

RICARDO MATHEUS PIRES

**Políporos (Basidiomycota) do Núcleo Santa
Virgínia do Parque Estadual da Serra do Mar, SP,
Brasil**

Dissertação apresentada ao Instituto de Botânica da Secretaria do Meio Ambiente, como parte dos requisitos exigidos para a obtenção do título de MESTRE em BIODIVERSIDADE VEGETAL E MEIO AMBIENTE, na Área de Concentração de Plantas Avasculares e Fungos em Análises Ambientais.

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RESUMO

Esse trabalho desenvolveu o levantamento dos políporos do Núcleo Santa Virgínia do Parque Estadual da Serra do Mar, uma das áreas de Mata Atlântica mais preservadas do estado de São Paulo, a fim de contribuir para a ampliação do conhecimento da biodiversidade paulista. Um total de 318 espécimes foram coletados nas sete excursões, de abril de 2013 a abril de 2014. Desses espécimes, puderam ser determinadas 95 espécies distribuídas em três ordens, dez famílias e *Trichaptum sector*, de posição taxonômica indefinida (*Incertae sedis*). Por se tratar de um trabalho pioneiro no Parque Estadual da Serra do Mar, todos os registros configuram-se como primeira citação para a localidade, e contribuem para o conhecimento da biodiversidade e sua distribuição geográfica. São apresentadas duas espécies novas: *Fuscoporia atlantica* sp. nov. *ad int.* e *Laetiporus squalidus* sp. nov. *ad int.* Além disso, *Dichomitus campestris*, *Dichomitus cylindrosporus*, *Fulvifomes glaucescens*, *Laetiporus gilbertsonii*, *Perenniporia cremeopora* e *Postia undosa* são registrados pela primeira vez para o Brasil. Esse estudo também apresenta 24 registros novos para o estado: *Antrodiella luteocontexta*, *Ceriporiopsis flavilutea*, *Cinereomyces dilutabilis*, *Diplomitoporus navisporus*, *Flaviporus brownii*, *Flaviporus subhydrophilus*, *Flaviporus venustus*, *Fulvifomes melleoporus*, *Fuscoporia chrysea*, *Fuscoporia rhabarbarina*, *Grammothele fuligo*, *Inonotus linteus*, *Inonotus portoricensis*, *Inonotus tropicalis*, *Junghuhnia carneola*, *Oxyporus latemarginatus*, *Phellinus bambusarum*, *Phellinus grenadensis*, *Phellinus roseocinereus*, *Phellinus undulatus*, *Postia subcaesia*, *Postia tephroleuca*, *Rigidoporus crocatus* e *Skeletocutis nivea*. Todos os materiais estudados foram depositados no Herbário “Maria Eneyda P. K. Fidalgo” (SP). Também foram realizados sequenciamentos de DNA (região ITS e nLSU) de alguns materiais de interesse, além de isolamento e cultivo de alguns espécimes visando testes enzimáticos qualitativos. Os dados são apresentados na forma de cinco capítulos na forma de manuscritos para submissão em revistas científicas.

Palavras-chave: Aphyllophorales, fungos xilófilos, Mata Atlântica, microbiota neotropical.

ABSTRACT

This research developed the survey of polypores from Núcleo Santa Virgínia of the Parque Estadual da Serra do Mar, one of the most preserved areas of Atlantic Rainforest of São Paulo, in order to contribute to the expansion of knowledge of biodiversity in São Paulo. A total of 318 specimens were collected in seven field trips, from April 2013 to April 2014. From these specimens, 95 species was identified and distributed in 3 orders, 10 families and 1 taxon of indefinite taxonomic position (*Incertae sedis*). Since this is a pioneering study at Parque Estadual da Serra do Mar, all records are configured as first citation to the location, and contribute to the knowledge of biodiversity and its geographical distribution. Two new species are presented to science: *Fuscoporia atlantica* sp.nov. *ad int.* and *Laetiporus squalidus* sp.nov. *ad int.* In addition, *Dichomitus campestris*, *Dichomitus cylindrosporus*, *Fulvifomes glaucescens*, *Laetiporus gilbertsonii*, *Perenniporia cremeopora* and *Postia undosa* represent the first record for Brazil. This study also presents 24 new records to the state: *Antrodiella luteocontexta*, *Ceriporiopsis flavilutea*, *Cinereomyces dilutabilis*, *Diplomitoporus navisporus*, *Flaviporus brownii*, *Flaviporus subhydrophilus*, *Flaviporus venustus*, *Fulvifomes melleoporus*, *Fuscoporia chrysea*, *Fuscoporia rhabbarbarina*, *Grammothele fuligo*, *Inonotus linteus*, *Inonotus portoricensis*, *Inonotus tropicalis*, *Junghuhnia carneola*, *Oxyporus latemarginatus*, *Phellinus bambusarum*, *Phellinus grenadensis*, *Phellinus roseocinereus*, *Phellinus undulatus*, *Postia subcaesia*, *Postia tephroleuca*, *Rigidoporus crocatus* and *Skeletocutis nivea*. All materials examined were deposited at Herbarium Maria Eneyda P. K. Fidalgo (SP). Also, DNA sequencing were performed (ITS and nLSU region) in some materials of interest, as well as isolation and cultivation of some specimens combined with qualitative enzyme tests. The data are presented in five chapters formatted according to manuscripts prepared for submission to scientific journals.

Keywords: Aphyllophorales, Atlantic Rainforest, neotropical mycobiota, xylophilous fungi.

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INTRODUÇÃO

CLASSIFICAÇÃO DOS POLÍPOROS

Os políporos estão incluídos no Filo Basidiomycota R.T. Moore, que se caracterizam por formar estruturas denominadas basídios, órgãos onde ocorre a cariogamia e a meiose, originando esporos, denominados basidiósporos, os quais ficam inseridos diretamente sobre a parede dos basídios ou sobre extensões dos mesmos, os esterigmas (Webster & Weber 2007). Os basídios são normalmente formados em estruturas macroscópicas denominadas basidioma, e são incluídos no Subfilo Agaricomycotina Dowel (Hibbett *et al.* 2007). Tradicionalmente, os políporos, em sua grande maioria eram incluídos nas famílias Ganodermataceae Donk, Hymenochaetaceae Imazeki & Toki e Polyporaceae Corda em Aphyllophorales (Alexopoulos & Mims 1979), e ainda são grupos utilizados até hoje para a identificação morfológica das espécies, no modelo de chave proposto por Ryvarden (1991), segregando Ganodermataceae pela presença de esporos de parede dupla e ornamentada; Hymenochaetaceae, em função da presença de septo simples, setas e reação xantocróica (cujo basidioma enegrece em presença de KOH); e Polyporales *sensu lato*, um grupo grande e artificial que reúne todas as outras famílias do grupo.

Com a utilização de ferramentas moleculares, a sistemática do grupo se modificou e a ordem Aphyllophorales não é mais considerada por ser amplamente artificial. Dessa forma, os políporos passaram a constituir um grupo polifilético incluídos em diversas ordens da Classe Agaricomycetes Dowel, sobretudo em Polyporales Gäum. e Hymenochaetales Oberw., que englobam o maior número de espécies poróides (Hibbett *et al.* 2007, Kirk *et al.* 2008). Entretanto, muitos representantes de políporos estão classificados dentro de outras ordens, como Agaricales Underw., Corticiales K.H. Larss., Gloeophyllales Thorn, Russulales Kreisel ex P.M. Kirk, P.F. Cannon & J.C. David e Trechisporales K.H. Larss. (Hibbett *et al.* 2007, Kirk *et al.* 2008).

A ordem Hymenochaetales abriga duas famílias: Hymenochaetaceae e Schizoporaceae (Kirk *et al.* 2008) e o gênero *Trichaptum*, alocado ainda como *Incertae sedis*. Apesar de morfológicamente muito distintas, estudos moleculares demonstram que estas famílias formam um único clado, que inclui além de espécies consideradas em Hymenochaetaceae, espécies tradicionalmente consideradas em Corticiaceae (como *Hyphodontia* J. Erikss.) e em Polyporales (como *Schizopora* Velen. e *Trichaptum* Murrill) (Larsson *et al.* 2006, Binder *et al.* 2013).

Paralelamente a Hymenochaetales, diversos estudos tem mostrado que Polyporales contém a grande maioria dos políporos, distribuídos em quatro grandes grupos, denominados ‘Clado Antrodia’ (do inglês, ‘*Antrodia Clade*’), ‘Núcleo Poliporoide’ (do inglês, ‘*Core Poliporoid*’), ‘Clado Phlebioide’ (do inglês, ‘*Phlebioid Clade*’), além de um grupo formado por diversos gêneros, composto por grupos com características diversas, o ‘Clado Poliporoide Residual’ (do inglês, ‘*Residual Polyporoid Clade*’) e somado a isso, determinados táxons (*Gelatoporia* Niemelä, *Grifola* Gray e *Tyromyces* P. Karst.) aparentemente não pertencem a nenhuma das principais linhagens de Polyporales, mas são considerados até o momento como clados distintos (‘*Gelatoporia Clade*’, ‘*Grifola Clade*’ e ‘*Tyromyces Clade*’), porém pouco resolvidos (Binder *et al.* 2005, Garcia-Sandoval *et al.* 2011, Hibbett & Donoghue 1995, Larsson *et al.* 2004, Miettinen *et al.* 2011).

O ‘Clado Antrodia’ que se estabelece dentro de Polyporales foi introduzido pela primeira vez por Hibbett & Donoghue (2001) e posteriormente delineado por Binder *et al.* (2005) possui os seguintes gêneros: *Antrodia* P. Karst., *Auriporia* Ryvardeen, *Cinereomyces* Jülich, *Daedalea* Pers., *Fomitopsis* P. Karst., *Grifola* Gray, *Laetiporus* Murrill, *Obba* Miettinen & Rajchenb., *Oligoporus* Bref., *Phaeolus* (Pat.) Pat., *Piptoporus* P. Karst., *Postia* Fr., *Skeletocutis* Kotlába & Pouzar, *Tyromyces* P. Karst, *Wolfiporia* Ryvardeen & Gilb., entre outros. Esse grupo caracteriza-se principalmente por todos os táxons serem causadores de podridão parda na deterioração da madeira.

Entretanto a composição do ‘Clado Antrodia’ tem sido uma das principais questões na filogenia de Polyporales. No trabalho de Binder *et al.* (2013) e Ortiz-Santana *et al.* (2013) um pequeno clado de políporos de podridão branca (‘Clado Tyromyces’) aparece dentro de duas linhagens de podridão parda. Enquanto que em outros trabalhos, ‘Clado Gelatoporia’, ‘Clado Tyromyces’ e ‘Clado Grifola’ aparecem em diferentes posições nas árvores filogenéticas, apresentando baixas similaridades (Miettinen & Rajchenberg 2012, Binder *et al.* 2005, Hibbett & Donoghue 2001), o que significa que o grupo ainda está com muitos problemas de resolução filogenética e necessita estudos mais aprofundados (Ortiz-Santana *et al.* 2013).

O ‘Núcleo Poliporoide’ nomeado por Binder *et al.* (2005) é representado pelos gêneros *Abundisporus*, *Amauroderma*, *Corioloopsis* sensu lato, *Datronia* Donk, *Dichomitus* D.A. Reid, *Earliella* Murrill, *Echinochaete* D.A. Reid, *Fomes* (Fr.) Fr., *Fomitella* Murrill, *Ganoderma* P. Karst., *Grammothele* Berk. & M.A. Curtis, *Hexagonia* Fr., *Lentinus* Fr., *Microporus* P. Beauv., *Pachykytospora* Kotlába & Pouzar, *Perenniporia* Murrill, *Perenniporiella* Decock & Ryvardeen, *Polyporus* P. Micheli ex Adans. sensu lato, *Porogramme* (Pat.) Pat., *Trametes* Fr., e outros. Este núcleo

inclui táxons caracterizados morfológicamente como causadores de podridão branca e a maioria di- ou trimítico e sistemas de cruzamento tetrapolar.

Introduzido por Larsson *et al.* (2004), o ‘Clado Phlebioide’ é representado por gêneros como *Aurantiopileus* Ginns, D.L. Lindner & T.J. Baroni, *Bjerkandera* P. Karst., *Byssomerulius* Parmasto, *Ceriporia* Donk, *Gloeoporus* Mont., *Hapalopilus* P. Karst., *Hydnopolyporus* D.A. Reid, *Irpex* Fr., *Merulius* Fr., *Phanerochaete* P. Karst., *Phlebia* Fr. e outros . Esse clado é o grupo irmão do ‘Clado Antrodia’ e do ‘Núcleo Poliporoide’ e suas linhagens relacionadas. O grupo ainda está longe de ser resolvido filogeneticamente, sendo possível encontrar muitos gêneros polifiléticos, como por exemplo, *Phlebia*, que possui 26 táxons e quando feita uma análise com a ordem Polyporales inteira, as espécies aparecem amplamente distribuídas dentro e fora do clado (Moreno *et al.* 2011).

O ‘Clado Poliporoide Residual’, primeiramente nomeado em Binder *et al.* (2005), engloba gêneros como *Abortiporus* Murrill, *Antrodiella* Ryvarde & I. Johans., *Cerrena* Gray, *Diplomitoporus* Domanski, *Junghuhnia* Corda, *Meripilus* P. Karst., *Nigroporus* Murrill, *Panus* Fr., *Physisporinus* P. Karst., *Spongipellis* Pat., *Steccherinum* Gray, entre outros. Esse clado representa um grupo heterogêneo dentro da ordem Polyporales, agrupando gêneros que não se enquadram nos demais grupos da ordem. Os autores ressaltam que resolver as relações filogenéticas deste grupo é fundamental para identificar as primeiras linhagens divergentes de Polyporales para, eventualmente permitir um estudo detalhado da evolução dos caracteres na ordem.

Binder *et al.* (2013) trazem uma revisão filogenética e filogenômica da Ordem Polyporales, na qual dez espécies de fungos poróides aparecem com seu genoma completamente sequenciado, a saber, *Phanerochaete chrysosporium* Burds., *Rhodonía placenta* (Fr.) Niemelä, K.H. Larss. & Schigel, *Gelatoporia subvermispóra* (Pilát) Niemelä, *Dichomitús squalens* (P. Karst.) D.A. Reid, *Fomitopsis pinicola* (Sw.) P. Karst., *Trametes versicolor* (L.) Lloyd, *Wolfiporia cocos* (F.A. Wolf) Ryvarde & Gilb., *Bjerkandera adusta* (Willd.) P. Karst., *Ganoderma* sp. (*lucidum* complex) e *Phlebia brevispora* Nakasone. O genoma das sete primeiras espécies são de trabalhos anteriores (Martinez *et al.* 2004; Martinez *et al.* 2009; Fernandez-Fueyo *et al.* 2012; Floudas *et al.* 2012), que foram somados aos três novos genomas desse trabalho, sendo esses dez genomas de 35 000 000 a 50 000 000 pares de bases e 10 000–16 000 genes.

Dentro do ‘Clado Antrodia’, três genomas estão totalmente sequenciados, *Fomitopsis pinicola* (Sw.) P. Karst., *Rhodonía placenta* (Fr.) Niemelä e *Wolfiporia cocos* (F.A. Wolf) Ryvarde & Gilb. e duas estão sendo feitas, *Daedalea quercina* (L.) Pers. e *Laetiporus sulphureus* (Bull.) Murrill. No

‘Núcleo Poliporoide’, três genomas estão disponíveis, *Dichomitus squalens* (P. Karst.) D.A. Reid, *Ganodema* sp. e *Trametes versicolor* (L.) Lloyd, e mais dois estão em andamento *Lentinus tigrinus* (Bull.) Fr. e *Polyporus arcularius* (Batsch) Fr.. O ‘Clado Phlebioide’ conta com três genomas completos, de *Bjerkandera adusta* (Willd.) P. Karst., *Phlebia brevispora* Nakasone, e *Phanerochaete chrysosporium* Burds., e o genoma de *Phanerochaete carnosae* (Burt) Parmasto está em andamento. E neste momento não existem nenhum genoma completo para os membros do ‘Clado Poliporoide Residual’, mas o sequenciamento do genoma de *Panus rudis* Fr. está em andamento. Binder *et al.* (2013), dessa forma, entendem que as árvores filogenéticas apresentadas em seu trabalho podem ser usadas para selecionar as espécies-alvo para as próximas rodadas de sequenciamento de genomas inteiros, além de apresentar nós e problemas a serem resolvidos dentro da ordem.

MORFOLOGIA DOS POLÍPOROS

O termo políporo é utilizado para denominar os fungos cuja parte fértil do basidioma, geralmente localizada na superfície voltada em direção ao solo, caracteriza-se pela presença de tubos internamente revestidos pelo himênio, que contém os basídios e outras estruturas estéreis, formando uma superfície himenoforal poróide (Ryvarden 1991, Rajchenberg 2006). O basidioma, principal unidade de estudo desse grupo, pode apresentar-se de diferentes formas: quanto ao tempo de vida, pode ser anual, em que a superfície himenial forma-se apenas uma vez e em seguida senesce, ou perene, onde novas camadas de tubos vão se desenvolvendo ao longo dos anos sobre as camadas mais antigas. O hábito dos basidiomas varia de ressupinado, totalmente aderido ao substrato, a pileado, popularmente chamado de “chapéu”. Esse basidioma varia também na sua coloração, forma e tamanho dos poros e dos tubos. Os poros podem apresentar-se de forma bastante variável, podendo ser regulares (arredondados ou angulares), ou irregulares (alongados, sinuosos, dedalóides ou quase lamelados).

Microscopicamente, o grupo apresenta uma grande diversidade de características, de extrema importância taxonômica, como o sistema hifal, proposto por Corner (1932), onde temos basicamente três tipos de hifas: as generativas (reprodutivas), que se caracterizam por serem as precursoras das demais hifas, possuem septação (septo simples ou septos com ansas), e geralmente possuem paredes finas; as hifas esqueléticas (somáticas) são formadas a partir das generativas e caracterizam-se pela ausência de septos, pelas paredes espessadas, e costumam ser retas, de grande calibre, com poucas ramificações; e as hifas conectivas (somáticas), que também derivam-se das generativas, apresentam

muitas ramificações, paredes levemente engrossadas a sólidas e menor calibre. O sistema hifal é chamado monomítico, quando apresenta apenas hifas generativas; dimítico quando apresenta hifas generativas e esqueléticas – ou anfimítico se possuir hifas generativas e conectivas (Singer 1986); ou ainda ser nomeado trimítico se o basidioma conter os três tipos de hifas. O himênio, que recobre a parede interna dos tubos, é formado pelos basídios (células que formam os esporos sexuais do grupo, basidiospóros) e elementos estéreis. Os basidiospóros são de extrema importância taxonômica, que variam quanto a sua morfologia, podendo ser globosos, elipsoides, cilíndricos, alantóides e com outras formas. As paredes podem ser finas ou espessadas (com uma ou duas paredes), lisas ou ornamentadas. Os elementos estéreis podem ou não estar presentes e também possuem grande importância na identificação das espécies, são os cistídios, cistidiolos, basidíolos, setas himeniais, medas, dendrohidídeos e as hifas setais.

ECOLOGIA DOS POLÍPOROS: ESTRATÉGIAS DE VIDA E BIOLOGIA

Os representantes deste grupo são sapróbios, em sua grande maioria, lignícolas, apresentando basidioma coriáceo a lenhoso, muitas vezes perenes, sendo conhecidos popularmente por “orelhas de pau”. Algumas vezes, dependendo das condições ambientais e do hospedeiro, certas espécies podem se tornar parasitas, sendo oportunistas e lignícolas facultativas ao se instalar na árvore senescente ou injuriada, persistindo após sua morte como sapróbios, ou formam associações micorrízicas (Ryvarden 1991, Capelari *et al.* 1998). Sua principal função ecológica resulta de sua atividade como decompositores, constituindo um dos elos essenciais na ciclagem dos nutrientes, liberando-os de tal forma que possam ser reutilizados por outros organismos (Boddy 1991, Capelari *et al.* 1998, Rajchenberg 2006). Uma vez que a madeira é o maior componente da biosfera, representando mais de 90% da biomassa em ecossistemas florestais, a atuação das espécies lignícolas é de primordial importância na sua manutenção (Glazer & Nikaido 1995, Rayner 1995, Boddy *et al.* 2008).

Dependendo do aparato enzimático que possuem, podem ser classificados em dois grupos: causadores de podridão parda e causadores de podridão branca na madeira (Ryvarden 1991, Rajchenberg 2006, Webster & Weber 2007, Lundell *et al.* 2010).

Os causadores de podridão parda removem seletivamente a celulose e a hemicelulose da madeira, sendo também capazes de causar limitadas mudanças na lignina, a qual pode ser oxidada, em parte, até CO₂, dando a coloração marrom. Durante o processo de decomposição, a madeira perde

rapidamente suas propriedades de resistência e sofre drásticas perdas de peso, apresentando, nos estágios finais de decomposição, aparência amorfa e desintegrada, sendo composta, principalmente, por lignina levemente modificada (Ryvarden, 1991, Rajchenberg 2006, Lundell *et al.* 2010).

Os fungos causadores de podridão branca por sua vez, possuem celulases e ligninases, sendo capazes de metabolizar as moléculas dos principais componentes da madeira (celulose, hemicelulose e lignina), quebrando-os em moléculas menores sendo, portanto, denominados de fungos lignocelulolíticos. A madeira, durante o processo de decomposição, perde gradualmente suas propriedades de resistência e retém sua estrutura fibrosa, tornando-se esponjosa, ou laminada, de coloração esbranquiçada (Ryvarden 1991, Rajchenberg 2006, Lundell *et al.* 2010).

APLICAÇÕES BIOTECNOLÓGICAS E POTENCIALIDADE DE USOS DOS POLÍPOROS

Diversos políporos lignocelulolíticos vêm sendo utilizados em processos biotecnológicos (Matheus & Okino 1998, Desai & Nityanand 2011). Algumas espécies, como *Pycnoporus sanguineus* (L.) Murrill, *Ganoderma lucidum* (Curtis) P. Karst., *Corioloopsis occidentalis* (Klotzsch) Murrill, *Corioloopsis rigida* (Berk. & M.A. Curtis) Murrill, *Grifola frondosa* (Fr.) S.F. Gray e *Trametes versicolor* (L.) Lloyd removem seletivamente a lignina, podendo ser utilizadas na fabricação de papel, não só na liberação das fibras da madeira após a delignificação, mas também na fase de branqueamento, substituindo com vantagem o uso de substâncias químicas, as quais são as principais causadoras da poluição da água (Boominathan & Reddy 1992, Matheus & Okino 1998, Desai & Nityanand 2011). A capacidade de diversas espécies de políporos de descolorir uma grande variedade de corantes sintéticos também tem sido comprovada, sugerindo a utilização destes organismos no tratamento de efluentes da indústria têxtil (Matheus & Okino 1998, Desai & Nityanand 2011). Além disso, muitas destas espécies possuem um sistema enzimático capaz de degradar outras substâncias de estrutura complexa, como os poluentes diclorodifeniltricloroetano (DDT), pentaclorofenol (PCP) e outros organoclorados. Estes resultados são extremamente importantes, uma vez que tais compostos são recalcitrantes, acumulando-se no meio ambiente (Boominathan & Reddy 1992, Matheus & Okino 1998).

No Brasil, diversos isolados de políporos coletadas em áreas de Mata Atlântica têm sido utilizados na degradação de pentaclorofenol e hexaclorobenzeno, em solos contaminados (Okino *et al.* 2000, Matheus *et al.* 2000; Machado *et al.* 2005) e na descoloração de corantes sintéticos (Machado *et*

al. 2006, Lyra *et al.* 2009). A degradação destes compostos é devido a produção de um complexo enzimático envolvido na degradação da lignina, que abrange diversas enzimas, tais como lacases, lignina-peroxidase e manganês-peroxidase (Matheus & OKino 1998; Lundell *et al.* 2010).

