western Ghats of Karnataka though Usha & Janardhana (2014) in their biodiversity study, listed *L. cladopus* and *L. sajor-caju* from the Western Ghats of Chickmagalur and Hassan.

Here, the generic concept of Corner (1981) is followed for *Lentinus* and *Panus*. A new species, *Panus natarajanus* that differs morphotaxonomically from other reported species is described, illustrated and discussed. *Panus alpacus* is proposed as a new combination for *L. alpacus*. A short description with illustrations is provided for *L. concinnus*, reported here for the first time from Western Ghats, to provide a clear demarcation from the common and widely distributed *L. tigrinus*. *Panus similis* is also reported from the Kadamakkal reserve forest of the Western Ghats of Karnataka. In addition, a synoptic key to the *Lentinus* and *Panus* species of the Western Ghats and its foothills is provided.

MATERIALS AND METHODS

Collections were made from different forest regions of the Western Ghats of Maharashtra and Karnataka. The colour terminologies used are from Kornerup & Wanscher (1978). Thin handmade sections were made from dried specimens rehydrated with alcohol. The microscopic observations were made in 10% KOH, stained in 3% phloxine and Cotton blue. The range of spores with extreme values in parentheses precedes average spore dimensions in parenthesis. The spore quotient (Q) represents mean length by mean width of 50 basidiospores measured. The holotype specimens were deposited at Ajrekar Mycological Herbarium (AMH), MACS' Agharkar Research Institute, Pune, India, and isotypes are preserved in personal collections (Macrofungal Collection

of India (MCI) at SRM Research Institute, SRM University, Kattankulathur, Tamil Nadu, India. The key for the lentinoid fungi of Western Ghats is prepared on the basis of published reports. Index Fungorum (www.indexfungorum.org) and Species Fungorum (www.speciesfungorum.org) are followed for nomenclature and currently accepted names, excluding some species as mentioned in the discussion.

TAXONOMY

Panus natarajanus Senthil., sp. nov.

Mycobank MB805095

(Figs 1–2)

Etymology: '*natarajanus*', in honour of the late Krishnamoorthy Natarajan (1942–2008), an eminent mycologist with incredible knowledge on the fleshy fungi of India.

Diagnosis: Differs from *Panus velutinus* in the concentrically zonate pileus, shorter and slenderer stipe, and the slightly smaller spores.

Type: **India**: Karnataka state: Sirsi, 14°27'15.0"N 74°41'60.6"E, 11 Oct. 2012, G. Senthilarasu (AMH 9470 – holotype; MCI 966 – isotype).

Description: Pileus 8–80 mm diam, thin, coriaceous, broadly, deeply infundibuliform, expanding to cyathiform; surface often with pale purplish tints when young, becoming different shades of reddish brown (8D5, 8D6, 8E8, 9E6, 9E7), darker towards the centre and covered by concentrically arranged, dense squamules, <1 mm long, more towards the centre, short hispid, <1 mm long, towards the margin, uniformly hispid when young, often with pale to dark concentric zones especially towards margin; margin at first strongly involute, becoming reflexed, not striate, not ciliate, lobed. *Lamellae* arcuate, short to deeply decurrent, Venetian red (8D8) to reddish brown (8E8), becoming dark reddish brown (9E8) on drying, often with vinaceous tints when young, narrow, <1mm wide, densely crowded with lamellulae of different lengths; edge entire. *Stipe* 20–40 × 1–5 mm, slender, cylindric, equal, expanding slightly at the base and apex, solid; surface concolorous with the pileus, short hispid with the indumentums extending into the bases of the lamellae, arising from a pseudosclerotium. *Pileal context* to 1 mm thick at the centre, white. *Basidiospores* 4.5–5(–5.5) × 2.5–3 (4.81 ± 0.21 × 2.78 ± 0.13) μm, Q = 1.73, oblong to cylindric, hyaline, thin-walled, with few visible contents. *Basidia* 15.5–20 × 3.5–5 μm, narrowly clavate-cylindric, bearing four short, thick sterigmata. *Lamella* edge sterile with scattered cheilocystidia, soon collapsing. *Cheilocystidia* 25–30 × 7–9 μm, cylindric-clavate, often sinuous, thin walled. *Sclerocystidia* abundant on sides of lamellae to scattered on lamellae edge, 22–60 × 4.5–8 μm, initially clavate with refractive gloeo-contents, soon developing a thickened wall up to 1 μm thick, hyaline

Fig 1. A. *Lentinus concinnus* in its natural habitat, surface view (AMH 9568 paratype). B. *L. concinnus* gills view (AMH 9568 paratype). C. *Panus natarajanus* in its natural habitat, gills view (AMH 9470, holotype). D. *P. natarajanus* surface view (AMH 9470, holotype).



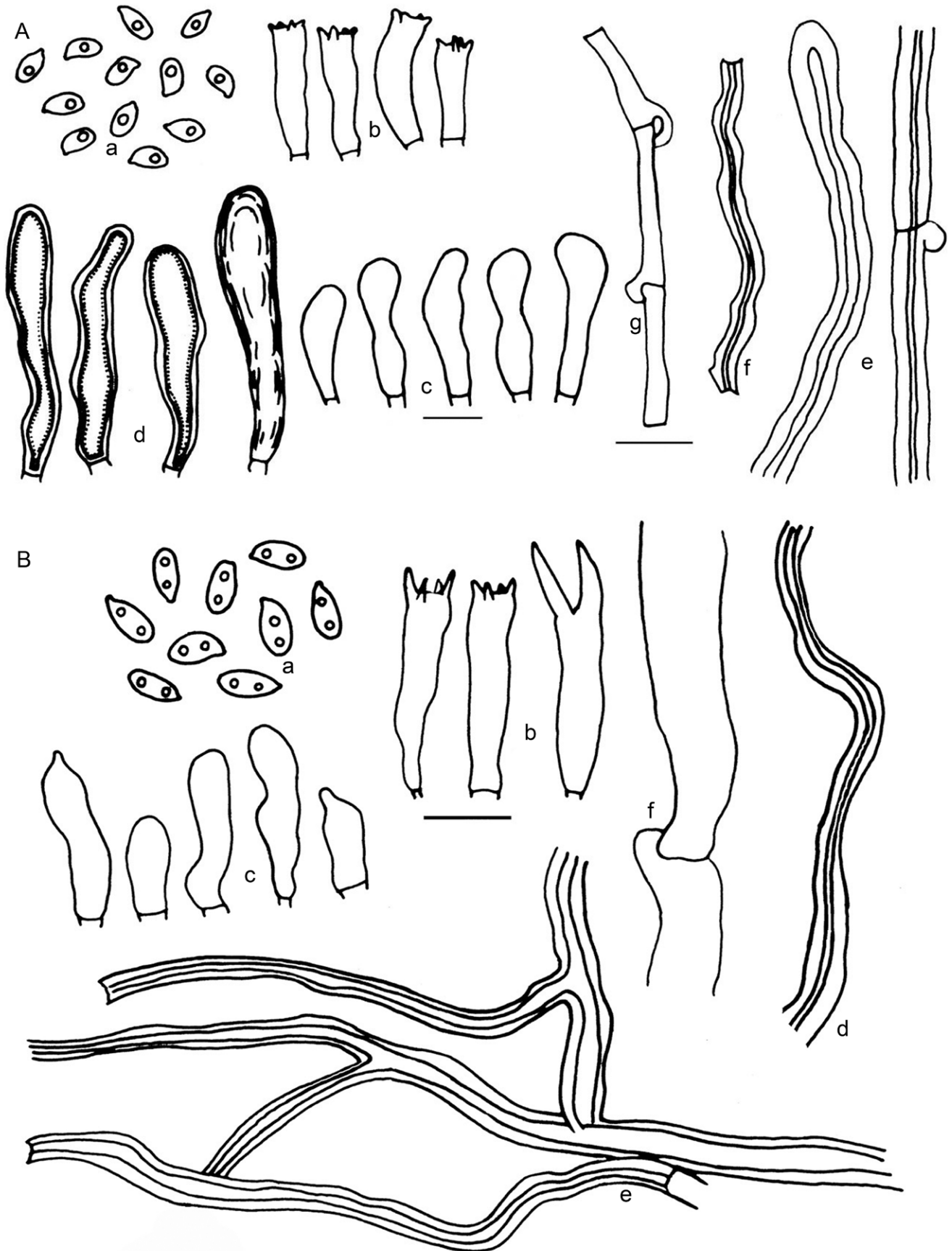


Fig 2. A. *Panus natarajanus* (AMH 9470, holotype). **a.** Basidiospores. **b.** Basidia. **c.** Cheilocystidia. **d.** Sclerocystidia. **e.** Epicuticular generative hyphae. **f.** Skeletal hyphae. **g.** Generative hyphae with clamp-connections. **B.** *Lentinus concinnus* (AMH 9568, paratype). **a.** Basidiospores. **b.** Basidia. **c.** Cheilocystidia. **d.** Skeletal hyphae. **e.** Skeleto-ligative hyphae. **f.** Inflated generative hyphae. Bars = 10 μ m.

to brownish, scarcely projecting 15 μm beyond the basidia. *Hymenophoral trama* irregular, of radiate construction, hyaline, consisting of generative hyphae and skeletal hyphae. *Subhymenial layer* narrow, irregular. *Hypodermium* subgelatinized, to 250 μm wide, consisting of hyaline, generative hyphae, to 3 μm diam. *Pileal context* consisting of a dimittic hyphal system with skeletal and non-inflated generative hyphae, hyaline, thin-walled with abundant clamp-connections; skeletal hyphae 1.5–4 μm diam, thick-walled, wall to 1.5 μm thick, hyaline; generative hyphae to 2.5 μm diam, hyaline, branched, thin-walled with abundant clamp-connections. *Pileal surface* an indefinite epicutis producing erect, loose fascicles, to 700 μm long, of brown, generative hyphae, 3–7 μm diam, thick-walled, to 2 μm thick, with obtusely rounded apex and abundant clamp-connections.

Habitat: Lignicolous, on an unidentified wood, solitary, scattered to gregarious, in *Vateria indica*/ *Dipterocarpus indicus* dominant dipterocarp forest. Known only from the type locality.