No entanto, alguns estudos atuais têm demonstrado que o processo de degradação da madeira não somente é devido à ação das diversas enzimas lignocelulolíticas, mas também à participação de compostos de baixa massa molar (Machuca 1995, Arantes *et al.* 2006, Aguiar *et al.* 2007). As enzimas lignocelulolíticas não conseguem penetrar na estrutura da parede celular, nas fases iniciais de degradação, por causa de seu alto peso molecular (Blanchette *et al.* 1997). Teorias sugerem que os compostos de baixa massa molar (CBMM) são os responsáveis pelo processo inicial de degradação, penetrando e funcionando em conjunto com os metais para a despolimerização da parede celular da madeira (Goodell *et al.* 1997). Dentre estes compostos, encontram-se os agentes quelantes de metais ou sideróforos, oxalatos e peptídeos, com capacidade de complexar Fe^{3+} e reduzi-lo a Fe^{2+} . Na presença de peróxido de hidrogênio, esses compostos desempenham papel degradativo, atacando a celulose e hemicelulose da madeira, por meio de radicais, gerados pela reação do tipo Fenton (Milagres *et al.* 2002).

Alguns políporos são comestíveis, a maioria não explorada economicamente, como *Polyporus tenuiculus* (P. Beauv.) Fr. (Gugliotta & Bononi 1999), *Grifola gargal* Singer, *Grifola sordulenta* (Mont.) Singer, *Fistulina antarctica* Speg., *Fistulina endoxantha* Speg. (Rajchenberg 2006) e *Laetiporus sulphureus* (Bull.) Murrill (Ayaz *et al.* 2011).

DIVERSIDADE DE POLÍPOROS NO BRASIL, NA MATA ATLÂNTICA E NO ESTADO DE SÃO PAULO

Apesar da fundamental importância ecológica destes fungos, a diversidade do grupo no Brasil ainda é pobremente conhecida, sobretudo pela carência de taxonomistas no grupo. Além disso, a quantidade de dados disponíveis nas bases de dados sobre a diversidade brasileira é ainda muito pequena. De acordo com o INCT – Herbário Virtual da Flora e dos Fungos (2015) ainda há grandes lacunas no conhecimento da diversidade de fungos no Brasil. Por exemplo, dentre os 477 nomes aceitos de Polyporales, extraída da Lista de Espécies da Flora do Brasil (Gugliotta *et al.* 2015), 122 não apresentam nenhum registro nos herbários vinculados à rede *SpeciesLink*, e apenas 182 espécies apresentam registros com coordenadas geográficas consistentes. O mesmo ocorre com Hymenochaetales, outra ordem que engloba elevado número de espécies de políporos; dentre os 170

nomes aceitos na Lista (Gibertoni *et al.* 2015), não existe registro disponível na rede *SpeciesLink* para 32 espécies, sendo que quando a busca é realizada considerando os registros com coordenadas geográficas consistentes fornecidas pela fonte de dados, são relacionadas apenas 75 espécies (INCT – Herbário Virtual da Flora e dos Fungos 2015).

Essa situação se mantém no estado de São Paulo, onde ainda há grandes lacunas no conhecimento, mesmo no bioma mais estudado até o momento, a Mata Atlântica (Capelari *et al.* 1998, Capelari & Gugliotta 2006, Prado *et al.* 2008). Cabe ainda ressaltar que dentre os diversos inventários realizados no estado (Fidalgo & Fidalgo 1957, Bononi 1979, 1984a, b, Bononi *et al.* 1981, Jesus 1993, Gugliotta 1997, Soares & Gugliotta 1998, Gugliotta & Bononi 1999, Xavier-Santos *et al.* 2004, Louza & Gugliotta 2007, Leal & Gugliotta 2008, Abrahão *et al.* 2009, Gugliotta *et al.* 2010, Gugliotta *et al.* 2011, Motato-Vásquez & Gugliotta 2013, Motato-Vásquez *et al.* 2014), nenhum trata da diversidade do Parque Estadual da Serra do Mar, uma das principais áreas de Mata Atlântica preservada no estado.

Outros fatores também contribuem para a enorme lacuna no conhecimento da diversidade fúngica, como a grande variabilidade morfológica de algumas espécies, que dificulta a identificação e a distinção de espécies crípticas com base nos caracteres morfológicos, tradicionalmente utilizados na taxonomia. Análises moleculares têm sido conduzidas em diversos grupos de políporos no intuito de sanar esses problemas, como os estudos realizados por Moncalvo & Buchanan (2008), Justo & Hibbett (2011), Vlasák *et al.* (2010), Lesage-Meessen *et al.* (2011), Amalfi *et al.* (2010), Welti *et al.* (2012), entre outros. No entanto, a condução de estudos moleculares tem sido dificultada por inúmeras razões, expostas por Nilsson *et al.* (2006) e que permanecem até o presente, como o reduzido número de sequências disponíveis no GenBank, o maior depósito de sequências gênicas, a carência de sequências confiáveis e devidamente identificadas e publicadas, e a falta de material testemunho em coleções científicas (*vouchers*).

Em relação às espécies de políporos neotropicais a situação ainda é mais precária, pois o número de espécies sequenciadas não é suficiente para resolução de grande parte dos problemas taxonômicos.

A fim de contribuir para uma melhoria nesse quadro, propõe-se o levantamento dos políporos do Parque Estadual da Serra do Mar, uma das áreas de Mata Atlântica mais preservadas do estado de São Paulo, com a obtenção de *vouchers* e sequências gênicas corretamente identificados.

OBJETIVOS

- Conhecer os políporos encontrados no Núcleo Santa Virgínia do Parque Estadual da Serra do Mar.
- Fornecer um tratamento taxonômico para as espécies encontradas, também descrições e ilustrações de espécies novas ou pouco conhecidas no Brasil e no Estado de São Paulo.
- Utilizar técnicas de biologia molecular para auxiliar na delimitação dos táxons e/ou reconhecimento de espécies crípticas, bem como preencher lacunas existentes no GenBank.
- Ampliar a documentação da biodiversidade paulista, aumentando os acervos da coleção de fungos do Herbário SP e da Coleção de Culturas do Instituto de Botânica (CCIBt).
- Avaliar a atividade enzimática dos isolados obtidos agregando conhecimentos que possam subsidiar a utilização de espécies em processos biotecnológicos.

MATERIAIS E MÉTODOS

ÁREA DE ESTUDO

A Mata Atlântica, que originalmente ocupava 1 315 460 km² do território brasileiro, hoje guarda cerca de 8% de sua extensão original (Fundação SOS Mata Atlântica & INPE 2009, 2011), estando entre os cinco primeiros colocados na lista das regiões biologicamente mais ricas e ameaçadas do planeta (*Hotspots*) (Mittermeier *et al.* 2004). Embora tenha sido em grande parte destruída, colocando em risco a sobrevivência de incontáveis espécies, ainda abriga mais de 8000 espécies endêmicas de plantas vasculares, anfíbios, répteis, aves e mamíferos. Constitui o segundo maior bloco de florestas tropicais do país, incluindo diversos tipos de ecossistemas tropicais como as faixas litorâneas do Atlântico, as florestas de baixada e de encosta da Serra do Mar, as florestas interioranas e as matas de Araucária (Secretaria de Estado de Meio Ambiente 1996, Fundação SOS Mata Atlântica & INPE 2009, 2011).

O estado de São Paulo abriga parcela significativa desta importante floresta atlântica. São 2 670 324 hectares de mata semicontínua, que ocorrem, principalmente, ao longo de seu litoral e nas encostas da Serra do Mar, o que corresponde a 15,78% de seu território (Fundação SOS Mata Atlântica & INPE 2011).

A Serra do Mar encontra-se tanto na Região Sudeste como Região Sul do Brasil, estendendo-se paralelamente ao mar por mais de mil quilômetros, do sul de Santa Catarina ao norte do Rio de Janeiro. Em grande extensão constitui um divisor de águas entre a drenagem que se dirige diretamente ao oceano e aquela que flui para o interior, em direção ao rio Paraná. A altitude geralmente varia de 800 m a 1200 m, podendo atingir nas serras marginais altitudes de até 2000 m, como na Serra da Bocaina (Bigarella 1991, Secretaria de Estado de Meio Ambiente 2000).

O Parque Estadual da Serra do Mar (PESM), criado pelo Decreto Estadual nº 10 251, de 30 de agosto de 1977, é a unidade de conservação com maior área de florestas do domínio do Bioma Mata Atlântica no país com 315 390 ha, envolvendo 11 municípios litorâneos e 15 situados no Planalto Atlântico (Secretaria de Estado de Meio Ambiente 2000) (**Figura 1**).

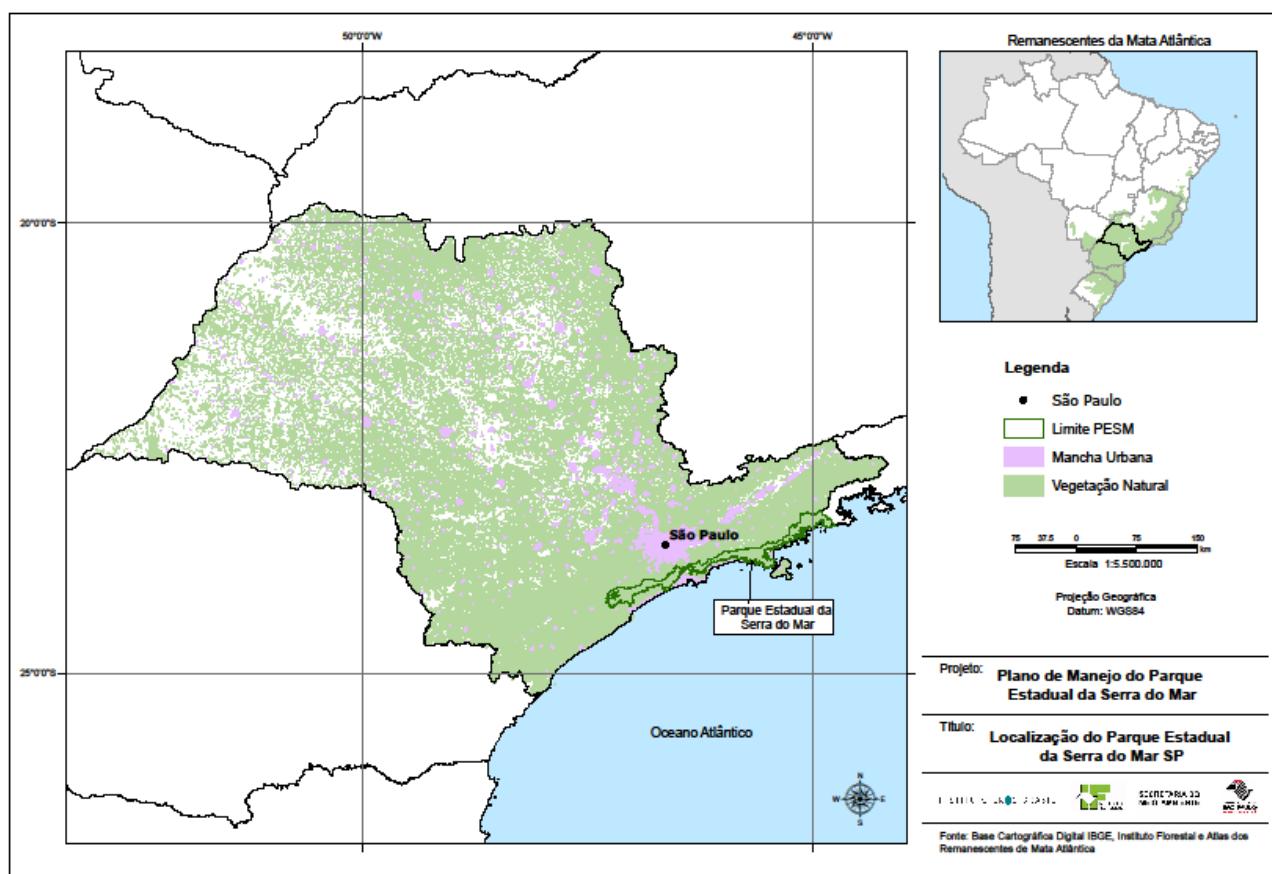


Figura 1 - Mapa de localização do Parque Estadual da Serra do Mar. FONTE: Plano de Manejo do PESM (2008).

Dada a grande extensão territorial do Parque Estadual da Serra do Mar (PESM) e a heterogeneidade das características socioculturais, históricas e ambientais, o parque é administrado a partir de oito núcleos que se encontram em diferentes níveis de implantação, são eles: Picinguaba, Cunha, Santa Virgínia, Caraguatatuba, São Sebastião, Itutinga Pilões, Curucutu e Itariru (Fundação Florestal 2012) (**Figura 2**). Esses núcleos conformam um mosaico de condições diversas, caracterizadas pelo do uso do solo, grau de proteção/degradação da floresta e dos programas de manejo historicamente desenvolvidos, demandando uma atuação diferenciada da administração, considerando ainda o domínio das terras, que são públicas ou estão em diversos estágios de regularização fundiária (Plano de Manejo do PESM, 2008).

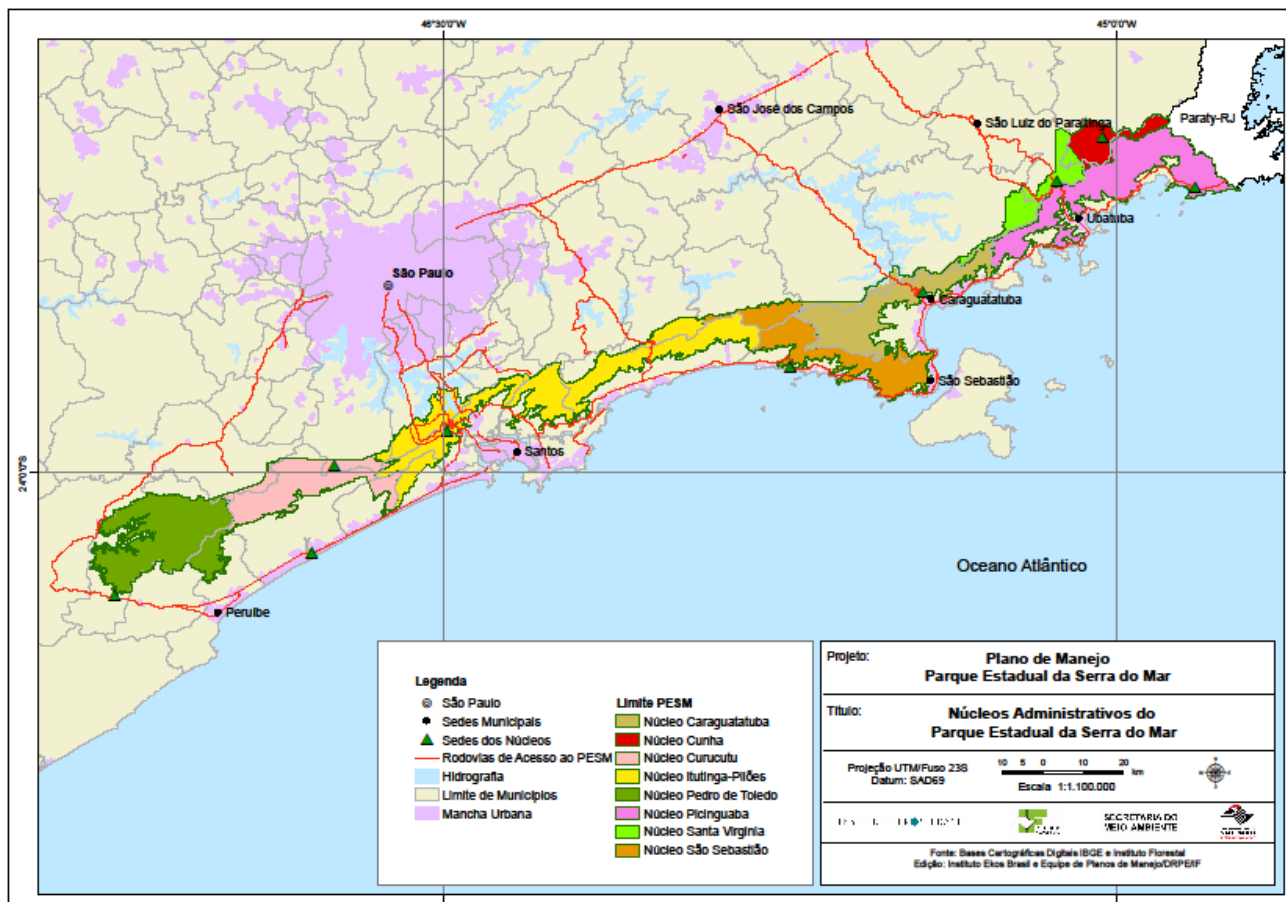


Figura 2 - Mapa de localização dos núcleos administrativos do Parque Estadual da Serra do Mar. FONTE: Plano de Manejo do PESH (2008).

Localizado nos municípios de São Luiz do Paraitinga e Natividade da Serra, o Núcleo Santa Virgínia do PESH, área de estudo desse trabalho, abrange uma área total de 17 000 ha, e situa-se nas coordenadas geográficas 45°03' O e 23°24' a 23°17' S (localização da sede). De amplitude altitudinal variando de 860 m a 1650 m e temperaturas máxima de 35°C, média de 21°C e mínima de -3°C, sua vegetação é caracterizada pela Floresta Ombrófila Densa Montana (Floresta Sempre-verde do Planalto), com alguns pequenos trechos de Campos de Altitude (Estepe) e de Floresta de Neblina (Floresta da Crista da Serra do Mar). Regionalmente configura-se o chamado “clima úmido das costas expostas à massa tropical atlântica”. Santa Virgínia forma a Unidade Planalto Atlântico - Bacia Superior do Paraíba. Localizado em regiões com altos índices pluviométricos, com médias anuais que variam de 1.600 a 4.000 mm/ano, as florestas do Parque conservam não só a qualidade da água, como também sua perenidade (Plano de Manejo do PESH, 2008).

O Núcleo desenvolve ações voltadas à conservação do parque no que tange a flora e a fauna locais, bem como desenvolve e participa de projetos de educação ambiental e sensibilização dos moradores quanto ao valor da floresta em pé. Além disso, o Núcleo ainda colabora com pesquisas na área de biodiversidade e ecologia, principalmente com palmito Jussara, mastofauna, avifauna, entre outros.

A equipe do parque mantém seis trilhas usadas para o monitoramento, turismo, educação ambiental e pesquisa (**Tabela 1**); divididas em duas Bases: a (i) Base Sede, onde se encontra a administração, o centro de capacitação e pesquisa, o alojamento e o refeitório principal, e a (ii) Base Vargem Grande, que possui um alojamento menor. Através dessas trilhas, tem-se acesso às diferentes fitofisionomias do parque, às cachoeiras e corredeiras.

Tabela 1 - Trilhas do Núcleo Santa Virgínia do PESH. FONTE: Adaptado do Site da Fundação Florestal (<http://www.ambiente.sp.gov.br/parque-serra-do-mar-nucleo-santa-virginia/principais-atrativos/>).

Trilha	Distância	Características
<i>Base Centro de Capacitação e Pesquisa – Sede (Rodovia Oswaldo Cruz, km 78)</i>		
Trilha do Pirapitinga	5.700 m	Trilha margeando os Rios Ipiranga e Paraibuna, passa por Floresta Atlântica em vários estágios de sucessão, possui mirante, diversas corredeiras e cachoeiras com possibilidade de banho.
Trilha do Poço do Pito	8.000 m	Trilha margeando o Rio Paraibuna com corredeiras e áreas para banho; passa por floresta atlântica em vários estágios de sucessão.
Trilha do Rio Ipiranga	14.000 m	Trilha margeando o Rio Ipiranga, sob floresta atlântica em vários estágios de sucessão, ótima para observar pássaros. Com trechos mais abertos de trilha, e terminando em segmentos de mata altamente preservadas.
<i>Base Vargem Grande (Rodovia Oswaldo Cruz km 66)</i>		
Trilha do Corcovado	17.000 m	Trilha margeando o Rio Grande, passando por Floresta Atlântica em vários estágios de sucessão e mirante. Ótima para observação de pássaros. O percurso bastante íngreme leva ao Pico do Corcovado com 1.168 metros de altitude, com vista para o mar.
Trilha do Garcêz	6.000 m	Trilha margeando os Rios Grande, Jacu e Garcêz, passa por cachoeiras e corredeiras

Trilha	Distância	Características
Trilha da Cachoeira da Boneca	12.000 m	com possibilidade de banho e o deslocamento é no interior da floresta atlântica. Trilha margeando o Rio Grande até a cachoeira da Boneca. Passa por diversos ambientes da Floresta Atlântica. Ótima para observação de pássaros e fauna.

COLETAS

As coletas na área de estudo foram bimensais, realizadas no período de abril de 2013 a abril de 2014, e todas as trilhas disponíveis no parque foram visitadas para coleta ao menos duas vezes.

Os basidiomas encontrados foram coletados inteiros, com o auxílio de um canivete, fotografados, georreferenciados, e acondicionados individualmente em sacos de papel, observando-se e anotando-se dados como local e data de coleta, número do coletor, condições do microhabitat, coloração, substrato e outras características macroscópicas necessárias (Fidalgo & Bononi 1984).

ARMAZENAMENTO EM SÍLICA E LIOFILIZAÇÃO

Para as extrações de DNA, todos os espécimes coletados tiveram parte do basidioma acondicionado em vidro de penicilina com sílica gel para secagem dos mesmos. Depois de secos, esses vidros de penicilina foram colocados em freezer e posteriormente liofilizados (Liofilizador Thermo Scientific Heto PowerDry). Depois de liofilizados foram armazenados em geladeira, aguardando futura extração de DNA.

IDENTIFICAÇÃO

Para a identificação dos espécimes, é necessária a análise dos caracteres macroscópicos e microscópicos do basidioma (Fidalgo & Bononi 1984). A análise macroscópica foi realizada em laboratório e contempla os seguintes itens: basidioma (hábito e habitat), píleo (forma, coloração, superfície, margem, tamanho, contexto), poros (coloração, forma, espaçamento, número por milímetro), estipe, quando houver (forma, coloração, consistência, superfície, ápice, base, tamanho). As

cores foram descritas baseadas no atlas de cores de Küppers (2002) e quando a cor não era contemplada pelo atlas, foram indicadas cores de acordo com a interpretação pessoal do autor.

Na análise microscópica, foram realizados cortes a mão livre em seções transversais e longitudinais aos tubos para observação de estruturas do himênio e trama. Os cortes foram hidratados com solução de KOH 5%, que reidratam as hifas, e corados com floxina 1% ou em reagente de Melzer para evidência de reações dextrinoides e amiloides. Os cortes, entre lâmina e lamínula, foram analisados em microscópio Leica DM1000. Foram analisados os basidiósporos (coloração, parede, reações, tamanho, Q e Q_m), basídios (forma, coloração, parede, número de esporos, tamanho), elementos estéreis (presença, tipo, forma, coloração, parede, reações, tamanho, encrustação), contexto (coloração, sistema hifal).

As medidas foram realizadas em número mínimo de 20 estruturas. Foram tomadas as medidas de comprimento e largura de basidiósporos, basídios (sem esterigmas) e cistídios; nas medidas das hifas foi considerado somente o diâmetro. Para os basidiósporos foram considerados o Q , que representa a variação do quociente entre o comprimento e a largura de cada basidiósporo, e Q_m que representa o valor médio de Q (Coelho 2005). A nomenclatura utilizada foi baseada, principalmente, nos trabalhos de Fidalgo & Fidalgo (1957).

A identificação foi baseada em comparação com descrições das espécies tipo e outros materiais, com o uso de chaves de identificação e com o estudo de materiais previamente estudados e identificados provenientes de herbários nacionais e internacionais. O arranjo sistemático dos táxons (sistema de classificação) adotado foi a base de dados mundialmente conhecida MycoBank (<http://www.mycobank.org/>) (Robert *et al.* 2005).

ANÁLISE MOLECULAR

A extração do material genético nuclear foi feita a partir de fragmentos do basidioma das espécies por meio de kit de extração Sigma-Aldrich Gen Elute™ Plant Genomic DNA Miniprep Kit e as regiões do genoma de interesse foram amplificadas por meio de reações de PCR (*Polymerase Chain Reaction*), com o kit Sigma-Aldrich ReadMix™ Taq PCR P4600 (Sigma-Aldrich Corporation, St. Louis, MO, USA), seguindo as recomendações do fabricante; as reações de PCR foram realizadas num termociclador (C1000 Touch™ Thermal Cycler Bio-Rad). Os pares de primers usados foram ITS1 e

ITS4 para a região ITS (incluindo ITS1, 5.8S e ITS2) e LR0R e LR7 para a região nLSU (White *et al.* 1990).