Notes: The pantropical *Panus velutinus* (Pegler 1983a, as *L. velutinus*) differs from *P. natarajanus* in having larger basidiomes (pileus 20–175 vs 8–80 mm diam), velutinate, distinctly not zonate or obscurely zonate pileus, elongated, thick stipe (20–250 \times 2–10 vs 20–40 \times 1–5 mm) and larger spores (5–8 \times 3–3.5 vs 4.5–5.5 \times 2.5–3 μm). *Panus tephroleucus* (Pegler 1983a, as *L. tephroleucus*) differs from *P. natarajanus* in having a smaller pileus (10–40 vs 8–80 mm diam), yellowish to greyish brown surface, moderately, distantly spaced lamellae, larger basidiospores (6–8 vs 4.5–5.5 μm), and smaller sclerocystidia (22–28 vs 22–60 μm). *Panus natarajanus* differs from *P. ciliatus* (Pegler 1983a, as *L. ciliatus*) in having smaller (8–80 vs 2–150 mm), non striate pileus lacking ciliate margin, shorter and slenderer stipe (20–40 \times 1–5 vs 3–130 \times 3–15 mm), and larger sclerocystidia (22–60 vs 19–30 μm).

Panus natarajanus closely resembles the Himalayan *P. hookerianus* (Pegler 1983a, as *L. hookerianus*) in having similar sized and coloured basidiomes with a hispid pileus and stipe. However, *P. natarajanus* differs in having shorter hispid hairs, (\leq 700 μm vs 1–2 mm long), concentrically zonate pileus, slightly smaller spores (4.5–5.5 \times 2.5–3 vs 5–6.5 \times 2.7–3.5 μm), larger cheilocystidia (25–30 \times 7–9 vs 14–19 \times 3–4 μm) and sclerocystidia (22–60 \times 4.5–8 vs 17–25 \times 6–7.5 μm). *Lentinus fasciatus* (Pegler 1983a) differs from *P. natarajanus* in having longer hispid hairs (1–3 mm) and spores (6–8.5 \times 3–4 μm).

Panus natarajanus morphologically also closely resembles *L. concentricus* (Karunarathna *et al.* 2011a) described from Thailand in having somewhat similar sized basidiomes and a concentrically zonate pileus. However, *L. concentricus* differs morphologically in the yellowish brown to yellowish brown clay pileus, Pompeian yellow lamellae, and microscopically in the slightly larger basidiospores (5–7 \times 2.5–4 vs 4.5–5.5 \times 2.5–3 μm) and absence of sclerocystidia. Another Thailand species, *L. megacystidiatus* (Karunarathna *et al.* 2011a) differs from *P. natarajanus* in the greyish orange, smaller pileus (2–20 vs 8–80 mm diam), with densely ciliate margin, greyish orange lamellae, shorter

and slenderer stipe (2–14 \times 2–4 vs 20–40 \times 1–5 mm) and larger basidiospores (6–8 \times 3–4 vs 4.5–5.5 \times 2.5–3 μm). Both *L. concentricus* and *L. megacystidiatus* have a greater resemblance to *Panus* rather than *Lentinus* on the basis of morphotaxonomic characters.

***Panus alpacus* (Senthil. & S.K. Singh) Senthil., comb. nov.**

MycoBank MB805096

Basionym: *Lentinus alpacus* Senthil. & S.K. Singh, *Mycotaxon* **121**: 70 (2013) ["2012"].

Type: **India:** Maharashtra state: Pune, Pune University Campus, 18°31'18.4"N 73°49'53.6"E, on decaying twigs, solitary, 21 Jul. 2011, G. Senthilarasu (AMH 9442 – holotype).

Additional material examined: **India:** Maharashtra state: Pune, Pune University Campus, 18°31'18.4"N 73°49'53.6"E, on an unidentified twig, solitary to scattered, 3 Aug. 2009, G. Senthilarasu (AMH 9457); *loc. cit.*, 26 July 2012, G. Senthilarasu (AMH 9526), 1 Aug. 2012 G. Senthilarasu (AMH 9527, MCI 951).

Notes: Senthilarasu & Singh (2012) described this species as *Lentinus alpacus* from the Western Ghats of Maharashtra and it is known only from the type locality. However, the distinguishing morphotaxonomic characters of skeletal hyphae in the context, the lack of hyphal pegs, and the presence of metuloids in the hymenium, agree with the genus *Panus sensu* Corner, and hence the new combination *Panus alpacus* is made here.

Panus alpacus has already been compared with *L. courtetianus*, *P. tephroleucus*, and *P. ciliatus* (Senthilarasu & Singh 2012). *Panus alpacus* morphologically also differs from another small (10–20 mm pileal diam) species, *Panus parvus* (Drechsler-Santos *et al.* 2012) described from Brazil, in having a reddish brown pileus with shorter squamules (\leq 840 μm long) more scattered towards the disc rather than blackish, spiniform, longer squamules (to 1 mm long) on the pileus, more towards the margin (ciliate), and longer and slenderer stipe (14–25 \times 1–1.5 vs 5–15 \times 1–4 mm). In addition, *P. parvus* differs microscopically from *P. alpacus* in the larger gloeocystidia (40–75 \times 8–17 vs 18–45 \times 5–11 μm) and metuloids (30–80 \times 9–13 vs 19–25 \times 7–11.5 μm).

***Panus similis* (Berk. & Broome) T.W. May & A.E. Wood, *Mycotaxon* **54**: 148 (1995).**

Material examined: **India:** Karnataka state: Kadamakkal Reserve Forest, Manadukka, 12°30'N 79°39'E, on wood, solitary to scattered, 10 Aug. 2010, G. Senthilarasu (MCI 1002); Uppangala forest, (12°30'N 79°39'E), 12 Aug. 2010, G. Senthilarasu (MCI 1005).

Notes: *Panus similis* differs from *P. velutinus*, *P. ciliatus*, and *P. hookerianus* in the strongly plicate striate pileus. *Panus similis* is a common species that was earlier reported as *L. similis* from the Nagarhole wildlife sanctuary in the Coorg district of Karnataka (Pegler 1983a). The morphotaxonomic characters of the present collections agree with the description of *L. similis* provided by Pegler (1983a). The basidiospore measurements of our collections are 4.5–6 \times 2–3 μm .