Os ciclos de amplificação para a região ITS foram realizados usando os seguintes parâmetros: 1 ciclo a 95°C por 2 min, 5 ciclos a 95°C por 30 s, 60°C por 45 s e 72°C por 45 s onde a temperatura de anelamento diminui 1°C a cada ciclo até atingir 55°C, técnica de *touch-down* (Korbie & Mattick 2008); 30 ciclos a 95°C por 45 s, 55°C por 45 s, 72°C por 45 s e 72°C por 10 min. Para a região nLSU, os seguintes parâmetros foram utilizados: 1 ciclo a 94°C por 2 min, 5 ciclos a 94°C por 45 s, 54°C por 50 s e 72°C por 1 min e 20 s onde a temperatura de anelamento diminui 1°C a cada ciclo até atingir 50°C técnica de *touch-down* (Korbie & Mattick 2008); 30 ciclos a 95°C por 45 s, 50°C por 50 s, 72°C por 1 min e 20 s e 72°C por 10 min. Os produtos de PCR foram checados em gel de agarose a 2% antes do sequenciamento. Os produtos de PCR foram sequenciados em ambas as direções usando os mesmos primers das amplificações. As sequências de nucleotídeos foram determinadas usando o sequenciador Applied Biosystems 3730xl DNA Analyser (Macrogen, Korea). As sequências editadas foram depositadas no GenBank.

Todas as sequências foram checadas junto ao banco de dados de sequências do GenBank - BLAST (<http://blast.ncbi.nlm.nih.gov/>), e seus graus de identidade foram considerados sequências de boa qualidade quando a busca apresentava gêneros e espécies próximas ao espécime em questão (*Query cover* e *Ident* entre 94 a 100%). As sequências retiradas do GenBank (NCBI) incluídas nesses estudos foram selecionados baseados na qualidade, identidade e tamanho. As sequências de nucleotídeos foram alinhadas automaticamente com o programa *online* MAFFT v.7 (<http://mafft.cbrc.jp/alignment/server/>), e então otimizadas manualmente com BioEdit 7.2.0 (Hall 1999). Os melhores modelos de evolução foram estimados usando o programa JModeltest 2.c1.4 (Darriba *et al.* 2012). A análise Bayesiana foi realizada baseada em “*independent Markov chain Monte Carlo*” (MCMC). As Probabilidades Posteriores (PP) foram determinadas no programa MrBayes 3.2.2 (Ronquist *et al.* 2012) para testar o suporte dos ramos. Valores de PP iguais ou maiores que 0,95 foram considerados estatisticamente significantes, dessa forma, todos os suportes abaixo desse valor foram descartados. Análises de Máxima Verossimilhança foram feitas usando o programa RaxML 7.5.4-standard (Stamatakis 2006) e MEGA6 (Tamura *et al.* 2013) com *rapid bootstrap* de 1000 réplicas. Análises de Máxima Parsimônia e Neighbor-Joining foram realizadas com o programa MEGA6 (Tamura *et al.* 2013). A árvore de Máxima Parsimônia foi obtida usando o algoritmo “*Subtree-Pruning-Regrafting*” (SPR) (Nei & Kumar 2000) com 1000 réplicas. Todas as posições contendo *gaps*

ou dados ausentes foram eliminados. Para Neighbor-Joining, as distâncias evolutivas foram computadas usando o método “*Maximum Composite Likelihood*” (Tamura *et al.* 2004) e os testes de *bootstrap* foram com 1000 réplicas.

CULTURAS E TESTES ENZIMÁTICOS

Para isolar os fungos até a obtenção da cultura pura, foram utilizados dois métodos: obtenção de esporada e isolamento por fragmentos do basidioma (Lodge *et al.* 2004). Para obtenção das esporadas, os basidiomas foram mantidos em câmara úmida com a superfície himenial posicionada sobre lâminas estéreis por aproximadamente 24 horas, com isso os basidiósporos foram liberados e depositados sobre a lâmina. A esporada foi diluída em água destilada estéril e inoculada por estriamento numa placa de Petri contendo meio de cultura batata dextrose ágar (BDA) ou agar extrato de malte (MEA). Os meios de cultura são descritos por Smith & Onions (1994).

O isolamento por fragmentos do basidioma envolveu a lavagem desses fragmentos em hipoclorito de sódio 5% por 10-20 segundos e posterior lavagem por 10-20 segundos em água destilada estéril. As frações do basidioma esterilizadas foram inoculadas em placa de Petri contendo meio de cultura (BDA ou MEA) com cloranfenicol (antibiótico antibacteriano $0,025\text{gL}^{-1}$) (Okino 1996, Xavier-Santos 2003).

Os isolados foram crescidos em meio de cultura contendo guaiacol para determinação de atividade de fenoloxidasas, verificada através da formação de um halo avermelhado (Okino 1996). Para a detecção das enzimas lacase e peroxidase, pelos isolados fúngico, foi realizado o teste de gotas segundo Stalpers (1978), Okino (1996) e Okino *et al.* (2000), utilizando-se as seguintes soluções: lacase: 0,1 M de α -naftol em etanol 96% e peroxidase: partes iguais de peróxido de hidrogênio 0,4% e solução de pirogalol 1%.

Após o crescimento em meio de cultura contendo guaiacol uma gota das soluções acima foi colocada em contato com o micélio fúngico. Em contato com o meio colonizado pelo micélio fúngico, as soluções apresentam diferentes colorações resultantes da oxidação do substrato pelas respectivas enzimas: púrpura para lacase e amarelo-acastanhado para peroxidase.

A presença das enzimas lignolíticas extracelulares também foi verificada através da degradação do corante RBBR em meio sólido conforme Okino *et al.* (2000).

Também foi verificada a produção de sideróforos pelos isolados, através do método proposto por Schwyn & Neilands (1997), que se baseia na competição por ferro entre um complexo férrico de um corante indicador [chrome azurol (CAS)] e um sideróforo produzido pelo microorganismo.

RESULTADOS E DISCUSSÃO

Um total de 318 espécimes foram coletados nas sete excursões, de abril de 2013 a abril de 2014 (**Tabela 2**). Desses espécimes, puderam ser determinadas 95 espécies (**Tabela 3**) distribuídas em três ordens e 10 famílias, além de um taxon de posição indefinida (*Incertae sedis*).

Tabela 2 – Relação das coletas na área de estudo e número de espécimes coletados.

Coleta	Data da coleta	Nº de espécimes coletados
1 ^a	17/04/2013 a 19/04/2013	40
2 ^a	11/06/2013 a 13/06/2013	46
3 ^a	07/08/2013 a 09/08/2013	38
4 ^a	29/10/2013 a 31/10/2013	60
5 ^a	18/12/2013 a 20/12/2013	25
6 ^a	10/02/2014 a 12/02/2014	48
7 ^a	25/04/2014 a 27/04/2014	61
Total		318

Por se tratar de um trabalho pioneiro no Parque Estadual da Serra do Mar, todos os registros configuraram-se como primeira citação para a localidade, e contribuem para o conhecimento da biodiversidade e sua distribuição geográfica. Nesse trabalho são descritas duas espécies novas para a ciência, *Fuscoporia atlantica ad int.* e *Laetiporus squalidus ad int.* Além disso, *Dichomitus campestris* (Quél.) Domanski & Orlicz, *Dichomitus cylindrosporus* Ryvardeen, *Fulvifomes glaucescens* (Petch) Y.C. Dai, *Laetiporus gilbertsonii* Burds., *Perenniporia cremeopora* Decock & Ryvardeen e *Postia undosa* (Peck) Jülich representam o primeiro registro para o Brasil.

Esse estudo também contribui para a ampliação da documentação da micota paulista, apresentando vinte e quatro registros novos para o estado: *Antrodiella luteocontexta* Ryvardeen & de Meijer, *Ceriporiopsis flavilutea* (Murrill) Ryvardeen, *Cinereomyces dilutabilis* (Log.-Leite & J.E. Wright) Miettinen, *Diplomitoporus navisporus* Gibertoni & Ryvardeen, *Flaviporus brownii* (Humb.) Donk, *Flaviporus subhydrophilus* (Speg.) Rajchenb., *Flaviporus venustus* A. David & Rajchenb., *Fulvifomes melleoporus* (Murrill) Baltazar & Gibertoni, *Fuscoporia chrysea* (Lév.) Baltazar & Gibertoni, *Fuscoporia rhabarbarina* (Berk.) Groposo, Log.-Leite & Góes-Neto, *Grammothele fuligo* (Berk. & Broome) Ryvardeen, *Inonotus linteus* (Berk. & M.A. Curtis) Teixeira, *Inonotus portoricensis* (Overh.) Baltazar & Gibertoni, *Inonotus tropicalis* (M.J. Larsen & Lombard) T. Wagner & M. Fisch., *Junghuhnia carneola* (Bres.) Rajchenb., *Oxyporus latemarginatus* (Durieu & Mont.) Donk, *Phellinus bambusarum* (Rick) M.J. Larsen, *Phellinus grenadensis* (Murrill) Ryvardeen, *Phellinus roseocinereus*

(Murrill) D.A. Reid, *Phellinus undulatus* (Murrill) Ryvarden, *Postia subcaesia* (A. David) Jülich, *Postia tephroleuca* (Fr.) Jülich, *Rigidoporus crocatus* (Pat.) Ryvarden e *Skeletocutis nivea* (Jungh.) Jean Keller.

Todos os materiais estudados foram depositados no Herbário Maria Eneyda P. K. Fidalgo (SP).

Tabela 3 – Listagem das espécies de políporos inventariados no PESM com *vouchers*. RP = Ricardo Pires + número de coletor.

Família/Espécie	Vouchers
POLYPORALES	
FOMITOPSIDACEAE	
<i>Antrodia albida</i> (Fr.) Donk	RP95, RP137, RP177, RP187, RP287, RP311
<i>Antrodia malicola</i> (Berk. & M.A. Curtis) Donk	RP45
<i>Laetiporus gilbertsonii</i> Burds	RP152, RP233, RP234
<i>Laetiporus squalidus</i> Pires, Motato-Vásquez & Gugliotta <i>ad int.</i>	RP232
<i>Postia subcaesia</i> (A. David) Jülich	RP75, RP78, RP139, RP315
<i>Postia tephroleuca</i> (Fr.) Jülich	RP331
<i>Postia undosa</i> (Peck) Jülich	RP189
GANODERMATACEAE	
<i>Amauroderma sprucei</i> (Pat.) Torrend	RP195
<i>Ganoderma australe</i> (Fr.) Pat.	RP4, RP24, RP57, RP159, RP161, RP252
MERIPILACEAE	
<i>Henningsia brasiliensis</i> (Speg.) Speg.	RP193, RP200, RP212, RP215
<i>Rigidoporus crocatus</i> (Pat.) Ryvarden	RP127
<i>Rigidoporus lineatus</i> (Pers.) Ryvarden	RP13, RP173, RP182, RP196, RP208, RP230, RP249
<i>Rigidoporus microporus</i> (Sw.) Overeem	RP122, RP160
<i>Rigidoporus undatus</i> (Pers.) Donk	RP97
<i>Rigidoporus vinctus</i> (Berk.) Ryvarden	RP183, RP185, RP251, RP255, RP277
MERULIACEAE	
<i>Bjerkandera fumosa</i> (Pers.) P. Karst.	RP317
<i>Ceriporia xylostromatoides</i> (Berk.) Ryvarden	RP165
<i>Ceriporiopsis flavilutea</i> (Murrill) Ryvarden	RP87
<i>Flaviporus brownii</i> (Humb.) Donk	RP64
<i>Flaviporus hydrophilus</i> (Berk. & M.A. Curtis)	RP153

Família/Espécie	Vouchers
Ginns	
<i>Flaviporus liebmannii</i> (Fr.) Ginns	RP15, RP27, RP37, RP150, RP201, RP203
<i>Flaviporus subhydrophilus</i> (Speg.) Rajchenb. & J.E. Wright	RP35, RP147, RP191
<i>Flaviporus subundatus</i> (Murrill) Ginns	RP332
<i>Flaviporus venustus</i> A. David & Rajchenb.	RP262
<i>Loweomyces fractipes</i> (Berk. & M.A. Curtis) Jülich	RP197
PHANEROCHAETACEAE	
<i>Antrodiella angulatopora</i> Ryvar den	RP56, RP58, RP110, RP303, RP310
<i>Antrodiella duracina</i> (Pat.) I. Lindblad & Ryvar den	RP52, RP69, RP85, RP96, RP174, RP192
<i>Antrodiella luteocontexta</i> Ryvar den & de Meijer	RP299, RP318
<i>Antrodiella semisupina</i> (Berk. & M.A. Curtis) Ryvar den	RP41
<i>Junghuhnia carneola</i> (Bres.) Rajchenb.	RP2
<i>Junghuhnia nitida</i> (Pers.) Ryvar den	RP79
<i>Junghuhnia semisupiniformis</i> (Murrill) Ryvar den	RP62
<i>Junghuhnia undigera</i> (Berk. & M.A. Curtis) Ryvar den	RP130, RP295, RP300, RP309, RP329
POLYPORACEAE	
<i>Abundisporus subflexibilis</i> (Berk. & M.A. Curtis) Parmasto	RP124
<i>Cinereomyces dilutabilis</i> (Log.-Leite & J. E. Wright) Miettinen	RP1, RP221
<i>Corioloopsis caperata</i> (Berk.) Murrill	RP199
<i>Corioloopsis rigida</i> (Berk. & Mont.) Murrill	RP72, RP107, RP144, RP148, RP172, RP188, RP247
<i>Dichomitus campestris</i> (Quél.) Domanski & Orlicz	RP51
<i>Dichomitus cavernulosus</i> (Berk.) Masuka & Ryvar den	RP239, RP313
<i>Dichomitus cylindrosporus</i> Ryvar den	RP31, RP93
<i>Dichomitus setulosus</i> (Henn.) Masuka & Ryvar den	RP320
<i>Diplomitoporus navisporus</i> Gibertoni & Ryvar den	RP180
<i>Fomes fasciatus</i> (Sw.) Cooke	RP34, RP61, RP204
<i>Fomitella supina</i> (Sw.) Murrill	RP18, RP28, RP55, RP60, RP205, RP248, RP336
<i>Fuscocerrenea portoricensis</i> (Fr.) Ryvar den	RP113, RP123
<i>Grammothele fuligo</i> (Berk. & Broome) Ryvar den	RP211
<i>Grammothelopsis puiggarii</i> (Speg.) Rajchenb. & J.E. Wright	RP134
<i>Pachykytospora alabamae</i> (Berk. & Cooke)	RP146

Família/Espécie	Vouchers
Ryvarden	
<i>Perenniporia cremeopora</i> Decock & Ryvarden	RP120
<i>Perenniporia ochroleuca</i> (Berk.) Ryvarden	RP285, RP324
<i>Perenniporiella neofulva</i> (Lloyd) Decock & Ryvarden	RP286
<i>Polyporus ciliatus</i> Fr.	RP132, RP136, RP156, RP164
<i>Polyporus dictyopus</i> Mont.	RP170, RP241, RP264, RP301, RP334
<i>Polyporus grammocephalus</i> Berk.	RP237
<i>Polyporus guianensis</i> Mont.	RP261
<i>Polyporus tenuiculus</i> (P. Beauv.) Fr.	RP6, RP178, RP228, RP250, RP254
<i>Pycnoporus sanguineus</i> (L.) Murrill	RP70, RP71
<i>Skeletocutis nivea</i> (Jungh.) Jean Keller	RP84
<i>Spongipellis caseosus</i> (Pat.) Ryvarden	RP125
<i>Tinctoporellus epimiltinus</i> (Berk. & Broome) Ryvarden	RP20, RP105, RP211
<i>Trametes membranacea</i> (Sw.) Kreisel	RP145
<i>Trametes versicolor</i> (L.) Lloyd	RP297
<i>Trametes villosa</i> (Sw.) Kreisel	RP74, RP88, RP118
RICKENELLACEAE	
<i>Sidera lenis</i> (P. Karst.) Miettinen	RP39, RP90, RP94, RP102, RP111, RP116, RP117, RP186, RP223, RP236, RP242, RP256, RP281, RP288, RP322
HYMENOCHAETALES	
INCERTAE SEDIS	
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	RP63, RP67
HYMENOCHAETACEAE	
<i>Fomitiporella umbrinella</i> (Bres.) Murrill	RP 276
<i>Fomitiporia maxonii</i> Murrill	RP 327
<i>Fulvifomes glaucescens</i> (Petch) Y.C. Dai	RP 307
<i>Fulvifomes melleoporus</i> (Murrill) Baltazar & Gibertoni	RP 280, RP 284
<i>Fulvifomes nilgheriensis</i> (Mont.) Bondartseva & S.Herrera	RP 115
<i>Fuscoporia atlantica</i> Motato-Vásquez, Pires & Gugliotta <i>ad int.</i>	RP 8
<i>Fuscoporia callimorpha</i> (Lév.) Groposo, Log.-Leite & Góes-Neto	RP 135
<i>Fuscoporia chrysea</i> (Léveillé) Baltazar & Gibertoni	RP 83, RP 330

Família/Espécie	Vouchers
<i>Fuscoporia ferrea</i> (Pers.) G. Cunn.	RP 194
<i>Fuscoporia gilva</i> (Schwein.) T. Wagner & M. Fisch.	RP 17, RP 21, RP 54, RP 104, RP 108, RP 149, RP 151, RP 168, RP 220, RP 323
<i>Fuscoporia rhabarbarina</i> (Berk.) Groposo, Log.-Leite & Góes-Neto	RP 100
<i>Fuscoporia senex</i> (Nees & Mont.) Ghobad-Nejhad	RP 314
<i>Fuscoporia wahlbergii</i> (Fr.) T. Wagner & M. Fisch.	RP 36, RP 259
<i>Inonotus iodinus</i> (Mont.) G. Cunn.	RP 49, RP 53, RP 112, RP 244
<i>Inonotus linteus</i> (Berk. & M.A. Curtis) Teixeira	RP 157
<i>Inonotus portoricensis</i> (Overh.) Baltazar & Gibertoni	RP 23
<i>Inonotus tabacinus</i> (Mont.) G.Cunn.	RP 5
<i>Inonotus tropicalis</i> (M.J. Larsen & Lombard) T. Wagner & M. Fisch.	RP 73, RP 176
<i>Phellinus apiahynus</i> (Speg.) Rajchenb. & J.E. Wright	RP 253
<i>Phellinus bambusarum</i> (Rick) M.J. Larsen	RP 50
<i>Phellinus grenadensis</i> (Murrill) Ryvardeen	RP 240
<i>Phellinus rimosus</i> (Berk.) Pilát	RP 68
<i>Phellinus roseocinereus</i> (Murrill) D.A. Reid	RP 258
<i>Phellinus undulatus</i> (Murrill) Ryvardeen	RP 283
<i>Phylloporia pectinata</i> (Klotzsch) Ryvardeen	RP 121

SCHIZOPORACEAE

<i>Echinoporia inermis</i> G. Coelho	RP80, RP179, RP306
<i>Oxyporus latemarginatus</i> (Durieu & Mont.) Donk	RP260
<i>Schizopora flavipora</i> (Berk. & M.A. Curtis ex Cooke) Ryvardeen	RP81, RP163, RP167, RP171, RP184, RP198, RP229, RP294, RP305
<i>Schizopora paradoxa</i> (Schrad.) Donk	RP141, RP278, RP279, RP308

TRECHISPORALES

HYDNODONTACEAE

<i>Trechispora regularis</i> (Murrill) Liberta	RP246, RP296, RP298
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Foram sequenciados 22 materiais e após a formação das sequências consenso, todos os dados foram depositados no GenBank (**Tabela 4**), condicionados a liberação para uso público após a publicação dos resultados.

Tabela 4 – Listagem dos espécimes sequenciados e o número de acesso no GenBank.

Espécies	Região	Vouchers	Número de acesso GenBank
<i>Fuscoporia atlantica</i> Motato-Vásquez, Pires & Gugliotta	ITS	RP 8	KP058514
<i>Fuscoporia atlantica</i> Motato-Vásquez, Pires & Gugliotta	LSU	RP 8	KP058517
<i>Fuscoporia gilva</i> (Schwein.) T. Wagner & M. Fisch	ITS	RP 17	KP859295
<i>Fuscoporia gilva</i> (Schwein.) T. Wagner & M. Fisch	LSU	RP 17	KP859305
<i>Grammothelopsis puiggarii</i> (Speg.) Rajchenb. & J.E. Wrigh	ITS	RP 134	KP859299
<i>Grammothelopsis puiggarii</i> (Speg.) Rajchenb. & J.E. Wrigh	LSU	RP 134	KP859308
<i>Inonotus tropicalis</i> (M.J. Larsen & Lombard) T. Wagner & M. Fisch.	ITS	RP 176	KP859301
<i>Laetiporus squalidus</i> Pires, Motato-Vásquez & Gugliotta	LSU	RP 232	KP765242
<i>Laetiporus squalidus</i> Pires, Motato-Vásquez & Gugliotta	ITS	RP 232	KP765238
<i>Laetiporus gilbertsonii</i> Burds.	ITS	RP 152	KP765237
<i>Laetiporus gilbertsonii</i> Burds.	ITS	RP 233	KP765239
<i>Laetiporus gilbertsonii</i> Burds.	ITS	RP 234	KP765240
<i>Loweomyces fractipes</i> (Berk. & M.A. Curtis) Jülich	ITS	RP 197	KP859304
<i>Loweomyces fractipes</i> (Berk. & M.A. Curtis) Jülich	LSU	RP 197	KP859309
<i>Rigidoporus lineatus</i> (Pers.) Ryvardeen	ITS	RP 182	KP859302
<i>Rigidoporus microporus</i> (Sw.) Overeem	ITS	RP122	KP859298
<i>Rigidoporus microporus</i> (Sw.) Overeem	ITS	RP160	KP859300
<i>Rigidoporus vinctus</i> (Berk.) Ryvardeen	ITS	RP 185	KP859303
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	ITS	RP 63	KP859296
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	LSU	RP 63	KP859306
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	ITS	RP 67	KP859297
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	LSU	RP 67	KP859307

Além do trato taxonômico e dos materiais sequenciados, culturas de fungos e testes enzimáticos foram realizados com alguns espécimes isolados. Os isolados fúngicos obtidos foram preservados utilizando-se o método de Castellani, em água destilada estéril (Castellani 1967, Nakasone *et al.* 2004) e incluídas na Coleção de Culturas de Algas, Cianobactérias e Fungos – CCIBt (**Tabela 5**), mantida no

Núcleo de Pesquisa em Micologia do Instituto de Botânica, credenciado como Fiel Depositário pelo Conselho de Gestão do Patrimônio Genético (CGEN).

Tabela 5 – Isolados obtidos e forma de preservação.

Espécies	Nº do Coletor	Métodos de preservação
<i>Antrodia</i> sp.	RP109	Cultura em tubo de ensaio.
<i>Antrodiella angulatopora</i>	RP56, RP58	Cultura em tubo de ensaio e Castellani.
<i>Antrodiella duracina</i>	RP52, RP96	Cultura em tubo de ensaio.
<i>Fomes fasciatus</i>	RP34	Cultura em tubo de ensaio e Castellani.
<i>Fomitella supina</i>	RP28, RP55, RP248	Cultura em tubo de ensaio e Castellani.
<i>Fuscocerreana portoricensis</i>	RP113	Cultura em tubo de ensaio.
<i>Ganoderma australe</i>	RP57	Castellani.
<i>Grammothelopsis puiggarii</i>	RP 134	Cultura em tubo de ensaio.
<i>Inonotus tabacinus</i>	RP5	Cultura em tubo de ensaio e Castellani.
<i>Inonotus tropicalis</i>	RP73, RP176	Cultura em tubo de ensaio.
<i>Junghuhnia nitida</i>	RP79	Cultura em tubo de ensaio e Castellani.
<i>Meripilus</i> sp.	RP200	Cultura em tubo de ensaio.
<i>Pachykytospora alabamiae</i>	RP146	Cultura em tubo de ensaio.
<i>Inonotus</i> sp.	RP101	Cultura em tubo de ensaio.
<i>Pycnoporus sanguineus</i>	RP70, RP71	Castellani.
<i>Skeletocutis nivea</i>	RP84	Cultura em tubo de ensaio.
<i>Tinctoporellus epimiltinus</i>	RP105, RP211, RP238	Cultura em tubo de ensaio e Castellani.
<i>Trametes villosa</i>	RP74, RP88, RP118	Cultura em tubo de ensaio e Castellani.
<i>Trichaptum sector</i>	RP63, RP67	Cultura em tubo de ensaio e Castellani.
<i>Tyromyces</i> sp.	RP26	Cultura em tubo de ensaio.