Sathe & Kulkarni (1980) reported *L. velutinus* from Sampaje in the Western Ghats of Karnataka. The original description and illustrations of this species indicate the pileal surface is sulcate striate which is the distinguished character of *P. similis*. Their report may represent *P. similis* in having a sulcate striate pileus, shorter stipe (30–67 × 5–7 mm) and smaller basidiospores (4.5–6 × 2.3–4 µm). However, the precise identity cannot be determined on the basis of presence of metuloidal cystidia in the hymenium.

Lentinus concinnus Pat., *Bull. Soc. mycol. Fr.* 8(2): 47 (1892).
(Figs 1–2)

Description: Pileus 10–40 mm diam, convex, becoming broadly convex to plane, narrowly, shallowly to deeply depressed; surface initially with dark violaceous tints covered by light brown squamules (7D5), squamules becoming yellowish white (4A2) to pale yellow (4A3) to greyish yellow (4B3), covered by light brown (7D5) to dark brown (9F6) to reddish brown (9F7) to violet brown (10F6–10F8), appressed, superficial, squamules, more numerous towards the disc, pellucid to tuberculate striate; margin initially incurved, becoming decurved to plane, faintly to distinctly striate, ciliate when young. Gills subdecurrent, light orange (5A4) to greyish orange (5B4), becoming yellowish white (4A2) to pale yellow (4A3) to yellowish white (2A2), rarely furcated, regularly intervenose, moderately close; margin serrulate. Stipe 12–22 × 1–3 mm, central to eccentric; surface yellowish white (4A2) to greyish yellow (4B3) to greyish orange (5B3), covered by loose, scattered, superficial, light brown (7D5) squamules,

leathery, solid becoming stuffed. *Basidiospores* (5.5–)6.5–7.5(–9.5) × 3–3.5(–4.0) (7.11 ± 0.54 × 3.31 ± 0.21) µm, Q = 2.14, cylindrical. *Basidia* 20–28 × 4–6 µm, narrowly clavate. *Lamella* edge sterile. *Cheilocystidia* 13.5–33 × 4.5–6.5 µm, clavate to fusoid, often sinuous-nodulose. *Hyphal pegs* scattered, 38–70 × 20–50 µm, projecting 40–60 µm beyond the hymenial layer. *Pileal context* trimitic, with skeletal, skeleto-ligative and generative hyphae; generative hyphae inflated to 20 µm diam.

Material examined: India: Maharashtra state: Sinhgad, 18°31'18.4"N 73°49'53.6"E, solitary to caespitose, on an unidentified log, 30 June 2012, G. Senthilarasu (AMH 9568).

Notes: The morphotaxonomic characters of the present collection agree with the description of *L. concinnus* provided by Pegler (1983a). However, it differs in having slightly larger spores and basidia and more inflated generative hyphae. *Lentinus concinnus* is easily confused with *L. tigrinus*. The former is clearly distinguished from *L. tigrinus* in the field by the smaller basidiomes, whitish to cream pileus, covered by reddish brown to violet brown squamules, regularly interveined, moderately close lamellae, and shorter, slenderer stipe. *Lentinus tigrinus* has larger basidiomes (≤10 cm diam pileus), a whitish to cream pileus with greyish brown to blackish squamules, is occasionally slightly interveined, crowded lamellae and has an elongated, thick stipe (≤10 mm). Although this species has already been reported from Chennai, Tamil Nadu (Pegler 1983a), this is the first record from the Western Ghats region.