A atividade enzimática dos isolados foi avaliada qualitativamente: fenoloxidasas (através da oxidação do guaiacol), lacase e peroxidase (através dos testes de gotas) e celulase. A degradação do corante Rhemazol Brilliant Blue-R (RBBR) também foi avaliada, assim como a produção de sideróforos em meio CAS (**Tabela 6**).

Tabela 6 – Atividade lignocelulolítica de fungos basidomicetos. Código: número de identificação do isolado. F: fenoloxidasas. L: lacase. P: peroxidase, C: celulase. RBBR: degradação do corante

Rhemazol-Brilliant-Blue-R. CAS: Produção de sideróforos utilizando Chromo-Azurol-S. O símbolo ‘+’ representa presença da enzima estudada; ‘-’ representa ausência da enzima.

Espécie	Código	F	L	P	C	RBBR	CAS
<i>Antrodiella angulatopora</i>	RP56	+	+	+	-	+	-
<i>Antrodiella angulatopora</i>	RP58	+	+	+	-	+	-
<i>Antrodiella duracina</i>	RP52	-	+	+	+	+	-
<i>Antrodiella duracina</i>	RP96	+	+	+	-	+	-
<i>Fomes fasciatus</i>	RP34	+	+	+	+	+	+
<i>Fomitella supina</i>	RP28	+	+	+	+	+	+
<i>Fomitella supina</i>	RP55	+	+	+	+	+	-
<i>Fusocerreana portoricensis</i>	RP113	+	+	+	+	+	+
<i>Inonotus tabacinus</i>	RP5	+	+	+	+	+	-
<i>Inonotus tropicalis</i>	RP73	-	+	+	+	+	-
<i>Junghuhnia nitida</i>	RP79	+	+	+	-	+	-
<i>Inonotus</i> sp.	RP101	-	+	+	+	+	+
<i>Trichaptum sector</i>	RP63	-	+	+	+	+	-
<i>Trichaptum sector</i>	RP67	-	+	+	+	+	-

Esses estudos agregam dados que podem subsidiar a seleção de isolados para a utilização em processos biotecnológicos ou de biorremediação.

O primeiro capítulo traz uma relação de oito registros novos para o estado de São Paulo e um registro novo para o Brasil. Esse trabalho foi elaborado antes dos demais para garantir a novidade dos dados e foi apresentado ainda no primeiro ano do presente mestrado. O segundo capítulo apresenta uma nova espécie encontrada na área de estudo, *Fuscoporia atlantica*. Para esse trabalho, dados de morfologia e de biologia molecular se complementaram para uma boa definição do conceito dessa espécie.

O terceiro capítulo é parte fundamental desse trabalho, pois apresenta a lista de espécies da família Hymenochaetaceae, uma lista composta por vinte e cinco espécies, sendo dessas um registro novo para o Brasil e oito registros novos para o estado de São Paulo. No quarto capítulo apresentado, uma nova espécie do gênero *Laetiporus* é descrita, *L. squalidus*, utilizando-se dados morfológicos e moleculares. Além disso, ainda é registrado para o Brasil a espécie *Laetiporus gilbertsonii* Burds., que pertence ao complexo *Laetiporus sulphureus*, até então uma das únicas conhecidas para o país, junto com *L. persicinus*. No quinto capítulo são apresentadas as espécies pertencentes ao maior grupo de políporos, a ordem Polyporales, junto com gêneros afins. São apresentadas setenta espécies para a localidade, sendo que dessas, três são citações novas para o país e oito são novos registros para o estado de São Paulo.

CAPÍTULO 1

New records of
polypores
(Basidiomycota) of São
Paulo state, Brazil

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New records of polypores (Basidiomycota) of São Paulo state, Brazil

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ABSTRACT – Polypores are characterized by a tubular hymenium ending in a surface with pores. The diversity of this group in Brazil is still poorly known. During a survey of polypores from Núcleo Santa Virgínia in the Parque Estadual da Serra do Mar, São Paulo state from April 2013 to April 2014, eight species previously unregistered in the area were found and identified. *Cinereomyces dilutabilis*, *Flaviporus brownii*, *F. subhydrophilus*, *Inonotus tropicalis*, *Junghuhnia carneola*, *Phellinus bambusarum*, *Rigidoporus crocatus* and *Skeletocutis nivea* are new records for São Paulo state and *Dichomitus cylindrosporus* is a new record for Brazil. Full descriptions, illustrations and comments about all the species are given.

Key words: Brazilian Atlantic rainforest, Fungal diversity, Neotropics, Polyporales, Taxonomy.

RESUMO – Novos registros de Políporos (Basidiomycota) do Estado de São Paulo, Brasil. Políporos são Basidiomycetes caracterizados por um himênio tubular que termina numa superfície com poros. A diversidade deste grupo no Brasil ainda é pouco conhecida. Durante o levantamento de políporos do Núcleo Santa Virgínia do Parque Estadual da Serra do Mar, Estado de São Paulo entre abril de 2013 a abril de 2014, nove espécies não registradas na área foram encontradas e identificadas. *Cinereomyces dilutabilis*, *Flaviporus brownii*, *F. subhydrophilus*, *Inonotus tropicalis*, *Junghuhnia carneola*, *Phellinus bambusarum*, *Rigidoporus crocatus* e *Skeletocutis nivea* são novos registros para o Estado de São Paulo e *Dichomitus cylindrosporus* é um novo registro para o Brasil. Descrições, ilustrações e comentários para todas as espécies são apresentadas.

Palavras-chave: Diversidade de fungos, Mata Atlântica Brasileira, Neotrópico, Polyporales, Taxonomia.

INTRODUCTION

Polypores are fungi characterized by the presence of a tubular hymenophore where the basidia and basidiospores are formed, ending in a surface with pores, feature that gives the name to the group (Ryvarden 1991, Rajchenberg 2006). The polypores are included in the Basidiomycota phylum and they are considered a polyphyletic group distributed in several orders, especially in *Polyporales* Gäum and *Hymenochaetales* Oberw., which include the largest number of species with tubular hymenophore. Other minor orders including polypores are *Agaricales* Underw., *Corticiales* K.H. Larss., *Gloeophyllales* Thorn, *Russulales* Kreisel ex P.M. Kirk, P.F. Cannon & J.C. David and *Trechisporales* K.H. Larss. (Hibbett *et al.* 2007, Kirk *et al.* 2008).

Polypores are saprophytic, predominantly xylophilous but sometimes, depending of environmental conditions and type of host, certain species may become parasites, opportunistic or facultative in senescent or injured trees, persisted after it death like saprophytic or forming mycorrhizal associations (Ryvarden 1991, Capelari *et al.* 1998). Due its main ecological role as decomposers, constituting one of the main links in the nutrients cycling (Boddy 1991, Begon *et al.* 2006). Since wood

is the largest component of the biosphere representing more than 90% of the biomass in forest ecosystems, the role of wood-decay fungi is very important in maintaining terrestrial ecosystems (Glazer & Nikaido 1995, Rayner 1995, Boddy *et al.* 2008).

In the São Paulo state are still gaps in the knowledge of the fungi diversity even in the Atlantic rainforest, one of the most studied domain (Capelari *et al.* 1998, Capelari & Gugliotta 2006, Prado *et al.* 2008). From the many studies conducted in the São Paulo state (Fidalgo & Fidalgo 1957, Bononi 1979, 1984a, b, Bononi *et al.* 1981, Jesus 1993, Gugliotta 1997, Soares & Gugliotta 1998, Gugliotta & Bononi 1999, Xavier-Santos *et al.* 2004, Louza & Gugliotta 2007, Leal & Gugliotta 2008, Abrahão *et al.* 2009, Gugliotta *et al.* 2010, Gugliotta *et al.* 2011), none addresses the diversity of the Parque Estadual da Serra do Mar, one of the most preserved area of these domain.

MATERIAL AND METHODS

The specimens were collected from April 2013 to April 2014 in the Parque Estadual da Serra do Mar (PESM), Núcleo Santa Virgínia (23° 17' -23°24' S e 45°03' -45°11' W) covering parts of the cities Natividade da Serra (7.527 ha), São Luiz do Paraitinga (7.557 ha), Cunha (1.581 ha) and Ubatuba (255 ha) (Joly *et al.* 2012, Instituto Florestal, 2012). The PESM has about 17,000 ha with a characteristic tropical vegetation of Atlantic rainforest. Data about floristic, phytosociology e physico-chemical of soil are given by Joly *et al.* (2012).

The identification of the specimens was based on macro and microscopic characters of the basidiomata (Ryvarden 1991, Teixeira 1995). The microstructures were analyzed follow recommendations of Teixeira (1995); all measures were made in KOH 3-5% solution and 1% aqueous phloxine solution. The evidence of dextrinoid and amiloid reactions was tested with Melzer's reagent (Gilbertson & Ryvarden 1986, Gugliotta & Bononi 1999). The basidiospores dimensions were obtained as Coelho (2005) proposed, by calculating the ratio $Q = L/W$ and average of Q (where L = length and W = width).

RESULTS AND DISCUSSION

During a survey of polypores from Núcleo Santa Virgínia in The Parque Estadual da Serra do Mar, São Paulo state, Brazil, eight species previously unregistered to São Paulo state were found and described here, and one species is rcordeed the first time for Brazil.

Cinereomyces dilutabilis (Loguercio-Leite & J.E. Wright) Miettinen, Mycotaxon 121:345, 2012

(Fig. 1-4, 34)

≡ *Diplomitoporus dilutabilis* Loguercio-Leite & J.E. Wright, Mycotaxon 68:48, 1998

BASIDIOMA: annual, resupinate. **PORE SURFACE:** white to yellow, 5-7 pores per mm. **HYPHAL SYSTEM:** trimitic; generative hyphae clamped, thin-walled, 2-4 µm diam.; skeletal hyphae dissolving in KOH, thick-walled, weakly amyloid in Melzer's reagent, 3-6 µm; binding hyphae 1-2 µm diam., solid to thick-walled. **STERILE ELEMENTS:** cystidia absent, fusoid cystidioles present, thin-walled, hyaline, 10-14 x 3.5-4 µm. **BASIDIOSPORES:** broadly cylindrical to ellipsoid, curved, hyaline, smooth, thin-walled, IKI-, 5-6.3 x 3-4 µm, Q = 1.1-1.5, Qm = 1.3.

Remarks: *Cinereomyces dilutabilis* is characterized by the skeletal hyphae amyloid and acyanophilous, dissolving in KOH. This species differs from *C. lindbladii* (Berk.) Jülich by its more fragile and small-pored basidiomas (pores 6-7 per mm in the former and 3-4 per mm in the latter) and by the wider basidiospores (>2.5 µm in the former and 1.8-2.4 µm in the latter) (Miettinen 2012). The specimen examined in this study presents basidiospores slightly larger than those examined by Miettinen (2012) 5-6.3 x 3-4 µm in the former and 4.8-5.5(-5.6) x (2.3-)2.4-2.8(-2.9) µm in the latter); but share the shape broadly cylindrical to ellipsoid and curved.

Distribution in Brazil: Santa Catarina (Loguercio-Leite & Wright 1998, Drechsler-Santos *et al.* 2008).

Specimens examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 17-IV-2013, Pires, R.M. RP 1 (SP).

Flaviporus brownii (Humb.) Donk, Persoonia 1(2): 189, 1959 (Fig. 5-9, 35)

≡ *Boletus brownii* Humb., Florae Fribergensis Specimen plantas cryptogamicas praesertim subterraneas exhibens: 101, 1793

BASIDIOMA: annual, pileate, dimidiate or imbricate, reddish-yellow pilear surface, with concentric dark-reddish-brown bands. **PORE SURFACE:** sulphurous yellow when fresh, paler when dry, with 8-10(-12) pores per mm. **HYPHAL SYSTEM:** dimitic, hyphae agglutinated; generative hyphae clamped, thin to thick-walled, 1.5-2.5(-3) µm diam.; skeletal hyphae thick-walled dominating in the trama and context, 2-4 µm diam. **STERILE ELEMENTS:** skeletocystidia into the hymenium strongly encrusted at the apex (22-50 x 7-10 µm). **BASIDIOSPORES:** broadly ellipsoid, hyaline, smooth, thin-walled, IKI, 2.8-3.5 x 1.7-2.6 µm, Q = 1.3-1.8, Qm = 1.5.

Remarks: this species is easily recognized by the dark reddish-brown pilear surface and reddish-yellow pore surface, these aspects are distinctive of other species of *Flaviporus* Murrill. In the specimen examined, basidiospores are slightly wider than the material described by Gerber & Loguercio-Leite (1997) (2.5-3 x 1.5-2 μm) and Ryvardeen & Gilbertson (1993) (2.6-2.8 x 1.8-2 μm), but corroborating with Bernicchia (1990) [(2.5-)3-3.5(-4) x 1.8-2.2(-2.5)]. The dimitic hyphal system with agglutinated hyphae and the presence of tramal cystidia with encrusted apex are important characteristics for recognition of this species (Gerber & Loguercio-Leite 1997).

Distribution in Brazil: Paraná (Rajchenberg & Meijer 1990, Gerber & Loguercio-Leite 1997, Ryvardeen & Meijer 2002, Meijer 2006); Rio Grande do Sul (Rick 1960, Sobestiansky 2005) and Santa Catarina (Gerber 1996, Gerber & Loguercio-Leite 1997, Gonçalves & Loguercio-Leite 2001, Groposo & Loguercio-Leite 2005).

Specimens examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESH Núcleo Santa Virgínia, 11-VI-2013, Pires, R.M. RP 64 (SP).

Flaviporus subhydrophilus (Speg.) Rajchenb. & J.E. Wright, Mycologia 79 (2): 259, 1987

(Fig. 10-12, 36)

\equiv *Polystictus subhydrophilus* Speg., Boletín de la Academia Nacional de Ciencias en Córdoba 11 (4): 444, 1889

BASIDIOMA: annual, pileate, solitary, dimidiate, velutinous pilear surface, concentrically zonate, brownish-yellow with reddish-yellow bands, context beige. **PORE SURFACE:** light reddish-brown, with (9-)10-12 pores per mm. **HYPHAL SYSTEM:** dimitic, generative hyphae clamped, thin-walled, 2-3.5 μm diam.; skeletal hyphae thick-walled, finely encrusted at the edge of the dissepiments, 2.5-6 μm diam. **STERILE ELEMENTS:** skeletocystidia into the hymenium strongly encrusted at the apex, 22-50 μm long, 7-10 μm wide. **BASIDIOSPORES:** cylindrical, hyaline, smooth, thin-walled, IKI-, 3-4 x 1.5-2 μm , $Q = 1.7-2.3$, $Q_m = 1.9$.

Remarks: *Flaviporus subhydrophilus* differs from the other species of the genus by the cylindrical basidiospores and by the absence of agglutinated hyphae in the context. The examined specimens show smaller pores than the descriptions of Gerber & Loguercio-Leite (1997) and Rajchenberg & Wright (1987) (8-9 pores per mm).

Distribution in Brazil: Rio Grande do Sul (Rajchenberg 1987, Silveira & Guerrero 1991, Gerber & Loguercio-Leite 1997) and Santa Catarina (Gerber 1996, Gerber & Loguercio-Leite 1997, Drechsler-Santos *et al.* 2008).

Specimens examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 18/IV/2013, Pires, R.M. RP 35 (SP); BRAZIL, São Paulo, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 18-XII-2013, Pires, R.M. RP 191 (SP).

Inonotus tropicalis (M.J. Larsen & Lombard) T. Wagner & M. Fisch., Mycologia. 94(6):998-1016, 2002.
(Fig. 13-15, 37)

≡ *Phellinus tropicalis* M.J. Larsen & Lombard, Mycologia 80: 73, 1988

BASIDIOMA: annual to perennial, resupinate. **PORE SURFACE:** dull brown and becoming paler toward the margin, with 7-9 pores per mm. **HYPHAL SYSTEM:** pseudodimitic; generative hyphae thin-walled, simple-septate, pale yellowish-brown, 2.5-5 µm diam.; skeletal hyphae thick-walled, infrequently simple-septate, dull yellowish brown, 3.5-4(-4.5) µm diam. **STERILE ELEMENTS:** hymenial setae mostly rare, dark brown, ventricose to uncinata, 14-23 x 5-10 µm. **BASIDIOSPORES:** broadly ellipsoid to oval, pale yellow, smooth, thin-walled, IKI-, 4-5 x 3-3.8 µm, Q = 1.1-1.5, Qm = 1.3.

Remarks: *Inonotus tropicalis* was recorded for São Paulo state by Bononi *et al.* (1981), but a detailed analysis of the voucher (SP142014) suggest that the identification was incorrect and the specimen really belongs to *Phellinus* Quéél. Thereby these constitute the first record of *I. tropicalis* for the state. Larsen & Cobb-Poullé (1990) described this species with hymenial setae more or less ventricose, but the studies of type material shows hymenial setae rare, ventricose to uncinata.

Distribution in Brazil: Paraná (Meijer 2006) and Rio Grande do Sul (Rick 1960).

Specimens examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 12-VI/-2013, Pires, R.M. RP 73 (SP), 31-X-2013, Pires, R.M. RP 176 (SP);

Additional specimens examined: BRAZIL, SÃO PAULO, Parque Estadual das Fontes do Ipiranga, 12-IV/1978, Trufem, S.F.B., s/n (SP142014). RIO GRANDE DO SUL, São Leopoldo, 1904, Rick 14 (SF15659 Holotype), Rick 423 (SF15660 Paratype).

Junghuhnia carneola (Bres.) Rajchenb., Revta Investnes agrop.: 45, 1984

(Fig. 16-18, 38)

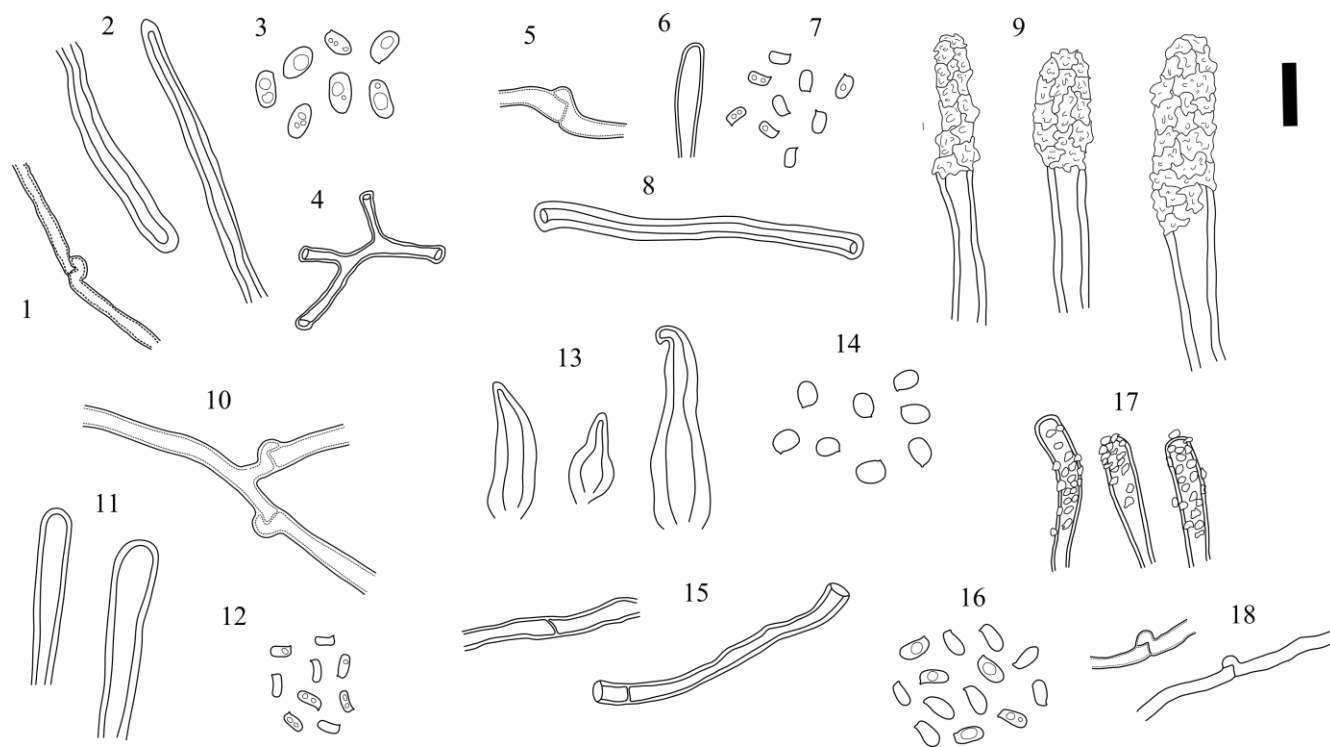
≡ *Poria carneola* Bres., Hedwigia 35: 282, 1896

BASIDIOMA: annual, resupinate, cartilaginous. **PORE SURFACE:** yellow, becoming reddish when bruised, distinctive margin cream, with 3-5 pores per mm. **HYPHAL SYSTEM:** dimitic, generative hyphae thin-walled, clamped, 2-4 μm diam.; skeletal hyphae, thick-walled, 3-6 μm diam. **STERILE ELEMENTS:** cystidia very abundant at the end of the dissepiments, encrusted, up to 40 μm long, 4-7 μm diam. **BASIDIOSPORES:** oblong-ellipsoid, hyaline, smooth, thin-walled, IKI-, 3.5-5.3 x 2-3 μm , $Q = 1.7-2$, $Q_m = 1.8$.

Remarks: *Junghuhnia carneola* can be easily recognized from the other resupinate species of the genus because of its yellow basidiomata that become reddish when bruised. Microscopically, the cystidia differs from the other species of the genus by having skeletal hyphae ending with slightly thickened walls and encrusted with small crystals (Westphalen *et al.* 2012).

Distribution in Brazil: Santa Catarina (Loguercio-Leite 1990) and Rio Grande do Sul (Rick 1960).

Specimen examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 17-IV-2013, Pires, R.M. RP 2 (SP).



Figures 1–18. 1-4. *Cinereomyces dilutabilis*: 1. Generative hyphae; 2. Skeletal hyphae; 3. Basidiospores; 4. Binding hyphae. 5-9. *Flaviporus brownii*: 5. Generative hyphae; 6. Skeletal hyphae of the dissepiments; 7. Basidiospores; 8. Skeletal hyphae of the trama; 9. Cystidia. 10-12. *Flaviporus subhydrophilus*: 10. Generative hyphae; 11. Skeletal hyphae of the dissepiments; 12. Basidiospores. 13-15. *Inonotus tropicalis*: 13. Hymenial setae; 14. Basidiospores; 15. Skeletal hyphae. 16-18. *Junghuhnia carneola*: 16. Basidiospores; 17. Generative hyphae; 18. Cystidia. Scale bar: 10 μm .

Phellinus bambusarum (Rick) M.J. Larsen, The genus *Phellinus* (Hymenochaetaceae): A survey of the world taxa: 40, 1990. (Fig. 19-22, 39)

≡ *Poria bambusarum* Rick, Brotéria Série Trimestral: Ciências Naturais 6: 146, 1927.

BASIDIOMA: resupinate. **PORE SURFACE:** yellowish to brown, with (8-)9-11 pores per mm. **HYPHAL SYSTEM:** dimitic, generative hyphae hyaline, septate, 1.5-3 µm diam.; skeletal hyphae thin to thick-walled, 2-4.5 µm diam. **STERILE ELEMENTS:** hymenial setae present, subventricose to ventricose, 14-23 x 6-8 µm. **BASIDIOSPORES:** globose to subglobose, hyaline, smooth, thin-walled, dextrinoid in Melzer's reagent, 4-5 x 4-4.5 µm, Q = 1-1.3, Qm = 1.1.