Key to species of *Lentinus* and *Panus* occurring in Western Ghats

- 1 Context having thick walled branched skeleto-ligative hyphae; hyphal pegs present (rarely absent in one species); hymenium lacking gloeocystidia and thick-walled metuloids or sclerocystidia 2
Context having thick walled, unbranched skeletal hyphae; hyphal pegs never present; hymenium having conspicuous gloeocystidia and thick-walled metuloids or sclerocystidia 8
- 2 (1) Pileus often strigose, glabrescent at the center; surface yellowish brown to reddish brown, radially covered by concolorous, fibrillose hairs; margin not involute, distinctly ciliate; cilia cream to yellowish brown; stipe paler or concolorous with the pileus, covered by scattered, white to yellowish brown, scurfy squamules **L. crinitus**
Pileus surface not strigose, often squamulose, squamules appressed 3
- 3 (2) Generative hyphae inflated, ≤ 20 µm diam; lamellae edge dentate 4
Generative hyphae not inflated, ≤ 6 µm diam; lamellae entire or denticulate 5
- 4 (3) Pileus small to large, 10–100 mm diam; surface initially greyish to blackish brown, becoming pale ochraceous to cream to white, covered by greyish brown to blackish brown squamules; lamellae occasionally, slightly interveining; stipe 20–100 × 2–10 mm **L. tigrinus**
Pileus small, 10–40 mm diam, surface initially with violaceous tints, becoming yellowish white to pale yellow to greyish yellow, covered by light brown to dark brown to reddish brown to violet brown squamules; lamellae rarely furcated, regularly intervenose; stipe short and slender, 12–22 × 1–3 mm **L. concinnus**
- 5 (3) Hyphal pegs absent; pileal surface white to cream, glabrous to minute, fugacious, brown to blackish squamulose; margin sulcate striate, finely eroded; lamellae edge entire **L. patulus**
Hyphal pegs present, abundant; pileal surface glabrous to squamulose to squamose; margin not sulcate striate; lamellae finely denticulate 6

- 6 (5) Pileal surface variable in colour, at first whitish, becoming yellowish white to pale yellow greyish yellow or pale orange to brownish orange, glabrous with appressed reddish brown squamules especially towards the centre, finely radially striate to translucent striate, entire, becoming rimose; lamellae whitish; annulus present, fugacious **L. sajor-caju**
 Pileus surface tomentose to appressed to recurved fibrillose squamulose 7
- 7 (6) Pileal surface white to cream to pale yellow brown, becoming yellowish, covered by appressed to recurved, concolorous to greyish to fuscous brown squamules; lamellae white to pale yellowish brown **L. squarrosulus**
 Pileal surface ochraceous-cream to blond to greyish yellow to fuscous brown, covered by concentrically arranged, fine tomentum with recurved, fibrillose squamules; lamellae pale greyish black to greyish brown to reddish brown with reddish to purplish tints **L. polychrous**
- 8 (1) Hymenium having conspicuous refractive gloeocystidia and or thick walled metuloids 9
 Gloeocystidia and or thick walled metuloids absent; small sclerocystidia occasionally present 13
- 9 (8) Pileus villose to hispid strigose or squamulose 10
 Pileus fibrillose squamulose to tomentose, becoming glabrous 12
- 10 (9) Pileus flabelliform, small (10–30 mm diam); surface pale brown, becoming darker with age, covered by long concolorous, tuft of hairs; lamellae creamish white, becoming brown on drying; stipe reduced (5–10 × 2–3 mm), lateral **P. indicus**
 Pileus infundibuliform, small to large (6–100 mm diam); stipe well developed, central to eccentric 11
- 11 (10) Basidiomes mostly central, rarely eccentric, sometimes stipe branched, bearing two pilei; pileus very small (6–25 mm diam), surface Venetian red to Persian red to reddish brown bearing reddish brown squamules, more towards the disc; stipe short and slender (14–25 × 1–1.5 mm); gloeocystidia and metuloids present **P. alpacus**
 Basidiomes mostly eccentric to lateral, rarely central; pileus small to large (20–100 mm diam), surface white to yellowish brown, covered by villose to hispid tomentose, more towards the margin; stipe to 10 mm thick; gloeocystidia absent, metuloids present **P. neostrigosus** (as *L. strigosus*)
- 12 (9) Basidiomes often tufted with dead roots and bamboo rhizomes; pileus small to large, to 200 mm diam, surface initially reddish grey, becoming white to yellowish white to pale yellow, finely appressed squamulose, becoming glabrous; lamellae dichotomously furcate; stipe glabrous, becoming tomentose to strigose **L. bambusinus**
 Basidiomes always found to be associated with dead grass stems and roots; pileus small, to 30 mm diam, surface orange white to pale ochre, finely tomentose, becoming glabrous; lamellae not forked; stipe finely pruinose **P. caespiticola** (as *L. caespiticola* and *L. caespiticola* var. *asiaticus*)
- 13 (8) Basidiomes robust, often caespitose, centrally stipitate to eccentric to lateral; pileal surface white to yellowish brown, becoming darker towards center, initially tomentose fibrillose, becoming glabrescent; margin neither plicate nor striate, not ciliate; lamellae white, becoming yellowish brown; stipe whitish to cream, becoming yellowish brown to dark brown **L. connatus**
 Pileal surface densely hispid strigose or squamulose to velutinate or if glabrescent then strongly plicate striate 14
- 14 (13) Basidiomes medium to large; pileus 20–45(–80) mm diam; surface pale brown to cinnamon brown to dark brown, covered by hispid strigose with short erect hairs (0.5–2 mm); margin neither striate to sulcate striate nor zonate, densely ciliate; stipe concolorous with the pileus, velutinate to short hispid **P. hookerianus** (as *L. hookerianus*)
 Pileus almost smooth or squamulose to short hispid; margin either striate to sulcate striate or concentrically zonate 15
- 15 (14) Pileus 20–80 mm diam; surface initially with pinkish tints, becoming uniformly, pale brown to cinnamon brown, initially velutinate, becoming almost smooth, strongly plicate striate, striae extending up to the disc; margin concentrically not zonate; lamellae whitish; stipe central; surface concolorous with the pileus, felty; basidiospores 4.5–6 × 2–3 μm **P. similis** (as *L. similis*)
 Pileus velutinate to hispid to squamulose, neither smooth nor plicate striate; margin zonate or not zonate 16

- 16 (15) Pileus 8–80 mm diam; surface reddish brown, darker at the center, initially short hispid, becoming squamulose at the center, to short hispid towards margin, often with pale and dark concentric zones near margin; margin not ciliate; lamellae reddish brown, often with vinaceous tints; stipe short and slender (20–40 × 1–5 mm); surface concolorous with the pileus, short hispid; basidiospores small, 4.5–5.5 × 2.5–3 µm **P. natarajanus**
- Pileus 20–175 mm diam; surface pale brown to orange brown, reddish brown to reddish yellow to brownish yellow, velutinate to short hispid or subsquamulose, not zonate or obscurely zonate; margin densely ciliate; stipe very long and thick (20–250 × 2–10 mm); surface concolorous with the pileus, velutinate; basidiospores 5–8 × 3–3.5 µm **P. velutinus** (as *L. velutinus*)

EXCLUDED SPECIES

Lentinus dicholamellatus Manim., *Mycotaxon* **90**: 312 (2004).

Notes: Manimohan *et al.* (2004) described this species, *Lentinus dicholamellatus*, from Kerala and placed it in *Lentinus* subgen. *Lentinus* sect. *Dicholamellatae*, *sensu* Pegler, on the basis of the robust basidiomes having repeatedly furcate lamellae, with few or absence of lamellulae, presence of skeleto-ligative hyphae, scattered hyphal pegs and uninflated generative hyphae in the hymenium. The morphotaxonomic characters of this species are distinguished from *L. badius*, *L. araucariae* and *L. brunneofloccosus* that are placed in the same section (Pegler 1983a). Subsequently, *L. dicholamellatus* was reported from different regions of Kerala (Pradeep & Vrinda 2007, Varghese *et al.* 2010, Mohanan 2011). However, the ITS sequences generated from *L. dicholamellatus* confirms that this falls morphologically within the highly variable *L. sajor-caju* (Seelan *et al.* 2015).

Lentinus giganteus Berk., *London J. Bot.* **6**: 493 [bis] (1847).