Remarks: this species is characterized by the resupinate Basidioma, the globose and dextrinoid basidiospores and bamboo as host (Lowe 1963, Ryvarden 2004). According to Ryvarden (2004) *P. bambusarum* has rare hymenial satae and a little bit wider pores (7-8 per mm) differing of our specimen, but these are highly variable characteristics.

Distribution in Brazil: Santa Catarina (Gerber & Loguercio-Leite 2000, Drechsler-Santos *et al.* 2008, Loguercio-Leite *et al.* 2008) and Paraná (Rajchenberg & Meijer 1990, Ryvarden & Meijer 2002, Meijer 2006).

Specimen examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 11-VI-2013, Pires, R.M. RP 50 (SP).

Rigidoporus crocatus (Pat.) Ryvarden, Occasional Papers of the Farlow Herbarium of Cryptogamic Botany 18: 13 (1983) (Fig. 23-25, 40)

≡ *Poria crocata* Pat., Journal de Botanique (Morot) 8: 220, 1894

BASIDIOMA: annual to perennial, resupinate, hard, curly when fresh, rigid and corneous when dried, easily separable, finely tomentose. **PORE SURFACE:** pinkish-brown to pinkish-cream colored, pinkish brown to smoke-grey when dried, 5-7 pores per mm. **HYPHAL SYSTEM:** monomitic, generative hyphae simple-septate, thin to thick-walled, 3-8 µm diam. **STERILE ELEMENTS:** absent. **BASIDIOSPORES:** subglobose to ovoid, hyaline, smooth, thin-walled, IKI-, 5-5.7 x 4.3-5.1 µm, Q = 1.1-1.2, Qm = 1.1.

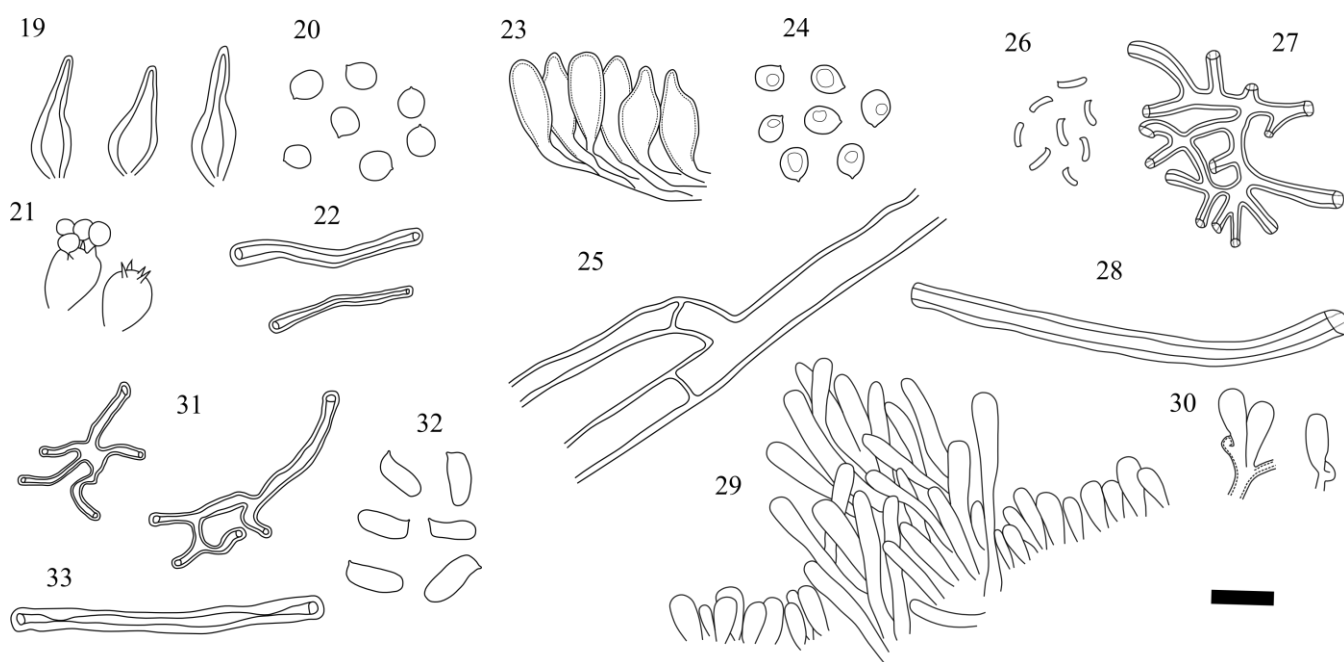
Remarks: this species is characterized by the corneous consistency of the dried basidiomas and the pinkish or flesh-coloured pore surface that darkens when dried (Ryvarden & Gilbertson 1994). Macroscopically, the specimens with a lighter color can be confused with *R. undatus* (Pers.) Donk, but

microscopically it can be easily separated by the presence of cystidia in the latter (Westphalen & Silveira 2012).

Distribution in Brazil: Rio Grande do Sul (Westphalen & Silveira 2012)

Specimen examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 08-VIII-2013, Pires, R.M. RP 127 (SP).

Additional specimens examined: BRASIL, RIO GRANDE DO SUL, São Francisco de Paula, FLONA, 22-VI-2009, Westphalen 231/09 (ICN 154316), 22-VI-2009, Westphalen 253/09 (ICN154319).



Figures 19-33. 19-22. *Phellinus bambusarum*: 19. Hymenial setae; 20. Basidiospores; 21. Basidium; 22. Skeletal hyphae. 23-25. *Rigidoporus crocatus*: 23. Fusoid cystidioles; 24. Basidiospores; 25. Generative hyphae. 26-30. *Skeletocutis nivea*: 26. Basidiospores; 27. Binding hyphae; 28. Skeletal hyphae; 29. Hyphal pegs; 30. Basidiolores; 31-33. *Dichomitus cylindrosporus*: 31. Arboriform skeletal hyphae; 32. Basidiospores; 33. Skeletal hyphae of the trama. Scale bar: 10 μ m.

Skeletocutis nivea (Jungh.) Jean Keller, Persoonia 10 (3): 353, 1979

(Fig. 26-30, 41)

\equiv *Polyporus niveus* Jungh., Praemissa in floram cryptogamicam Javae insulae: 48 (1838)

BASIDIOMA: annual, effused-reflexed or often resupinate, rarely sessile, pileus solitary or imbricate, white to cream pilear surface. **PORE SURFACE:** white to cream, 8-10 pores per mm. **HYPHAL SYSTEM:** trimitic, generative hyphae clamped, thin-walled, 2-4 μ m diam.; skeletal hyphae

predominant, thick-walled, 3-5 μm ; binding hyphae thick-walled, very branched, 1.5-2 μm diam. STERILE ELEMENTS: hyphal pegs present, usually abundant; fusoid cystidioles 10-12 x 3-4 μm . BASIDIOSPORES: allantoid, hyaline, smooth, thin-walled, IKI-, (3.5-)4-5 x 0.5-1 μm , Q = 3.5-8, Qm = 5.1.

Remarks: *Skeletocutis nivea* is recognized by the pileus and the tiny pores and basidiospores (Ryvarden & Gilbertson 1994). Microscopically the extremely tiny basidiospores are diagnostic.

Distribution in Brazil: Rio Grande do Sul (Rajchenberg 1987)

Specimen examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 13/VI/2013, Pires, R.M. RP 84 (SP).

Dichomitus cylindrosporus Ryvarden, Synopsis Fungorum 23: 40, 2007.

(Fig. 31-33, 42-43)

BASIDIOMA: annual, resupinate, margin narrow, pale brown to ochraceous. PORE SURFACE: white when fresh, becoming pale brown when dry, 2-4 pores per mm. HYPHAL SYSTEM: dimitic, generative hyphae clamped, thin to thick-walled, 2-3.5 μm diam.; skeletal hyphae thick-walled, 2-4 μm diam.; arboriform skeletal hyphae present, sparingly branched, dextrinoid in Melzer's reagent. STERILE ELEMENTS: absent. BASIDIOSPORES: cylindrical, hyaline, smooth, thin-walled, IKI-, 7.5-9(-10) x 2.5-4 μm , Q = 2-3.2, Qm = 2.6.

Remarks: *Dichomitus cylindrosporus* is easily distinguished microscopically by the dextrinoid skeletal hyphae and the narrow cylindrical basidiospores different from other species of the genus, which in general have wider and longer basidiospores (Ryvarden 2007). The specimen examined is very similar to the type, differing only in the thickness of the basidioma (2 mm in the type and 4 mm in the specimen examined in this study).

Distribution in Brazil: this is the first citation for Brazil.

Specimen examined: BRAZIL, SÃO PAULO, São Luiz do Paraitinga, PESM Núcleo Santa Virgínia, 18/IV/2013, Pires, R.M. RP 31 (SP).

Additional specimens examined: BELIZE, STAN CREED DISTR., Corkscomb basin Wildlife sanctuary, 16-XI-2001, Ryvarden, L. 44248 (O 450189 Holotype).



Figures 34-43. Photos in field of the basidiomes: **34.** *Cinereomyces dilutabilis*; **35.** *Flaviporus brownii*; **36.** *Flaviporus subhydrophilus*; **37.** *Inonotus tropicalis*; **38.** *Junghuhnia carneola*; **39.** *Phellinus bambusarum*; **40.** *Rigidoporus crocatus*; **41.** *Skeletocutis nivea*; **42-43.** *Dichomitus cylindrosporus*. Scale bar: 1 cm.

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REFERENCES

- Abrahão, M.C., Gugliotta, A.M. & Gomes, E. 2009. Poliporóides (Basidiomycota) em fragmentos de mata no perímetro urbano de São José do Rio Preto, São Paulo, Brasil. *Revista Brasileira de Botânica* 32:427-440.
- Begon, M., Townsend, C.R. & Harper, J.L. 2006. *Ecology: from individuals to ecosystems*. Blackwell Publishing, Oxford, 752pp.
- Bernicchia, A. 1990. Polyporaceae *s. l.* in Italia. Istituto di Patologia Vegetale, università degli Studi, Bologna, 584pp.
- Boddy, L. 1991. Importance of wood decay fungi in forest ecosystems. *In* Arora, D.K., Rai, B., Mukerji, K.G. & Knudsen, G.R. (eds.). *Handbook of Applied Mycology. Volume 1: Soil and Plants*. New York, Marcel Dekker et al. p. 507-540.
- Boddy, L., Frankland, J.C. & van West, P. 2008. *Ecology of Saprotrophic Basidiomycetes*. London, Academic Press. 372p.
- Bononi, V.L.R. 1979. Basidiomicetos do Parque Estadual da Ilha do Cardoso: II. Hymenochaetaceae. *Rickia* 8:85-99.
- Bononi, V.L.R. 1984a. Basidiomicetos do cerrado da reserva Biológica de Moji-Guaçu. *Rickia* 11:1-25.
- Bononi, V.L.R. 1984b. Basidiomicetos do Parque Estadual da Ilha do Cardoso: IV. Adições às famílias *Hymenochaetaceae*, *Stereaceae* e *Thelephoraceae*. *Rickia* 11:43-52.
- Bononi, V.L.R., Trufem, S.F.B. & Grandi, R.A.P. 1981. Fungos macroscópicos do Parque Estadual das Fontes do Ipiranga, depositados no Herbário do Instituto de Botânica. *Rickia* 9:37-53.
- Capelari, M. & Gugliotta, A.M. 2006. Macromicetos no sudeste do Brasil. *In*: *Anais 57º Congresso Nacional de Botânica*, Gramado, v. cd.
- Capelari, M., Gugliotta, A.M. & Figueiredo, M.B. 1998. O estudo dos fungos macroscópicos no estado de São Paulo. *In* *Biodiversidade do estado de São Paulo. Síntese do conhecimento ao final do*

século XX. 2: fungos macroscópicos e plantas (C.E. de M. Bicudo, & G.J. Shepherd, eds.). São Paulo, FAPESP 9-23 p.

- Coelho G. 2005. Brazilian new species of *Auriporia*. *Mycologia* 97: 266-270.
- Drechsler-Santos E.R., Groposo C., Loguercio-Leite C. 2008. Additions to the knowledge of lignocellulolytic Basidiomycetes (Fungi) in forests from Santa Catarina State, Brazil. *Mycotaxon* 103:197–200.
- Fidalgo, O. & Fidalgo, M.E.P.K. 1957. Revisão de Fungi São Paulensis. *Arquivos do Museu Nacional* 43:157-188.
- Gerber, A.L. 1996. Fungos xilófilos poróides (Aphylophorales) no Morro da Lagoa Da Conceição, Ilha de Santa Catarina, SC, Brasil. *Insula* 25:3-68.
- Gerber, A.L. & Loguercio-Leite, C. 1997. New records of Polypores (Aphylophorales) from Southern Brazil. *Mycotaxon* 62:305-318.
- Gerber, A.L., Loguercio-Leite C. 2000. Polyporoid wood-rotting fungi (Basidiomycetes) II – new records from Southern Brazil. *Mycotaxon* 76:175-185.
- Gilbertson, R.L. & Ryvarden, L. 1986. North American Polypores. Oslo, *Fungiflora*, 1:433 P.
- Glazer, A.N. & Nikaido, H. 1995. *Microbial biotechnology: fundamentals of applied microbiology*. New York, W.H. Freeman and Company. 660p.
- Gonçalves, G.V.C. & Loguercio-Leite, C. 2001. Biodiversidade de fungos poróides xilófilos (Basidiomycetes), na Unidade de Conservação Ambiental Desterro (UCAD), Ilha de Santa Catarina, SC, Brasil. *Insula* 30:1-19.
- Groposo, C. & Loguercio-Leite, C. 2005. Contribution to the lignocellulolytic fungi (Basidiomycetes) of the Atlantic Rain Forest in Southern Brazil. *Mycotaxon* 92:103-106.
- Gugliotta, A.M. 1997. Polyporaceae de mata ciliar da Estação Experimental e Reserva Biológica de Moji-Guaçu, SP, Brasil. *Hoehnea* 24:89-106.
- Gugliotta, A.M. & Bononi, V.L.R. 1999. *Polyporaceae* do Parque Estadual da Ilha do Cardoso, São Paulo, Brasil. *Boletim do Instituto de Botânica* 12:1-112.
- Gugliotta, A.M., Fonsêca, M.P. & Bononi, V.L.R. 2010. Additions to the knowledge of aphylophoroid fungi (Basidiomycota) of Atlantic Rain Forest in São Paulo State, Brazil. *Mycotaxon* 112:335-338.

- Gugliotta, A.M., Poscolere, G.D. & Campacci, T.V.S. 2011. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. *Fungos*, 10: *Ganodermataceae*. *Hoehnea* 38(4):687-695.
- Hibbett, D.S., Binder, M., Bischoff, J.F., Blackwell, M., Cannon, P.F., Eriksson, O.E., Huhndorf, S., James, T., Kirk, P.M., Lücking, R., Thorsten Lumbsch, H., Lutzoni, F., Matheny, P.B., McLaughlin, D.J., Powell, M.J., Redhead, S., Schoch, C.L., Spatafora, J.W., Stalpers, J.A., Vilgalys, R., Aime, M.C., Aptroot, A., Bauer, R., Begerow, D., Benny, G.L., Castlebury, L.A., Crous, P.W., Dai, Y.C., Gams, W., Geiser, D.M., Griffith, G.W., Gueidan, C., Hawksworth, D.L., Hestmark, G., Hosaka, K., Humber, R.A., Hyde, K.D., Ironside, J.E., Koljalg, U., Kurtzman, C.P., Larsson, K.H., Lichtwardt, R., Longcore, J., Miadlikowska, J., Miller, A., Moncalvo, J.M., Mozley-Standridge, S., Oberwinkler, F., Parmasto, E., Reeb, V., Rogers, J.D., Roux, C., Ryvarden, L., Sampaio, J.P., Schussler, A., Sugiyama, J., Thorn, R.G., Tibell, L., Untereiner, W.A., Walker, C., Wang, Z., Weir, A., Weiss, M., White, M.M., Winka, K., Yao, Y.J. & Zhang, N. 2007. A higher-level phylogenetic classification of the fungi. *Mycological Research* 111:509-547.
- Instituto Florestal. 2012. Unidades de Conservação. Available in: http://www.iflorestal.sp.gov.br/unidades_conservacao/informacoes.asp?cod=27&area=info. Accessed 04.09.2012.
- Jesus, M.A. 1993. Basidiomicetos lignocelulolíticos de floresta nativa e de *Pinus elliottii* Engelm. do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Hoehnea* 20:119-126.
- Joly, C.A., Assis, M.A., Bernacci, L.C., Tamashiro, J.Y., Campos, M.C.R. de, Gomes, J.A.M.A., Lacerda, M.S., Santos, F.A.M. dos, Pedroni, F., Pereira, L.S., Padgurschi, M.C.G., Prata, E.M.B., Ramos, E., Torres, R.B., Rochelle, A., Martins, F.R., Alves, L.F., Vieira, S.A., Martinelli, L.A., Camargo, P.B. de, Aidar, M.P.M., Eisenlohr, P.V., Simões, E., Villani, J.P., & Belinello, R. 2012. Florística e fitossociologia em parcelas permanentes da Mata Atlântica do sudeste do Brasil ao longo de um gradiente altitudinal. *Biota Neotropica* 12(1):125-145.
- Kirk, P.M., Cannon, P.F., Minter, D.W. & Stalpers, J.A. 2008. *Dictionary of the Fungi*. 10th ed., CABI Publishing, Wallingford. 771p.
- Larsen, M.J. & Cobb-Poulsen, L.A. 1990. The genus *Phellinus* (Hymenochaetaceae): A survey of the world taxa, *Fungiflora*, Oslo. 206 pp.

- Leal, G.R. & Gugliotta, A.M. 2008. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. Fungos, 9: *Meripilaceae*. Hoehnea 35(1):99-110.
- Loguercio-Leite C. 1990. Revisão histórica sobre fungos poliporóides (Aphylophorales) xilófilos de Santa Catarina, Brasil. Insula 20:3-10.
- Loguercio-Leite, C. & Wright, J. E. 1998. *Diplomitoporus dilutabilis* a new species of Polyporaceae (Aphylophorales) from Santa Catarina Island, Brazil. Mycotaxon 68:47-51.
- Loguercio-Leite, C., Michels, J., Baltazar, J.M. 2008. New records of lignocellulolytic Basidiomycetes (Fungi): Parque Estadual da Serra do Tabuleiro (P.E.S.T.), Santa Catarina, Brazil. Biotemas 21(3):7-14.
- Louza, G.S.G. & Gugliotta, A.M. 2007. *Polyporus* Fr. (Polyporaceae) no Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. Hoehnea 34: 365-382.
- Lowe, J.L. 1963. A synopsis of *Poria* and similar fungi from the tropical regions of the world. Mycologia Volume: 453-486.
- Meijer, A.A.R. 2006. Preliminary list of the macromycetes from the Brazilian state of Paraná. Bol. Mus. Bot. Munic. 68:1-55.
- Miettinen, O. 2012. *Diplomitoporus dilutabilis* belongs to *Cinereomyces* (Polyporales, Basidiomycota). Mycotaxon 121:345-348.
- Prado, J., Marcelli, M.P., Gugliotta, A.M., Bicudo, C.E.M., Bicudo, D.C., Yano, O. & Peralta D.F. 2008. Criptógamas. In: Diretrizes para a Conservação e Restauração da Biodiversidade no Estado de São Paulo (R.R. Rodrigues & V.L.R. Bononi, orgs.). São Paulo: Instituto de Botânica. 110-121 pp.
- Rajchenberg, M. 1987. Type studies of *Polyporaceae* (Aphylophorales) described by J. Rick. Nordic J. Bot. 7:553-568.
- Rajchenberg, M. 2006. Los Políporos (Basidiomycetes) de los Bosques Andino Patagónicos de Argentina. Biblioteca Mycologica 201:1-300.
- Rajchenberg, M. & Wright, J.E. 1987. Type studies of *Corticaceae* and *Polyporaceae* (Aphylophorales) described by C. Spegazzini. Mycologia 79(2):246-264.
- Rajchenberg, M. & Meijer, A.A.R. 1990. New and noteworthy polypores from Paraná and São Paulo States, Brazil Mycotaxon 38:173-185.

- Rayner, A.D.M. 1995. Fungi, a vital component of ecosystem function in woodland. *In*: Allsopp, D., Colwell, R.R. & Hawksworth, D.L. (eds.). *Microbial Diversity and Ecosystem Function*. Cambridge, University Press. p. 231-251.
- Rick J. 1960. Basidiomycetes eubasidii in Rio Grande do Sul – Brasilia. 4. *Meruliaceae, Polyporaceae, Boletaceae*. *Iheringia* 7:193–295.
- Ryvarden, L. 1991. Genera of Polypores. Nomenclature and taxonomy. *Synopsis Fungorum* 5. Oslo, Fungiflora. 363p.
- Ryvarden, L. 2004. Neotropical Polypores. Part 1. Introduction, *Hymenochaetaceae* and *Ganodermataceae*. *Synopsis Fungorum*. 19:1-227.
- Ryvarden, L. 2007. Studies in Neotropical polypores 23. New and interesting wood-inhabiting fungi from Belize. *Synopsis Fungorum*. 23:32-50.
- Ryvarden, L. & Gilbertson, R.L. 1993. European polypores. Part 1. *Synopsis Fungorum*. 6:1-387.
- Ryvarden, L. & Gilbertson, R.L. 1994. European polypores. Part 2. *Synopsis Fungorum*. 7:394-743.
- Ryvarden, L. & Meijer, A.A.R. 2002. Studies in Neotropical polypores 14 – new species from the state of Parana, Brazil. *Synopsis Fungorum* 15:34–69.
- Silveira, R.M.B. & Guerrero, R.T. 1991. Aphyllophorales poliporóides (Basidiomycetes) do Parque Nacional de Aparados da Serra, Rio Grande do Sul. *Bol. Inst. Bioci. Univ. Fed. Rio Grande do Sul* 48:1-127.
- Soares, S.C.S. & Gugliotta, A.M. 1998. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Fungos*, 7: Aphyllophorales (*Hymenochaetaceae*). *Hohenea* 25:11-31.
- Sobestiansky, G. 2005. Contribution to a macromycete survey of the states of Rio Grande do Sul and Santa Catarina in Brazil. *Brazilian Archives of Biology and Technology* 48(3):437–457.
- Teixeira, A.R. 1995. Método para estudo das hifas do basidiocarpo de fungos poliporáceos. São Paulo, Instituto de Botânica. Manual n.6, 20p.
- Westphalen, M.C. & Silveira, R.M.B. 2012. Interesting resupinate species of *Rigidoporus* from Brazil. *Nova Hedwigia* 94(3–4):397-404.
- Westphalen, M.C., Reck, M.A. & Silveira, R.M.B. 2012. The genus *Junghuhnia* in Brazil. *Nova Hedwigia* 94:209-220.
- Xavier-Santos, S., Carvalho, C.C., Bonfá, M., Silva, R., Capelari, M. & Gomes, E. 2004. Screening for Pectinolytic Activity of Wood-Rotting Basidiomycetes and Characterization of the Enzymes. *Folia Microbiologica* 49(1):46–52.

CAPÍTULO 2

Fuscoporia atlantica
(Hymenochaetaceae,
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Rainforest

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***Fuscoporia atlantica* (Hymenochaetaceae, Basidiomycota) a new species from the Brazilian Atlantic Rainforest**

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ABSTRACT — During a survey of polypore fungi in Atlantic forest areas of the São Paulo state, Brazil, an interesting specimen belonging to the genus *Fuscoporia* was found. *Fuscoporia atlantica* is described and illustrated based in this specimen, and the inferred phylogenetic relationships are based on sequence data from the ribosomal ITS and nLSU regions. The new species is characterized by an effused-reflexed to pileate basidioma, golden-yellow-ferruginous pore surface, tiny pores, dimitic hyphal system with thin-walled hyphae at dissepiments edges encrusted, mostly uncinata or hooked hymenial setae and broadly ellipsoid to ellipsoid basidiospores. An identification key to the species of *Fuscoporia* recorded from Brazil is provided.

KEY WORDS — basidiomycetes, *Hymenochaetales*, Neotropics, phylogeny, taxonomy

Introduction

Traditionally the species of the genus *Fuscoporia* Murrill were included in *Phellinus* s.l., a morphologically heterogeneous (Fiasson & Niemelä 1984) and phylogenetically polyphyletic group (Dai 1999, Wagner & Fischer 2001, 2002b; Larsson et al. 2006). However, molecular phylogenetic analyses have shown that *Fuscoporia* species form an independent clade from *Phellinus* s.s. (Wagner & Fischer 2002b, Larsson et al. 2006).

The genus *Fuscoporia* was described to accommodate species occurring principally on coniferous and deciduoud trees, with resupinate to pileate basidiomes, occurring principally on coniferous and deciduous trees; monomitic to dimitic hyphal system; encrusted generative hyphae at the dissepiments (which is described as a distinctive feature within *Phellinus* s.l.), hymenial setae and cylindric to ellipsoid, hyaline, inamyloid, indextrinoid, thin-walled and smooth basidiospores (Murrill 1907, Fiasson & Niemelä 1984, Dai 1999, 2010; Niemelä et al. 2001, Wagner & Fischer

2001). According to Mycobank databases (Robert et al. 2005) about 50 species worldwide are currently accepted in the genus, out of which 13 have been reported from Brazil: *F. bifurcata* Baltazar et al., *F. callimorpha* (Lév.) Groposo et al., *F. contigua* (Pers.) G. Cunn., *F. chrysea* (Lév.) Baltazar & Gibertoni, *F. ferruginosa* (Schrad.) Murrill, *F. ferrea* (Pers.) G. Cunn., *F. flavomarginata* (Murrill) Groposo et al., *F. gilva* (Schwein) T. Wagner & M. Fisch., *F. palmicola* (Berk. & M.A. Curtis) Bondartseva & S. Herrera, *F. punctatiformis* (Murrill) Zmitr. et al., *F. rhabarbarina* (Berk.) Groposo et al., *F. senex* (Nees & Mont.) Ghob.-Nejh. and *F. wahlbergii* (Fr.) T. Wagner & M. Fisch., mostly occurring in the Atlantic Rainforest (Baltazar et al. 2009, Gibertoni et al. 2014).

During the study of wood-inhabiting fungi in Atlantic Rainforest areas of the São Paulo state, Brazil, an unknown species of *Fuscoporia* was found and it is described as new. The phylogenetic inference of its relationship based on ribosomal ITS and LSU sequence data demonstrated that it forms a monophyletic terminal clade, distinct from all the other *Fuscoporia* species for which DNA sequence data are available. The species is described here as *F. atlantica*.

Materials & methods

Morphological study

Specimens were collected in the Atlantic Rainforest areas in the São Paulo state, Brazil, between 2012 and 2013. Specimens were examined according to Gilbertson & Ryvarden (1986) and Núñez & Ryvarden (2001). Basidioma colors are described according to Küppers (2002). For microscopic analysis, free hand sections of the basidiomata were mounted on microscope slides with a drop of 3% KOH solution and 1% aqueous phloxine solution. Amyloid and dextrinoid reactions were observed in Melzer's reagent. Drawings of the microstructures were made with the aid of a camera lucida. Abbreviations and codes used for the measurements are: Dm = diameter means, $L \times W$ = length mean \times width mean, Q = range of length/width ratios, Qm = length/width mean, and $n = x/y$ (x = number of measurements of a given number (y) of specimens) (Coelho 2005). Thirty basidiospores from each specimen were measured. The specimens are deposited in the herbarium SP (Instituto de Botânica, São Paulo, Brazil). The key to species of *Fuscoporia* was updated from Groposo *et al.* 2007.

Sequencing

Total DNA was extracted from dried basidiomata. Extractions were carried out using the Sigma-Aldrich Gen Elute™ Plant Genomic DNA Miniprep Kit and later amplified with Sigma-Aldrich ReadMix™ Taq PCR P4600 (Sigma-Aldrich Corporation, St. Louis, MO, USA), following the manufacturer's recommendations. PCR reactions were performed in a thermal cycler (C1000

Touch™ Thermal Cycler Bio-Rad). Primers pairs used were ITS1 and ITS4 for the ITS region (including ITS1, 5.8S and ITS2) and LR0R and LR7 for nLSU ((White et al. 1990). The amplification cycles were carried out using the following parameters: 1 cycle at 94°C for 2 min; 5 cycles at 94°C for 45 s, 60°C for 50 s and 72°C for 1 min and 20 s where the annealing temperature decreases 1°C each cycle until it reaches 56°C under the touch-down technique (Korbie & Mattick 2008); 30 cycles at 95°C for 45 s, 55°C for 50 s, 72°C for 1 min and 20 s; and 72°C for 10 min. PCR products were checked on 2% agarose gel before sequencing. PCR products were sequenced in both directions using the same primers as the amplification. Nucleotide sequences were determined using an Applied Biosystems 3730xl DNA Analyser (Macrogen, Korea). Edited sequences have been deposited in GenBank (Tables 1 and 2).

Phylogenetic analyses

All sequences were matched against the entire GenBank database using BLAST (<http://blast.ncbi.nlm.nih.gov/>), and their pairwise identity was recorded. Sequences retrieved from GenBank (NCBI) included in the study were selected based on the quality, identity, length and alignment test to build the ingroup. The selected outgroup for ITS analyses were *Phellinidium fragrans*, *P. weirii* and *P. sulphurascens*, based in the results of the LSU region, that places *Phellinidium* as a sister group of *Fuscoporia* and for LSU analyses were *Bondarzewia montana*, *P. sulphurascens* and *S. hirsutum* based in previous works (Wagner & Fischer 2002b). Vouchers and sequences used in this study are provided in Table 1 and 2. The LSU dataset comprised sequences of species of *Hymenochaetaceae* in order to assess the relative position of the new taxon within the family. In addition, an ITS dataset was assembled to verify the placement of the new species with regards to closely related taxa present in GenBank. Nucleotide sequences were aligned automatically with MAFFT v.7 (<http://mafft.cbrc.jp/alignment/server/>), and then optimized manually with BioEdit 7.2.0 (Hall 1999). Best models of evolution were estimated by using JModeltest 2.c1.4 (Darriba et al. 2012). The substitution model used in the LSU dataset was TrN+I+G and for ITS dataset was TVM+G. Bayesian analysis was performed based on independent Markov chain Monte Carlo (MCMC). The run consisted of five million generations, two independent runs, and four independent chains. The sampling frequency was every 500 generations. The first ten percent of the analysis (burn-in phase) was discarded. Posterior probabilities (PP) were determined in MrBayes 3.2.2 (Ronquist et al. 2012) to test the support of the branches' nodes. PP values equal to or higher than 0.95 were considered statistically significant, hence, all branches supported below this value were disregarded. Maximum likelihood (ML) analysis was performed using RaxML 7.5.4-standard (Stamatakis 2006) with 1000 rapid bootstrap replicates. Trees from ML analysis were compared

with those resulting from the Bayesian analysis and bootstrap values (above 50%) were used to support the respective nodes compatible between two trees.

TABLE 1. ITS dataset of *Fuscoporia* spp. used in the phylogenetic analyses. Published sequences are found in Brazeo et al. (2012)^a, Cantrell et al. (2013)^b, Jang et al. (2012)^c, Jeong et al. (GenBank, unpublished)^d, Lim et al. (2005)^e, Lim et al. (2008)^f, Lim et al. (GenBank, unpublished)^g, Spirin et al. (GenBank, unpublished)^h, Tomsovsky & Jankovsky (2007)ⁱ, Vlasak et al. (GenBank, unpublished)^j and new sequences provided by this study^k.

Species	Voucher specimens	GenBank accession numbers
<i>Fuscoporia atlantica</i> sp. nov	SP445618 (Holotype)	KP058515 ^k
	SP465829 (Paratype)	KP058514 ^k
<i>F. callimorpha</i> (Lév.) Groposo et al.	JV090487 (Haplotype)	JF692190 ^j
	JV090487 (Haplotype)	JF692191 ^j
	JV040914J	JF692193 ^j
<i>F. contigua</i> (Pers.) G. Cunn.	JV1007/3 (Haplotype)	JQ794546 ^j
	JV0907/2 ^a	JQ794547 ^j
	JV0309/118 (Haplotype)	JQ794548 ^j
	JV0309/171	JQ794550 ^j
<i>F. ferrea</i> (Pers.) G. Cunn.	CBS 444.48	AY558617 ^d
	D4-3B-b	DQ516525 ^g
	DLL2009-080	JQ673178 ^a
	SP5108	KJ677120 ^h
<i>F. ferruginosa</i> (Schrad.) Murrill	JV0202/2	J794572 ^j
	JV8909/74 (Haplotype)	JQ794573 ^j
	JV1109/24	JQ794577 ^j
<i>F. gilva</i> (Schwein.) T. Wagner & M. Fisch.	KCTC 6653	AY558620 ^d
	xsd08128	FJ481039 ^c
	SACCR 11076	JX427049 ^b
	ASIS24343	KF692068
<i>F. rufitincta</i> (Berk. & M.A. Curtis ex Cooke) Murrill	PRM915961	GU594160
	JV0610/14PK	JQ794579 ^j
	(Haplotype)	
	JV0610/14PK	JQ794580
<i>F. senex</i> (Nees & Mont.) Ghob.-Nejh.	(Haplotype)	
	CBS 442.76	AY558647 ^d
	KUC20110922-13	JX463658 ^c
<i>F. torulosa</i> (Pers.) T. Wagner & M. Fisch.	Q32	KC414230 ^d
	Pt134	EF068139
	Pt6	EF068238 ^f
	Pt7	EF068239 ^f
<i>F. viticola</i> (Schwein.) Murrill	CBS 381.82	AY558653 ^d
		JQ358814
	JV0709/163	JQ794583 ^j

<i>Phellinidium sulphurascens</i> * (Pilát)	Type 10	EF527215 ^e
Y.C. Dai	Type 11	EF527216 ^e
<i>Phellinidium weirii</i> * (Murrill) Y.C. Dai	CFS504	AY829341 ^d
	CFS586	AY829342 ^d

* Outgroup designed

TABLE 2. LSU dataset of *Fuscoporia* used in the phylogenetic analyses. Published sequences are found in He & Dai (2012)^l, Dai & Cui (GenBank, unpublished)^m, Miller et al. (2001)ⁿ, Moncalvo et al. (2000)^o, Pilotti et al. (2005)^p, Wagner & Fischer (2001)^q, (2002a)^f, (2002b)^s, Wagner et al. (2002)^t and new sequences provided by this study^k.

Species	Voucher specimens	GenBank accession numbers
<i>Coltricia cinnamomea</i> (Jacq.) Murrill	2464 REG	AF311003 ^q
<i>Coltricia montagnei</i> (Fr.) Murrill	MF 96-96 REG	AY039683 ^r
<i>Coltricia perennis</i> (L. : Fr.) Murrill	MF 92-96 REG	AF311004 ^q
<i>Coltriciella baoshanensis</i> Y.C. Dai & B.K. Cui	Dai 13075 BJFC	KC857267 ^m
<i>Coltriciella dependens</i> (Berk. & M.A. Curtis) Murrill	LR 39016 O	AY059059 ^s
<i>Coltriciella oblectabilis</i> (Lloyd) Kotl. et al.	RC 11835 O	AY059061 ^s
<i>Fomitiporella umbrinella</i> (Bres.) Murrill	CBS 303.66	AY059036 ^s
<i>Fomitiporia mediterranea</i> M. Fisch	FMG3	AY621000 ^p
<i>Fomitiporia punctata</i> (P. Karst.) Murrill	MF 85-74 REG	AF311007 ^q
<i>Fomitiporia robusta</i> (P. Karst.) Fiasson & Niemelä	TW 242 REG	AF311008 ^q
<i>Fulvifomes fastuosus</i> (Lév.) Bondartseva & S. Herrera	CBS 213.36	AY059057 ^s
<i>Fulvifomes robiniae</i> (Murrill) Murrill	CBS 211.36	AY059038 ^s
<i>Fuscoporia atlantica</i> sp. nov.	SP465829 (Paratype) SP445618 (Holotype)	KP058516 ^k KP058517 ^k
<i>Fuscoporia contigua</i>	TW 699 REG	AF311029 ^q
<i>Fuscoporia ferrea</i>	MF 87-8 REG	AF311030 ^q
<i>Fuscoporia ferruginosa</i>	MF 82-930 REG	AF311032 ^q
<i>Fuscoporia gilva</i>	MF 91-42e REG	AY059025 ^s
<i>Fuscoporia wahlbergii</i> (Fr.) T. Wagner & M. Fisch.	MF 89-922	AF311045 ^q
<i>Hymenochaete cyclolamellata</i> T. Wagner & M. Fisch.	Cui 8548	JQ279630 ^l
<i>Hymenochaete innexa</i> G. Cunn.	He 555	JQ279674 ^l
<i>Hymenochaete tropica</i> S.H. He & Y.C. Dai	He 493	JQ279677 ^l
<i>Inocutis dryophila</i> (Berk.) Fiasson & Niemelä	MF 87-918 REG	AF311012 ^q
<i>Inocutis jamaicensis</i> (Murrill) A.M. Gottlieb et al.	Gilb. 14740 O	AY059048 ^s

<i>Inocutis tamaricis</i> (Pat.) Fiasson & Niemelä	MF 96-415 REG	AF311021 ^q
<i>Inonotus cuticularis</i> (Bull. : Fr.) P. Karst.	MF 97-97 REG	AF311010 ^q
<i>Inonotus hispidus</i> (Bull. : Fr.) P. Karst.	MF 92-829 REG	AF311014 ^q
<i>Inonotus linteus</i> (Berk. & M.A. Curtis) Teixeira	TAA 84-12 TAA	AY059018 ^s
<i>Inonotus obliquus</i> (Ach. ex Pers.:Fr.) Pilát	TW 705 REG	AF311017 ^q
<i>Inonotus tropicalis</i> (M.J. Larsen & Lombard) T. Wagner & M. Fisch	CBS 617.89	AY059037 ^s
<i>Inonotus vaninii</i> (Ljub.) T. Wagner & M. Fisch.	Dai 1980 REG	AY059056 ^s
<i>Mensularia crocitincta</i> (Berk & M.A. Curtis) T. Wagner & M. Fisch	LR 41826 O	AY059043 ^s
<i>Mensularia hastifera</i> (Pouzar) T. Wagner & M. Fisch.	MF 84-1023a REG	AF311013 ^q
<i>Mensularia radiata</i> (Sowerby) Lázaro ibiza	TW 704 REG	AF311018 ^q
<i>Onnia tomentosa</i> (Fr. : Fr.) P. Karst	TW 445 REG	AF311023 ^q
<i>Onnia triquetra</i> (Pers.) Imazeki	TW 411 REG	AF311024 ^q
<i>Phellinidium ferrugineofuscum</i> (P. Karst.) Fiasson & Niemelä	TN 6121 REG	AF311031 ^q
<i>Phellinidium fragrans</i> (M.J. Larsen & Lombard) M. Fisch	CBS 202.90	AY059027 ^s
<i>Phellinus arctostaphyli</i> (Long) Niemelä	MF 91-329a REG	AY059026 ^s
<i>Phellinus cinereus</i> (Niemelä) M. Fisch	MF 85-917 REG	AF311027 ^q
<i>Phellinus igniarius</i> (L. : Fr.) Qué!l	MF 83-1110a REG	AF311033 ^q
<i>Phellinus laevigatus</i> (Fr. Ex P. Karst.) Bourdot & Galzin	TN 3260 REG	AF311034 ^q
<i>Phellinus occidentalis</i> (Overh. ex Lombard et al.) Gilb.	CBS 169.55	AY059019 ^s
<i>Phellinus spiculosus</i> (W.A. Campb. & R.W. Davidson) Niemelä	CBS 345.63	AY059055 ^s
<i>Phylloporia chrysitata</i> (Berk.) Ryvarden	N.W. Legon O	AF411821 ^t
<i>Phylloporia pectinata</i> (Klotzsch) Ryvarden	R. Coveny 113 O	AF411823 ^t
<i>Phylloporia spathulata</i> (Hook.) Ryvarden	Chay 456 O	AF411822 ^t
<i>Bondarzewia montana</i> (Qué!l.) Singer	SARs.n. 25S	AF042646 ^o
<i>Russula violacea</i> Qué!l.		AF218559 ⁿ
<i>Stereum hirsutum</i> (Willd. : Fr.) Pers.	TW 235 REG	AF385165 ^s

* Outgroup designed

Results and discussion

Taxonomy

Fuscoporia atlantica Motato-Vásquez, Pires et Gugliotta, **sp. nov. ad int.** FIGS. 1–9

MYCOBANK MB 810911

Basidiomata annua, effuso-reflexum vel pileatum; poris rotundis, exiguis, 7–9 per mm; systema hypharum dimiticum, hyphae generatoriae simpliciter septatae, cum crystalli incrustatum in dissepimentum; hymenial setae abundare, uncinatus, 20–45 x 7–10 μm, basidiosporae late ellipsoideae vel ellipsoideae, hyalinae, 4–4.5 x (2–)3–3.5 μm, inamyloideae, indextrinoideae.

TYPES: BRAZIL. SÃO PAULO STATE: Parque Estadual da Cantareira (23°32'36"S, 46°37'59"W), June 27, 2012, V. Motato-Vásquez, M.C. Westphalen & A.C. Bolaños 230 (HOLOTYPE SP445618); Parque Estadual da Serra do Mar, Núcleo Santa Virginia, May 11, 2013, R.M. Pires 8 (PARATYPE SP465829).

ETYMOLOGY: *atlantica* – refers to the Brazilian Atlantic Rainforest biome, the only known habitat of this species.

BASIDIOMA annual, pileate, sessile to effuse-reflexed, flexible when fresh to leathery when dry, solitary to imbricate, without odor or taste. PILEUS broadly attached, semicircular, appanate, up to (5.0–)8.0–9.0 × 4.0–6.0 × 0.1–0.4 cm; upper surface concentrically zonate, radially wrinkled, glabrous to tomentose, brown (N₆₀A₉₀M₆₀) to yellowish-brown (N₂₀A₉₀M₅₀), with a matte dark brown crust (N₅₀A₉₉M₉₉) at the base. MARGIN thin, obtuse, entire, not involute when dry, sterile, up to 0.2 cm, yellowish-brown (N₂₀A₉₀M₅₀) to black brown (N₉₀M₉₉C₉₉). CONTEXT homogeneous, dense, azonate, golden-yellow-ferruginous (N₃₀A₉₉M₃₀). PORE SURFACE golden-yellow-ferruginous (N₃₀A₉₉M₃₀), pores rounded, invisible to the naked eye, 7–9 per mm, tubes concolor with the pore surface, up to 0.2 cm deep, dissepiments entire to slightly lacerated, thin to slightly thick. HYPHAL SYSTEM dimitic, generative hypha simple-septate, hyaline, golden yellow to rusty brown, thin to thick-walled, straight, sparsely branched, 3.0–6.5 μm diam., rarely branched, thin-walled hyphae at dissepiments edges encrusted; skeletal hyphae thick-walled, straight, unbranched, dark-brown, 3.0–6.0 μm. HYMENIAL SETAE abundant, subulate to ventricose, mostly uncinuate or hooked, dark brown and thick-walled, 20–45 × 7–10 μm. CYSTIDIOLES abundant. BASIDIA clavate, hyaline, 4-sterigmated, thin-walled, 9–11 × 5–7 μm. BASIDIOSPORES abundant, broadly ellipsoid to ellipsoid, abundant, hyaline to pale yellow, smooth, thin-walled, inamyloid, 4–4.5 × (2–)3–3.5 μm ($Xm = 4.2 \times 2.8 \mu m$), $n = 60/2$, $Q = (1.1–)1.3–2$, $Qm = 1.5$.

ECOLOGY AND DISTRIBUTION: growing on dead branches and trunks of angiosperms. So far, known exclusively from the Brazilian Atlantic Rainforest, São Paulo state.



FIGURES 1–4. *Fuscoporia atlantica* (HOLOTYPE SP445618): 1. Basidioma. 2. Margin after dry. 3. Crust in the upper surface. 4. Hymenial surface. Scale bars: Fig. 1 = 5 cm; Figs. 2–3 = 0.1 cm; Fig. 4 = 0.05 cm.

ADDITIONAL SPECIMENS EXAMINED — BRAZIL. SÃO PAULO STATE: Parque Estadual da Cantareira, October 21, 2011, V. Motato-Vásquez & A.M. Gugliotta 22 (SP417971) (*F. gilva*), 16-II-2012, M. Capelari & J.J.S. Oliveira 4683 (SP445350) (*F. gilva*), SANTA CATARINA STATE: 26-XII-1988, F. Furlani & C.L. Leite 186 (FLOR 10929) (*F. rhabarbarina*). CANADA. On wood, Dr. Richardson 4 (K187843) [Lectotype of *P. rhabarbarinus* (Berk.) G. Cunn.].

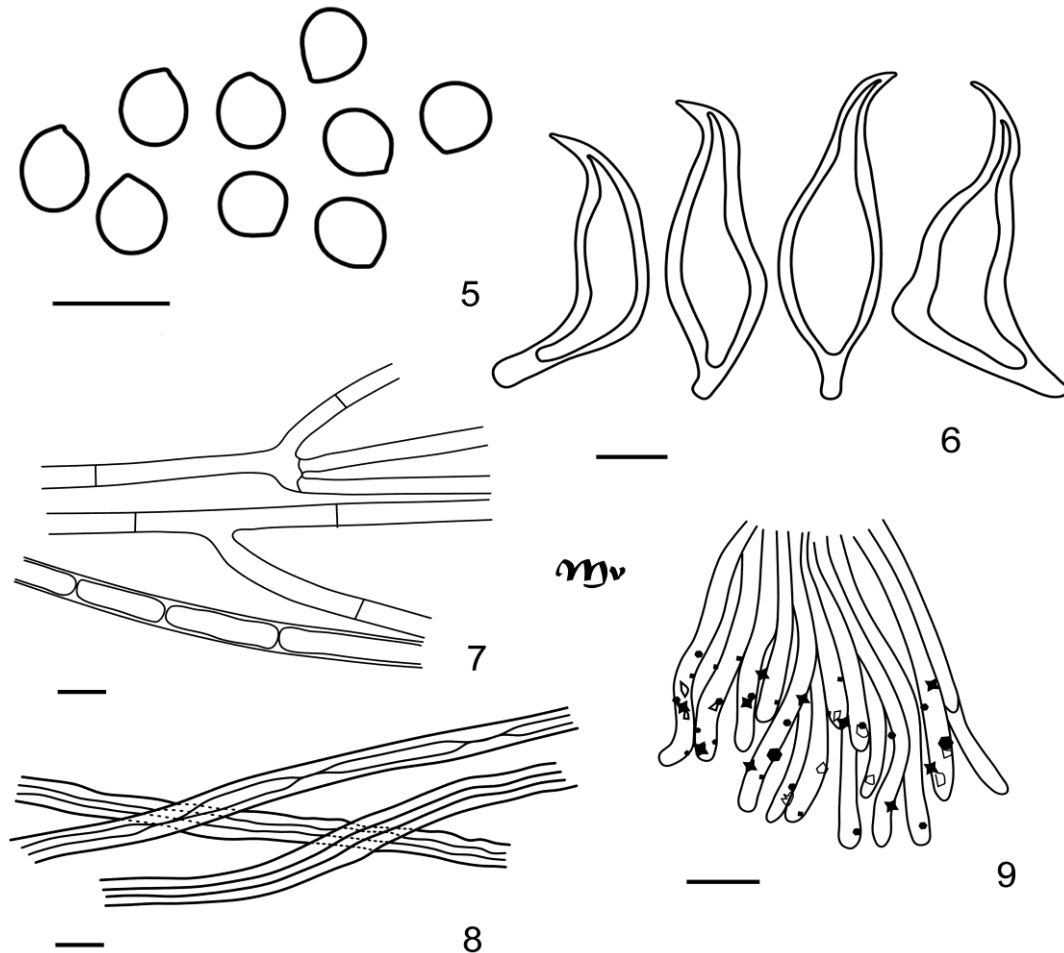
COMMENTS — *Fuscoporia atlantica* is a distinct species that produces effused-reflexed to pileate basidiomata, radially wrinkled and tomentose pileus, with a matte dark brown crust at the base, a yellowish-brown when fresh to black brown after dry margin, tiny pores, hooked hymenial setae and broadly ellipsoid to ellipsoid basidiospores. *Fuscoporia atlantica* is very similar to *F. gilva* sharing a similar macroscopic structure, although they can be easily distinguished at microscopical level by the hooked setae and larger basidiospores in the former. Furthermore, *F. atlantica* has a distinctive dark brown crust in the base of the pileus and a golden-yellow-ferruginous pore surface, while in *F. gilva* has a tomentose to glabrous pileus surface, without crust in the base of the pileus and dark purplish brown pore surface (Ryvarden & Johansen 1980, Loguercio-Leite & Wright

1995, Dai 1999). *Fuscoporia wahlbergii* is another effuse-reflexed to pileate species with hooked hymenial setae that occurs in Brazil. However, they can be easily distinguished macroscopically by the woody basidiomata, with a reddish-brown to umber upper surface, narrowly banded in concentric sulcate to flat zones, and a rusty to chestnut brown pore surface in *F. wahlbergii*. *Fuscoporia atlantica* is also morphologically similar to *F. rhabarbarina*, which can be easily distinguished macroscopically by a glabrous pileus, with sulcate zones and a distinctive black crust covering the entire pileus surface, yellowish brown context; and microscopically by the smaller basidiospores ($3-4 \times 2-3 \mu\text{m}$) and straight, ventricose hymenial setae (Groposo et al. 2007).