Notes: The taxonomic position of *L. giganteus*, described from Sri Lanka, is controversial. Corner (1981) treated *L. giganteus* as type of his new subgenus *Gigantopanus* of *Panus*, and Pegler (1983a) as type of section *Gigantopanus* of subgenus *Panus*. The morphotaxonomic characters of *L. giganteus* shared with *Lentinus* are a dimitic hyphal system with a radial construction of the hymenophoral trama, generative hyphae being much narrower than the skeletal hyphae, and spores with an oil guttule. These characters are also similar to *Pleurotus* in having wider, well separated lamellae, elongate ellipsoid to ellipsoid rather than cylindrical spores and conspicuous lecythiform cheilocystidia at the gill edge. However, in a revision of *L. giganteus* from Sri Lanka and Thailand, *L. giganteus* was nested within the *Pleurotus* clade and consequently the species has been transferred to *Pleurotus* (Karunarathna *et al.* 2011b). This species, which has been reported from different regions of the Western Ghats of Kerala (Joseph *et al.* 1995, Manimohan *et al.* 2004, Pradeep & Vrinda 2007, Mohanan 2011) is therefore excluded from the key.

Lentinus tuber-regium (Fr.) Fr., *Syn. Gen. Lentinus*: 3 (1836).

Notes: Corner (1981) placed the nematode destroying species *Pleurotus tuber-regium* and *Pl. levis* in *Panus*, whereas, Pegler

(1983a) placed these species in *Lentinus*. Singer (1975, 1986) and Kühner (1980) treated these species in *Pleurotus*. However, in a phylogenetic study, the nematotoxic compound producing *L. tuber-regium* was placed in the *Pleurotus* clade, supporting a placement in *Pleurotus* (Thorn *et al.* 2000). This fungus is therefore excluded from the key, but has been reported from the Western Ghats of Kerala (Geetha *et al.* 2002) and of Tamil Nadu (Johnsy *et al.* 2011, Davidson *et al.* 2012, Kumar & Kaviyaran 2012). This is a strictly terrestrial species arising from a subterranean sclerotium.

Panus torulosus Fr., *Epicr. Syst. Mycol.*: 397 (1838).

Notes: Sathe & Kulkarni (1980) reported *Panus torulosus* from Sampaje in the Western Ghats of Maharashtra. The presence of hyphal pegs in the hymenophore and context consisting of skeleto-ligative hyphae confirms that this represents a species of *Lentinus*. Further, the large pileus (7–170 mm diam) with a short stipe (22–25 × 12–17 mm), presence of lamellae and lamellulae which are not furcated, and the non-inflated generative hyphae in the hyphal system place this species in of *Lentinus* sect. *Tigrini* *sensu* Pegler (1983a).

DISCUSSION

The xeromorphic lentinoid species, *Lentinus* and *Panus* belonging to *Polyporaceae*, are widely distributed through tropical, subtropical, temperate, and boreal regions (Pegler 1983a, b, c, Corner 1981). The genera are well represented in India, with 20 species of *Lentinus* and eight of *Panus* (including *P. alpacus* and *P. natarajanus*) distributed in different regions (Bilgrami *et al.* 1979, 1991, Sathe & Daniel 1980, Sathe & Deshpande 1980, Sathe & Kulkarni 1980, Manjula 1983, Pegler 1983a, Manimohan *et al.* 2004, Natarajan *et al.* 2005, Farook *et al.* 2013, Senthilarasu 2014). Of the 17 species known in the Western Ghats, four species (*L. bambusinus*, *P. indicus*, *P. alpacus*, and *P. natarajanus*) are new to science. However, the morphotaxonomic characters of *L. bambusinus* agree with *Panus sensu* Corner. The lentinoid fungal diversity of the Western Ghats mainly comprises species familiar in south-east Asia as well as in other tropical regions, notably East Africa and the Lesser Antilles are present (Pegler 1977, 1983c, 1986). The most common species widely distributed in almost all the regions are *L. crinitus*, *L. polychrous*, *L. squarrosulus*, *L. sajor-caju*, *L. ciliatus*, *L. connatus*, *P. neostrigosus*, *P. velutinus*, and *P. similis*. However, all the lentinoid species newly described from the Western Ghats appear to be confined to that region. Although this study

confirms that the Western Ghats has a high species diversity of lentinoid fungi, the study of their diversity is confined to a part of Western Ghats of Kerala, Maharashtra, Tamil Nadu, and Karnataka. Large areas of the Western Ghats do, however, remain completely unexplored or underexplored for this widely distributed but often misunderstood tropical assemblage of macromycetes.

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