Key to species of *Fuscoporia* from Brazil

- 1a. Basidioma completely resupinate 2
- 1b. Basidioma effused-reflexed to pileate 5
- 2a. Tramal setae present, spores ellipsoid..... 3
- 2b. Tramal setae absent, spores cylindrical 4
- 3a. Pores 2–3 per mm, hymenial setae subulate *F. contigua*
- 3b. Pores 5–6 per mm, hymenial setae ventricose *F. ferruginosa*
- 4a. Basidioma dark reddish-brown, hymenial setae ($18.0-25.0-36.0 \times 5.0-8.0 \mu\text{m}$, basidiospores cylindrical, $4.0-7.0 \times 2.0-2.5(-3.0) \mu\text{m}$ *F. ferrea*
- 4b. Basidioma pale yellow to brown, hymenial setae ($10.0-10.5-14.5(-15.0) \times 5.0-7.5 \mu\text{m}$, basidiospores ellipsoid, $4.5-7.0 \times 2-2.5 \mu\text{m}$ *F. punctatiformis*
- 5a. Pileus with distinct black crust *F. rhabarbarina*
- 5b. Pileus without a black crust 6
- 6a. Hymenial setae bifurcate or spiny *F. bifurcata*
- 6b. Hymenial setae nor bifurcate neither spiny (all setae apically regular) 7
- 7a. Hymenial setae hooked to straight, both present 8
- 7b. Hymenial setae only straight 9
- 8a. Basidioma woody, upper surface without a crust, basidiospores subglobose, $4.0-5.0 \times 3.5-4.5 \mu\text{m}$ *F. wahlbergii*
- 8b. Leathery basidioma, upper surface with a dark brown crust, basidiospores ellipsoid to broadly ellipsoid, $4.0-4.5 \times (2.0-3.0-3.5) \mu\text{m}$ *F. atlantica*
- 9a. Pores 1–3 per mm *F. palmicola*
- 9b. Pores larger, above 4 per mm 10
- 10a. Pores 5–7 per mm 11
- 10b. Pores 8–11 per mm 13
- 11b. Context reddish-brown, basidiospores $2.0-2.5 \mu\text{m}$ wide *F. chrysea*
- 11b. Context yellowish brown, basidiospores $3.0-3.5 \mu\text{m}$ wide 12
- 12a. Basidiospores ellipsoid to ovoid, $4.0-5.0 \times 3.0-3.5 \mu\text{m}$, hymenial setae $20-30 \times 5-6 \mu\text{m}$ *F. gilva*

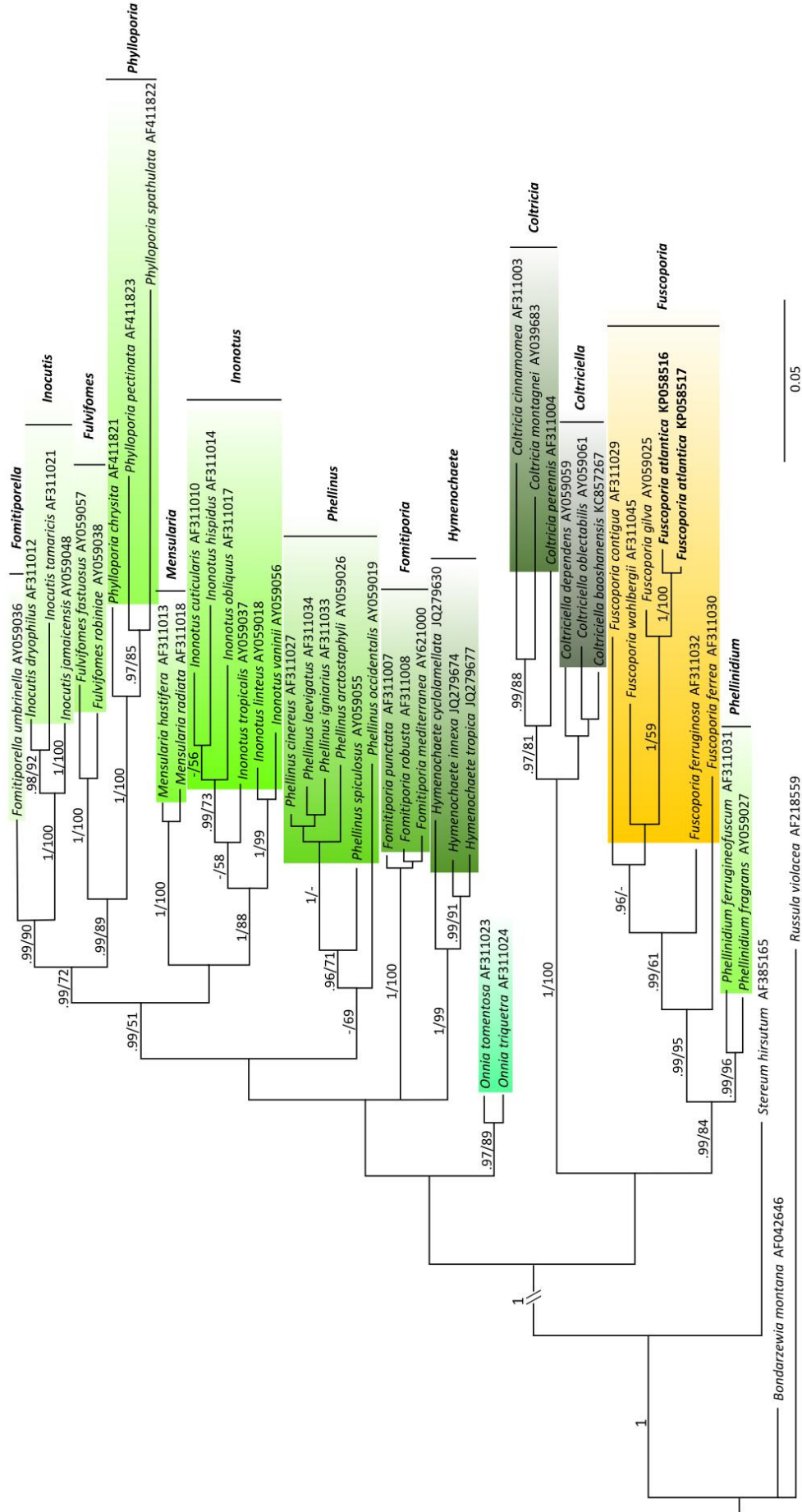
- 12b. Basidiospores ellipsoid, $3.0\text{--}4.5 \times 2.5\text{--}3.0 \mu\text{m}$, hymenial setae $15\text{--}30 \times 4.5\text{--}7.5 \mu\text{m}$.. *F. flavomarginata*
 13a. Basidiospores ellipsoid to subcylindrical, $3.5\text{--}4.5 \times 2\text{--}3 \mu\text{m}$ *F. callimorpha*
 13b. Basidiospores broadly ellipsoid, $4.5\text{--}6 \times 3.5\text{--}5 \mu\text{m}$ *F. senex*



FIGURES 5–9. *Fuscoporia atlantica* (from the holotype): 5. Basidiospores. 6. Hymenial setae. 7. Generative hyphae. 8. Skeletal hyphae. 9. Hyphal tips at dissepiments edges. Scale bar = $5 \mu\text{m}$.

Phylogenetic analyses

For LSU analyses, the final matrix consisted of 51 sequences and 838 characters, from which 534 were parsimony-informative (63.72%). Bayesian analysis resulted in average standard deviation of split frequencies = 0.003721. Results shown in the tree based on LSU sequences (Fig. 10) of different taxa of *Hymenochaetaceae* from GenBank, having *Bondarzewia montana*, *Russula violacea* and *Stereum hirsutum* as an outgroup, indicate that the new species presented in this study clustered within *Fuscoporia* genus, with full support.



0.05

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Literature cited

- Baltazar JM, Trierweiler-Pereira L, Loguercio-Leite C, Ryvarden L. 2009. Santa Catarina Island mangroves 3: a new species of *Fuscoporia*. *Mycologia* 101: 859–863. <http://dx.doi.org/10.3852/08-082>
- Brazee NJ, Lindner DL, Fraver D, D'Amato AW, Milo AM. 2012. Wood-inhabiting, polyporoid fungi in aspen-dominated forests managed for biomass in the U.S. Lake States. *Fungal Ecol* 5(5): 600–609. <http://dx.doi.org/10.1016/j.funeco.2012.03.002>
- Cantrell SA, Tkavc R, Gunde-Cimerman N, Zalar P, Acevedo M, Baez-Felix C. 2013. Fungal communities of young and mature hypersaline microbial mats. *Mycologia* 105: 827–836. <http://dx.doi.org/10.3852/12-288>
- Coelho G. 2005. A Brazilian new species of *Auriporia*. *Mycologia* 97(1): 263–267.
- Dai YC. 1999. *Phellinus* sensu lato (*Aphylllophorales*, *Hymenochaetaceae*) in East Asia. *Acta Bot. Fenn* 166: 1–115.
- Dai YC. 2010. *Hymenochaetaceae* (*Basidiomycota*) in China. *Fungal diversity* 45: 131–343. <http://dx.doi.org/10.1007/s13225-010-0066-9>
- Darriba D, Taboada GL, Doallo R, Posada D. 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nat. Methods* 9(8): 772–772. <http://dx.doi.org/10.1038/nmeth.2109>
- Fiasson JL, Niemelä T. 1984. The *Hymenochaetales*: a revision of the European poroid taxa. *Karstenia* 24: 14–28.
- Gibertoni TB, Gomes-Silva AC, Lira CRS, Soares AMS, Melo GSN, Araújo Neta L, Gugliotta AM, Medeiros PS, Silva VF, Chikowski RS, Silveira RMB, Drechsler-Santos ER. 2014. *Hymenochaetales* in Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Available in: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB92352> (Accessed 14 November 2014).
- Gilbertson RL, Ryvarden L. 1986. North American Polypores. Vol. 1: Oslo, Fungiflora.
- Groposo C, Loguercio-Leite C, Góes-Neto A. 2007. *Fuscoporia* Murrill (*Basidiomycota*, *Hymenochaetales*) in southern Brazil. *Mycotaxon* 101: 55–63.
- Hall TA. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symp. Ser.* 41: 95–98.

- He SH, Dai YC. 2012. Taxonomy and phylogeny of *Hymenochaete* and the allied genera of *Hymenochaetaceae* (Basidiomycota) in China. *Fungal Diver.* 56: 77–93. <http://dx.doi.org/10.1007/s13225-012-0174-9>
- Index Herbariorum
- Jang Y, Lee SW, Jang S, Lim YW, Lee JS, Kim JJ. 2012. Four unrecorded wood decay fungi from Seoul in Korea. *Mycobiology* 40: 195–201. <http://dx.doi.org/10.5941/MYCO.2012.40.3.195>
- Korbie DJ, Mattick JS. 2008. Touchdown PCR for increased specificity and sensitivity in PCR amplification. *Nature Protoc* 3: 1452–1456. <http://dx.doi.org/10.1038/nprot.2008.133>
- Küppers H. 2002. Atlas de los colores. Editorial Blume pp. 1–161.
- Larsson KH, Parmasto E, Fischer M, Langer E, Nakasone K, Redhead S. 2006. *Hymenochaetales*: a molecular phylogeny for the hymenochaetoid clade. *Mycologia* 98: 926–936.
- Lim YW, Yeung YCA, Sturrock R, Leal L, Breuil C. 2005. Differentiating the two closely related species, *Phellinus weirii* and *P. sulphurascens*. *For. Pathol.* 35: 305–314.
- Lim YW, Sturrock R, Leal L, Pellow K, Yamaguchi T, Breuil C. 2008. Distinguishing homokaryons and heterokaryons in *Phellinus sulphurascens* using pairing tests and ITS polymorphisms. *Antonie van Leeuwenhoek* 93: 99–110. <http://dx.doi.org/10.1007/s10482-007-9184-0>
- Loguercio-Leite C, Wright JE. 1995. The genus *Phellinus* (*Hymenochaetaceae*) on the Island of Santa Catarina, Brazil. *Mycotaxon* 54:361–388.
- Miller SL, McClean TM, Walker JF, Buyck B. 2001. A molecular phylogeny of the *Russulales* including agaricoid, gasteroid and pleurotoid taxa. *Mycologia* 93: 344–354.
- Moncalvo JM, Lutzoni FM, Rehner SA, Johnson J, Vilgalys R. 2000. Phylogenetic relationships of agaric fungi based on nuclear large subunit ribosomal DNA sequences *Syst. Biol.* 49: 278–305.
- Murrill WA. 1907. (*Agaricales*) *Polyporaceae* (pars). *N. Am. Fungi* 9: 1–131.
- Niemelä T, Wagner T, Fischer M, Dai YC. 2001. *Phellopilus* gen. nov. and its affinities within *Phellinus* s. lato and *Inonotus* s. lato (*Basidiomycetes*). *Ann. Bot. Fenn.* 38: 51–62.
- Núñez M, Ryvarden L. 2001. East Asian polypores vol II. *Synop. Fungorum* 14: 1–522.
- Pilotti M, Gervasi F, Brunetti A. 2005. Molecular identification of *Fomitiporia mediterranea* and *Eutypa lata*/*Libertella blepharis* in *Platanus x acerifolia*. *J Phytopathol* 153 (4): 193–202.
- Robert V, Stegehuis G, Stalpers J. 2005. The MycoBank engine and related databases. <http://www.mycobank.org> (Accessed 07 February 2014).
- Ronquist F, Teslenko M, van der Mark p, Ayres D, Darling A, Höhna S, LArget B, Liu L, Suchard MA, Huelsenbeck JP. 2012. MrBayes 3.3: efficient Bayesian phylogenetic inference and model

choice across a large model space. *Syst. Biol.* 61: 539–542.
<http://dx.doi.org/10.1093/sysbio/sys029>

- Ryvarden L, Johansen I. 1980. A preliminary polypore flora of East Africa. Oslo, Fungiflora.
- Stamatakis S. 2006. RaxML-VI-HPC: Maximum likelihood-based phylogenetic analysis with thousands of taxa and mixed models. *Bioinformatics* 22: 2688–2690.
- Tomšovský M, Jankovský L. 2007. DNA sequence analysis of extraordinary fruiting specimens of *Fuscoporia torulosa* (*Phellinus torulosus*) on *Pyrus* spp. *Czech Mycol.* 59(1): 91–99.
- Wagner T, Fischer M. 2001. Natural groups and revised system for the European poroid *Hymenochaetales* (*Basidiomycota*) supported by nLSU rDNA sequence data. *Mycol. Res.* 105: 773–782.
- Wagner T, Fischer M. 2002a. Classification and phylogenetic relationships of *Hymenochaete* and allied genera of the *Hymenochaetales*, inferred from rDNA sequence data and nuclear behaviour of vegetative mycelium. *Mycol. Progr.* 1: 93–104.
- Wagner T, Fischer M. 2002b. Proceedings toward a natural classification of the worldwide taxa *Phellinus* s.l. and *Inonotus* s.l., and phylogenetic relationships of allied genera. *Mycologia* 94: 998–1016.
- Wagner T, Fischer M, Ryvarden L. 2002. Phylogeny and taxonomy of the genus *Phylloporia* (*Hymenochaetales*). *Mycol. Progr.* 1: 105–116.
- White TJ, Bruns T, Lee S, Taylor J. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. 315–322, in MA Innis et al. (eds.), *PCR Protocols: a guide to methods and applications*. San Diego, Academic Press.

CAPÍTULO 3

Poroid
Hymenochaetaceae
(Basidiomycota) from
Parque Estadual da
Serra do Mar, Núcleo
Santa Virgínia, Brazil

Artigo redigido sob as normas da
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Poroid Hymenochaetaceae (Basidiomycota) from Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Brazil

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Hymenochaetaceae from Parque Estadual da Serra do Mar

Hymenochaetaceae poroides (Basidiomycota) do Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Brazil

Resumo: Esta pesquisa apresenta a primeira lista de espécies de fungos poroides da família Hymenochaetaceae do Parque Estadual da Serra do Mar, São Paulo, Brasil, onde 24 espécies são registradas pela primeira vez na localidade. *Fulvifomes melleoporus*, *Fuscoporia chrysea*, *F. rhabarbarina*, *Inonotus linteus*, *I. portoricensis*, *Phellinus grenadensis*, *P. roseocinereus* e *P. undulatus* são citados para o estado de São Paulo pela primeira vez, e *Fulvifomes glaucescens* é um novo registro para o Brasil. São apresentadas descrições, comentários sobre a morfologia e fotografias dos novos registros, além de uma chave de identificação para as 24 espécies encontradas no parque.

Palavras-chave: diversidade, fungos, Mata Atlântica, Políporos.

Poroid Hymenochaetaceae (Basidiomycota) from Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Brazil

Abstract: This survey presents the first poroid Hymenochaetaceae checklist from Parque Estadual da Serra do Mar, São Paulo state, Brazil, where 24 species are presented. *Fulvifomes melleoporus*, *Fuscoporia chrysea*, *F. rhabarbarina*, *Inonotus linteus*, *I. portoricensis*, *Phellinus grenadensis*, *P.* and *P. undulatus* are cited São Paulo state for the first time, and *Fulvifomes glaucescens* is a new record to Brazil. Full descriptions, comments on morphology, photos of the new records, and an identification key for the 24 confirmed species found in the park are presented.

Key words: Atlantic rainforest, diversity, fungi, polypores

Introduction

The family Hymenochaetaceae Imazeki & Toki (1954) is included into the order Hymenochaetales and 27 genera are currently accepted in the family, with 487 species (Kirk *et al.* 2008). All the species of this group live as saprophytes and/or parasites on a wide diversity of angiosperms and gymnosperms and they play a fundamental role by rotting wood and carbon cycling in the forest ecosystems, although they are understudied in most tropical regions (Ryvarden 1991).

This group is well defined by simple septa in the generative hyphae, xanthochroic reaction, the yellow to deep brown basidiomata, frequent occurrence of setae, and they cause white rot (Ryvarden 1991; Dai 2010). However, recent molecular studies have shown that many genera into the family are polyphyletic and new genera have been created to include the different species (Wagner & Fischer 2001; Wagner & Fischer 2002; Dai *et al.* 2008; He & Dai 2012; Vlasák *et al.* 2013). Traditional characters used before to separate the genera occur in parallel in different groups. Therefore, identifying these fungi is not an easy task. Combining the study of morphological and molecular characters is the better solution currently.

Brazilian Atlantic Forest is one of the most important tropical forests in the world, considered a hotspot of diversity, the flora and fauna may include 1–8% of the world's total species (da Silva & Casteleti 2003). Ribeiro *et al.* (2009) estimates a remaining coverage in a range of 11.4% to 16%, which demonstrates the extremely degraded state of the Atlantic rainforest, warning to urgent conservation and restoration actions.

According to Baltazar & Gibertoni (2009), the family Hymenochaetaceae in the Brazilian Atlantic Forest is represented for 103 species. The genus with the highest number of recorded species is *Phellinus* Quél. (42 species), followed by *Hymenochaete* Lév. (27 species). There are several studies on the diversity of fungi in the Brazilian Atlantic Forest (Góes–Neto *et al.* 2000; Groposo & Loguercio–Leite 2005; Drechsler–Santos *et al.* 2008, Westphalen *et al.* 2010, Motato–Vásquez & Gugliotta 2013, Westphalen & Silveira 2013, Motato–Vásquez *et al.* 2014) but this study presents

the first poroid Hymenochaetaceae checklist for Núcleo Santa Virgínia of the Parque Estadual da Serra do Mar, the largest Atlantic rainforest reserve in the São Paulo State. In this study, full descriptions, comments on morphology, photos of the new records, and an identification key for the 24 species found in the park are presented.

Material and methods

The Núcleo Santa Virgínia is one between the eight nuclei of Parque Estadual da Serra do Mar (PESM), the major estadual park of Atlantic rainforest from Brazil, occupying 315,000 ha in São Paulo state area. Situated in São Luiz do Paraitinga and Natividade da Serra county, the Núcleo Santa Virgínia, covers a total area of 17,000 ha and is located in the geographical coordinates 45°03' W and 23°24' – 23°17' S. Altitudinal range varies from 860 m to 1650 m, maximum temperatures 35°C, average of 21°C and a low of –3°C, its vegetation is characterized by Mountain Dense Ombrophilous Forest (Evergreen Forest from Plateau), with some small Altitude Fields sections (Steppe) and Cloud Forest (Forest of Serra do Mar Crest). Climatic aspects, the physical environment and vegetation can be found at Joly *et al.* (2012).

Samples were collected from April 2013 to April 2014, bimonthly. The sampling methods follow the recommendations of Fidalgo & Bononi (1984). Macro and microscopic characters basidiomata were analyzed to identify, following Fidalgo (1968), Ryvardeen (1991) and Teixeira (1995) and the microstructures were analyzed according to the recommendations of Teixeira (1995, 1962). The amyloid and dextrinoid reactions were tested with Melzer's reagent (Gilbertson & Ryvardeen 1986, Teixeira 1995). The basidiospores dimensions were obtained as Coelho (2005) proposed, by calculating the ratio $Q = L/W$ and average of Q (where L = length and W = width). All material collected are housed in the Herbaria SP.

Results and Discussion

The family is represented in the Núcleo Santa Virginia of the Parque Estadual da Serra do Mar by twenty five species, all new records to the park, eight represent new records for São Paulo State (*Fulvifomes melleoporus* (Murrill) Baltazar & Gibertoni, *Fuscoporia chrysea* (Lév.) Baltazar & Gibertoni, *F. rhabarbarina* (Berk.) Groposo, Log.-Leite & Góes-Neto, *Inonotus linteus* (Berk. & M.A. Curtis) Teixeira, *I. portoricensis* (Overh.) Baltazar & Gibertoni, *Phellinus grenadensis* (Murrill) Ryvardeen, *P. roseocinereus* (Murrill) D.A. Reid and *P. undulatus* (Murrill) Ryvardeen) and *Fulvifomes glaucescens* (Petch) Y.C. Dai, recorded for the first time for Brazil. Comments and illustrations (Fig. 1-3) of these taxa are provided, as well as descriptions for the new records for Brazil, examined material and an identification key to species present in PESM.

Key to species of poroid Hymenochaetaceae from Parque Estadual da Serra do Mar

- | | |
|--|---------------------------------|
| 1a. Basidioma completely resupinate | 2 |
| 1b. Basidioma effused–reflexed to pileate | 9 |
| 2a. Monomitic hyphal system | <i>Inonotus tropicalis</i> |
| 2b. Dimitic hyphal system | 3 |
| 3a. Hymenial setae absent..... | 4 |
| 3b. Hymenial setae present | 6 |
| 4a. Dextrinoid basidiospores | <i>Fomitiporia maxonii</i> |
| 4b. Basidiospores unchanging in Melzer’s reagent | 5 |
| 5a. Pores 4–6 per mm, pale golden yellow basidiospores | <i>Fulvifomes melleoporus</i> |
| 5b. Pores 6–8 per mm, rusty brown basidiospores | <i>Fomitiporella umbrinella</i> |
| 6a. Dextrinoid basidiospores | <i>Phellinus bambusarum</i> |
| 6b. Basidiospores unchanging in Melzer’s reagent | 7 |
| 7a. Hymenial setae hooked to straight | <i>Phellinus undulatus</i> |
| 7b. Hymenial setae only straight | 8 |

- 8a. Cylindrical basidiospores *Fuscoporia ferrea*
- 8b. Broadly ellipsoid to subglobose basidiospores *Fulvifomes glaucescens*
- 9a. Monomitic hyphal system 10
- 9b. Dimitic hyphal system, or at least dimitic in the trama 12
- 10a. Setal hyphae present..... *Inonotus portorisensis*
- 10b. Setal hyphae absent 11
- 11a. Pores 4–6 per mm *Inonotus iodinus*
- 11b. Pores 7–9 per mm *Inonotus tabacinus*
- 12a. Hymenial setae absent..... 13
- 12b. Hymenial setae present 17
- 13a. Dextrinoid basidiospores *Phellinus apiahynus*
- 13b. Basidiospores unchanging in Melzer’s reagent 14
- 14a. Basidiospores $3\text{--}3.5 \times 3 \mu\text{m}$ *Phylloporia pectinata*
- 14b. Basidiospores longer 15
- 15a. Pores 7–9 per mm *Fulvifomes nilgheriensis*
- 15b. Pores wider 16
- 16a. Basidiospores $4\text{--}6 \times 3\text{--}5 \mu\text{m}$, pores 4–7 per mm *Phellinus grenadensis*
- 16b. Basidiospores $5.5\text{--}7 \times 4\text{--}5 \mu\text{m}$, pores (3) 4–5 per mm *Phellinus rimosus*
- 17a. Hymenial setae hooked to straight 18
- 17b. Hymenial setae only straight 19
- 18a. Basidioma woody, upper surface without a crust, basidiospores subglobose, $4.0\text{--}5.0 \times 3.5\text{--}4.5 \mu\text{m}$ *Fuscoporia wahlbergii*
- 18b. Leathery basidioma, upper surface with a dark brown crust, basidiospores ellipsoid to broadly ellipsoid, $4.0\text{--}4.5 \times (2.0\text{--})3.0\text{--}3.5 \mu\text{m}$ *Fuscoporia atlantica*

19a. Pileus with distinct black crust	<i>Fuscoporia rhabarbarina</i>
19b. Pileus without a black crust	20
20a. Pores 5–7 per mm	21
20b. Pores 7–11 per mm	23
21b. Basidiospores 2.0–2.5 μm wide	<i>Fuscoporia chrysea</i>
21b. Basidiospores wider	22
22a. Basidiospores ellipsoid to ovoid, hyaline, 4.0–5.0 \times 3.0–3.5 μm	<i>Fuscoporia gilva</i>
22b. Basidiospores ellipsoid to subglobose, yellowish, 4.8–5.5 \times 3.9–4.6 μm	<i>Inonotus linteus</i>
23a. Pore surface cinnamon to deep umber brown	<i>Fuscoporia callimorpha</i>
23b. Pore surface yellow-fulvous, yellow to reddish brown	24
24a. Basidiospores broadly oval, 3.5–4 \times 2–3 μm	<i>Phellinus roseocinereus</i>
24b. Basidiospores broadly ellipsoid, 4.5–6 \times 3.5–5 μm	<i>Fuscoporia senex</i>

Fomitiporella umbrinella (Bres.) Murrill, North American Flora 9 (1): 13 (1907)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pau de Bala, 25.IV.2014, *R.M. Pires*, RP 276 (SP).

Fomitiporia maxonii Murrill, North American Flora 9 (1): 11 (1907)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga, 27.IV.2014, *R.M. Pires*, RP 327 (SP).

Fulvifomes glaucescens (Petch) Y.C. Dai, Fungal Diversity 45: 192 (2010) (Fig. 1d–g, Fig. 3a)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Poço do Pito, 26.IV.2014, *R.M. Pires*, RP 307 (SP).

BASIDIOMA: annual, resupinate, becoming woody hard upon drying. **PORE SURFACE:** greyish brown when fresh, dark brown when bruised, sometimes with a glaucous shade; pores circular to angular, 7–8 (9) per mm. **HYPHAL SYSTEM:** dimitic, generative hyphae with simple septa, up to

4 μm wide; skeletal hyphae yellowish to pale rusty brown, thick-walled with a narrow lumen, flexuous, unbranched, 2–5 μm in diam. STERILE ELEMENTS: Hymenial setae frequent, ventricose to subulate, straight, 14–24 \times 4.5–7 μm . BASIDIOSPORES: broadly ellipsoid to subglobose, yellowish, thick-walled, smooth, IKI–, 3.9–4.6 \times 3.1–3.7 μm , Q = 1.2–1.4, Qm = 1.2.

Remarks: The tiny pores in the resupinate basidiomata and the yellowish, thick-walled and medium size basidiospores can define this species. Although Nuñez & Ryvarde (2000) concern this is a somewhat confusing species and that the size of the setae is a variable characteristic. In Dai (2010) review for Chinese Hymenochaetaceae, he brought up some disagreements between authors concerning the validity of this species.

Fulvifomes melleoporus (Murrill) Baltazar & Gibertoni, Mycotaxon 111: 205 (2010) (Fig. 1a–c, Fig. 3b)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pau de Bala, 25.IV.2014, R.M. Pires, RP 280 (SP).

Remarks: *Fulvifomes melleoporus* has perennial and resupinate basidiome, with a golden brown to dark purplish brown pore surface. The lack of setae and small pale golden yellow basidiospores (4–4.6 \times 3.2–3.7 μm) are characteristic for recognizing this species. It is known in three Brazilian states: Mato Grosso do Sul, Bahia and Rio Grande do Norte (Gibertoni *et al.* 2015), and now in São Paulo.

Fulvifomes nilgheriensis (Mont.) Bondartseva & S.Herrera, Mikologiya i Fitopatologiya 26 (1): 13 (1992)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Poço do Pito, 7.VIII.2013, R.M. Pires *et al.*, RP 115 (SP).

Fuscoporia atlantica Motato–Vásquez, Pires & Gugliotta

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 17.IV.2013, R.M. Pires, RP 8 (SP).

Remarks: This is a new species found in studied area and was described in detail by Pires *et al.* (2015). The species is characterized by an effused-reflexed to pileate basidioma, golden-yellow-ferruginous pore surface, tiny pores, mostly uncinatae or hooked hymenial setae and broadly ellipsoid to ellipsoid basidiospores

Fuscoporia callimorpha (Lév.) Groposo, Log.–Leite & Góes–Neto, Mycotaxon 101: 57 (2007)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga (na sub-trilha do olho d'água), 29.X.2013, R.M. Pires *et al.*, RP 135 (SP).

Fuscoporia chrysea (Lév.) Baltazar & Gibertoni, Mycotaxon 111: 206 (2010) (Fig. 11–o, Fig. 3c)

Materials examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga, 13.VI.2013, R.M. Pires *et al.*, RP 83 (SP); 27.IV.2014, R.M. Pires, RP 330 (SP).

Additional material examined: PERNAMBUCO: São Vicente Férrer, Mata do Estado (Sirijí), J.M. Baltazar *et al.*, 1164 (URM).

Remarks: This species is characterized macroscopically by its effused reflexed basidioma, with small and imbricate pilei and microscopically by the hymenial setae common (24–30 x 6–8 µm) and the broadly ellipsoid and hyaline basidiospores (3.5–4.1 x 2–2.5 µm). The concept of this species is not well established, Ryvarden (2004) suggests that the original descriptions is only an early stage of development of basidioma, and a bigger pileus could be formed in later stages. *Fuscoporia gilva* is quite similar, differing by surface color and pore size (brown and 6–8 per mm in *F. gilva* and yellow and 5–6 per mm in *F. chrysea*). This collection represents the first record to São Paulo State and to Southern Brazil; hitherto, this species had only been recorded in Pernambuco, northeast Brazil (Gibertoni *et al.* 2015).

Fuscoporia ferrea (Pers.) G. Cunn., Bulletin of the New Zealand Department of Industrial Research 73: 7 (1948)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga, 18.XII.2013, *R.M. Pires et al.*, RP 194 (SP).

Fuscoporia gilva (Schwein.) T. Wagner & M. Fisch., *Mycologia* 94 (6): 1013 (2002)

Materials examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 17.IV.2013, *R.M. Pires et al.*, RP 17 (SP), RP 21 (SP); Trilha do Corcovado, 11.VI.2013, *R.M. Pires et al.*, RP 54 (SP); Trilha do Poço do Pito, 7.VIII.2013, *R.M. Pires et al.*, RP 104 (SP), RP 108 (SP); 30.X.2013, *R.M. Pires et al.*, RP 149 (SP), RP 151 (SP); Trilha do Pirapitinga, 31.X.2013, *R.M. Pires et al.*, RP 168 (SP); 10.II.2014, *R.M. Pires et al.*, RP 220 (SP); 27.IV.2014, *R.M. Pires*, RP 323 (SP).

Fuscoporia rhabarbarina (Berk.) Groposo, Log.–Leite & Góes–Neto, *Mycotaxon* 101: 61 (2007) (Fig. 1h–k, Fig. 3d)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Poço do Pito, 7.VIII.2013, *R.M. Pires et al.*, RP 100 (SP).

Remarks: *Fuscoporia rhabarbarina* is a pileate, wood and perennial species, with dimitic hyphal system and hymenial setae 20–30 x 4–5 µm. It is characterized by the glabrous black pilei surface and ellipsoid and hyaline small basidiospores (3.5–4 x 2–3 µm). Known in Rio Grande do Sul and Santa Catarina Brazilian states (Gibertoni *et al.* 2015), it is now the first record to São Paulo state.

Fuscoporia senex (Nees & Mont.) Ghobad–Nejhad, *Mycotaxon* 101: 208 (2007)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Poço do Pito, 26.IV.2014, *R.M. Pires*, RP 314 (SP).

Fuscoporia wahlbergii (Fr.) T. Wagner & M. Fisch., *Mycological Research* 105 (7): 780 (2001)

Materials examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 18.IV.2013, *R.M. Pires et al.*, RP 36 (SP); Trilha do Garcês, 12.II.2014, *R.M. Pires et al.*, RP 259 (SP).

Inonotus iodinus (Mont.) G. Cunn., Bulletin of the New Zealand Department of Industrial Research 78: 4 (1948)

Materials examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Corcovado, 11.VI.2013, *R.M. Pires*, RP 49 (SP), RP 53 (SP); Trilha do Poço do Pito, 7.VIII.2013, *R.M. Pires et al.*, RP 112 (SP); Trilha do Garcês, 12.II.2014, *R.M. Pires et al.*, RP 244 (SP).

Inonotus linteus (Berk. & M.A. Curtis) Teixeira, Revista Brasileira de Botânica 15 (2): 126 (1992) (Fig. 2k–m, Fig. 3e)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Poço do Pito, 30.X.2013, *R.M. Pires et al.*, RP 157 (SP).

Remarks: *Inonotus linteus* is a species complex characterized by pileate basidiomata, a heterogeneous hyphal system with a monomitic context and a dimitic hymenophoral trama, hymenial setae and broadly ellipsoid to subglobose, yellowish and thick-walled basidiospores (Tian *et al.* 2013). This collection has rare hymenial setae, pore size 5–6 per mm, basidiospores 4.8–6.2 x 4–4.9 μm . The basidiospores in our material are bigger than the Tian *et al.* (2013) descriptions [4.8–5.5(–5.7) \times (3.8–)3.9–4.6(–4.8) μm], but the name was accepted, since it can be a normal variation within the species. For more accurate discussion, molecular data are needed. It is the first report to São Paulo state, but it is well-known in northeast Brazil (Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí and Sergipe states), and southern Brazil (Paraná and Santa Catarina states) (Gibertoni *et al.* 2015).

Inonotus portoricensis (Overh.) Baltazar & Gibertoni, Mycotaxon 111: 206 (2010) (Fig. 2a–c, Fig. 3f)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 17.IV.2013, *R.M. Pires et al.*, RP 23 (SP).

Additional material examined: PERNAMBUCO: Recife, Parque Estadual de Dois Irmãos, Trilha atrás do casarão, *J.M. Baltazar et al.*, 500 (URM). ALAGOAS: Pilar, RPPN–Fazenda S. Pedro, *T.B. Gibertoni*, s.n. (URM).

Remarks: The species is characterized by its pileate sessile, applanate to effused reflexed basidiome with a more or less persistent velvety brown tomentum separated from the context by a distinct dark line (Ryvarden 2004). Besides, it presents setal hyphae (70–240 x 8–15 µm) and broadly ellipsoid to ellipsoid and slightly thick-walled basidiospores (4.8–5.5 x 3.6–4.2 µm and $Q_m=1.3$), at first pale yellow, becoming pale rusty brown with age (Larsen & Cobb–Pouille 1990). It has been reported to Tropical and sub-tropical America; in Brazil, it is known in Alagoas, Bahia, Pernambuco and Rio Grande do Sul State (Gibertoni *et al.* 2015). This present collection represents the first record to São Paulo.

Inonotus tabacinus (Mont.) G.Cunn., Bulletin of the New Zealand Department of Industrial Research 78: 3 (1948)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 17 IV 2013, *R.M. Pires et al.*, RP 5 (SP).

Inonotus tropicalis (M.J. Larsen & Lombard) T. Wagner & M. Fisch., Mycologia 94 (6): 1009 (2002)

Materials examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Ipiranga, 12.VI.2013, *R.M. Pires et al.*, RP 73 (SP); Trilha do Pirapitinga, 31.X.2013, *R.M. Pires et al.*, RP 176 (SP).

Additional material examined: RIO GRANDE DO SUL: São Leopoldo, 1904, Rick 14 (S F15659 Holotype), Rick 423 (S F15660 Paratype).

Phellinus apiahynus (Speg.) Rajchenb. & J.E. Wright, Mycologia 79 (2): 251 (1987)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Garcês, 12.II.2014, *R.M. Pires et al.*, RP 253 (SP).

Phellinus bambusarum (Rick) M.J. Larsen, The genus *Phellinus* (Hymenochaetaceae): A survey of the world taxa: 40 (1990)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Corcovado, 11.VI.2013, *R.M. Pires et al.*, RP 50 (SP).

Phellinus grenadensis (Murrill) Ryvar den, Norwegian Journal of Botany 19: 234 (1972) (Fig. 2n–p, Fig. 3g)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga, 11.II.2014, *R.M. Pires et al.*, RP 240 (SP).

Remarks: It is the first citation for São Paulo State, but known in other seven Brazilian States (Alagoas, Bahia, Pernambuco, Rio Grande do Norte, Rio de Janeiro, Paraná and Santa Catarina) (Gibertoni *et al.* 2015). *Phellinus grenadensis* presents perennial and pileate basidiomata, at first reddish brown, tomentose, then becoming crustose, dark brown to dull (Larsen & Cobb–Pouille 1990). Tubes distinctly stratified separated by context layers. Dimitic hyphal system and hymenial setae absent. Ellipsoid, golden yellow to rusty brown basidiospores (4–6. x 3–5 µm).

Phellinus rimosus (Berk.) Pilát, Annales Mycologici 38 (1): 80 (1940)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Corcovado, 11.VI.2013, *R.M. Pires et al.*, RP 68 (SP).

Phellinus roseocinereus (Murrill) D.A. Reid, Memoirs of The New York Botanical Garden 28 (1): 194 (1976) (Fig. 2h–j, Fig. 3h)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Garcês, 12.II.2014, *R.M. Pires et al.*, RP 258 (SP).

Remarks: the species presents a pileate, sessile, woody, convex to unguulate basidiomata, yellow to reddish brown pore surface (6–10 per mm) and broadly oval and hyaline basidiospores (3.5–4 x 2–3 µm). Larsen & Cobb–Pouille (1990) described the presence of hymenial setae 20–30 x 4–5 µm, in

the present collection the setae are smaller (15–20 x 4–7 µm). Once reported to Pernambuco State, is now cited to São Paulo State (Gibertoni *et al.* 2015).

Phellinus undulatus (Murrill) Ryvardeen, Norwegian Journal of Botany 19: 235 (1972) (Fig. 2d–g, Fig. 3i)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pau de Bala, 25.IV.2014, R.M. Pires, RP 283 (SP).

Remarks: The species is known from tropical and sub-tropical areas (Ryvardeen 2004), and was reported to Alagoas, Pará and Santa Catarina Brazilian states (Gibertoni *et al.* 2015), this collection of *P. undulatus* is the first citation to São Paulo State, It is characterized by its resupinate basidiome, golden–brown margin and greyish brown pore surface. Microscopically, the hooked hymenial setae (19–25 x 8–12 µm) are diagnostic, although some straight setae may occur. The basidiospores are broadly ellipsoid and hyaline (4.1–4.6 x 3.2–3.6 µm).

Phylloporia pectinata (Klotzsch) Ryvardeen, Synopsis Fungorum 5: 196 (1991)

Material examined: BRASIL. SÃO PAULO: São Luiz do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, Trilha do Pirapitinga, 8.VIII.2013, R.M. Pires *et al.*, RP 121 (SP).

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References

- Baltazar, J.M. & Gibertoni, T.B. 2009. A checklist of the aphylloroid fungi (Basidiomycota) recorded from the Atlantic Rain Forest. Mycotaxon 109: 439–442.
- Coelho G. 2005. Brazilian new species of *Auriporia*. Mycologia 97: 266-270.

- da Silva, J.M.C. & Casteleti, C.H.M. 2003. Status of the biodiversity of the Atlantic Forest of Brazil. *In*: Galindo-Leal, C. & Câmara, I. G. (Eds.) *The Atlantic Forest of South America: Biodiversity Status, Threats, and Outlook*. CABS and Island Press, Washington, pp. 43–59.
- Dai, Y.C. 2010. Hymenochaetaceae (Basidiomycota) in China. *Fungal Diversity* 45: 131–343.
- Dai, Y.C.; Cui, B.K. & Decock, C. 2008. A new species of *Fomitiporia* (Hymenochaetaceae, Basidiomycota) from China based on morphological and molecular characters. *Mycological Research* 112: 375–380.
- Drechsler-Santos, E.R.; Groposo, C. & Loguercio-Leite, C. 2008. New records of lignocellulolytic fungi (Basidiomycetes) from the Atlantic Rain Forest in the State of Santa Catarina, Brazil. *Hoehnea* 35(1): 57–61.
- Fidalgo, O. 1968. As microestruturas e sua importância na sistemática dos fungos superiores. *Rickia* 3: 117–159.
- Fidalgo, O. & Bononi, V.L.R., coords. 1984. Técnicas de coleta, preservação e herborização de material botânico. São Paulo, Instituto de Botânica. 62p. (Manual n.4).
- Gibertoni, T.B.; Gomes-Silva, A.C.; Chikowski, R.S.; Lira, C.R.S.; Soares, A.M.S.; Melo, G.S.N.; Araújo Neta, L.; Gugliotta, A.M.; Medeiros, P.S.; Silva, V.F.; Silveira, R.M.B.; Drechsler-Santos, E.R.; Montoya, C.A.S. Hymenochaetales in Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Disponível em: <<http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB92375>>. Acesso em: 03 Fev. 2015
- Gilbertson, R.L. & Ryvarden, L. 1986. North American Polypores. Oslo, *Fungiflora*. v.1, p.1–433.
- Góes-Neto, A.; Loguercio-Leite, C.; Guerrero, R.T. 2000. Taxonomy and qualitative ecological aspects of poroid Hymenochaetales in a Brazilian seasonal tropical forest. *Mycotaxon* 76: 197–211.
- Groposo, C. & Loguercio-Leite, C. 2005. Contribution to the lignocellulolytic fungi (Basidiomycetes) of the Atlantic Rain Forest in Southern Brazil. *Mycotaxon* 92: 103–106.

- He, S.H. & Dai, Y.C. 2012. Taxonomy and phylogeny of *Hymenochaete* and allied genera of Hymenochaetaceae (Basidiomycota) in China. *Fungal Diversity* 56: 77–93.
- Joly, C.A.; Assis, M.A.; Bernacci, L.C.; Tamashiro, J.Y.; Campos, M.C.R. de; Gomes, J.A.M.A.; Lacerda, M.S.; Santos, F.A.M. dos; Pedroni, F.; Pereira, L.S.; Padgurschi, M.C.G.; Prata, E.M.B.; Ramos, E.; Torres, R.B.; Rochelle, A.; Martins, F.R.; Alves, L.F.; Vieira, S.A.; Martinelli, L.A.; Camargo, P.B. de; Aidar, M.P.M.; Eisenlohr, P.V.; Simões, E.; Villani, J.P.; & Belinello, R. 2012. Florística e fitossociologia em parcelas permanentes da Mata Atlântica do sudeste do Brasil ao longo de um gradiente altitudinal. *Biota Neotropica* 12(1): 125–145.
- Kirk, P.; Cannon, P.F.; Minter, D.W. & Stalpers, J.A. 2008. *Ainsworth & Bisby's Dictionary of the Fungi*. 10th edn. CAB International, Wallingford, UK.
- Larsen, M.J. & Cobb–Pouille, L.A. 1990. The genus *Phellinus* (Hymenochaetaceae): A survey of the world taxa, 206 p.
- Motato-Vásquez, V. & Gugliotta, A.M. 2013. Polypores from an Atlantic rainforest area in southeast Brazil: resupinate species. *Brazilian Journal of Botany* 36 (3), 211-221.
- Motato-Vásquez, V., Pires, R.M. & Gugliotta, A.M. 2014. Polypores from an Atlantic rainforest area in southeast Brazil: pileate species. *Brazilian Journal of Botany* 37 (3), 1-16.
- Núñez, M.; Ryvardeen, L. 2000. East Asian polypores. *Synopsis Fungorum*. 13:1–168.
- Ribeiro, M.C.; Metzger, J.P.; Martensen, A.C.; Ponzoni, F.J. & Hirota, M.M. 2009. The Brazilian Atlantic forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation* 142(6): 1141–1153.
- Ryvardeen, L. 1991. Genera of polypores, nomenclature and taxonomy. *Synopsis Fungorum* 5:1–373.
- Ryvardeen, L. 2004. Neotropical Polypores. Part 1. Introduction, Ganodermataceae & Hymenochaetaceae. *Synopsis Fungorum* 19. Oslo, Fungiflora. 227p.

- Pires, R.M., Motato-Vásquez, V. & Gugliotta, A.M. 2015 *Fuscoporia atlantica* (Hymenochaetales, Basidiomycota) a new species from the Brazilian Atlantic Rainforest. *Mycotaxon in press*.
- Teixeira, A.R. 1995. Método para estudo das hifas do basidiocarpo de fungos poliporáceos. São Paulo, Instituto de Botânica. 20p. (Manual n.6).
- Teixeira, A.R. 1962. As microestruturas do basidiocarpo e sistemática do gênero *Fomes* (Fries) Kickx. *Rickia* 1:13–93.
- Tian, X.M.; Yu, H.Y.; Zhou, L.W.; Decock, C.; Vlasák, J. & Dai, Y.C. 2013. Phylogeny and taxonomy of the *Inonotus linteus* complex. *Fungal Diversity* 58: 159–169.
- Vlasák, J.; Li, H.J.; Zhou, L.W. & Dai, Y.C. 2013. A further study on *Inonotus linteus* complex (Hymenochaetales, Basidiomycota) in tropical America. *Phytotaxa* 124 (1): 25–36.
- Wagner, T. & Fischer, M. 2001. Natural groups and a revised system for the European poroid Hymenochaetales (Basidiomycota) supported by nLSU rDNA sequence data. *Mycological Research* 105: 773–782.
- Wagner, T. & Fischer, M. 2002. Proceedings towards a natural classification of the worldwide taxa *Phellinus* s. l. and *Inonotus* s. l., and phylogenetic relationships of allied genera. *Mycologia* 94(6): 998–1016.
- Westphalen, M.C., Reck, M.A. & Silveira, R.M.B. 2010. Polypores from Morro Santana, Rio Grande do Sul, Brazil. *Hoehnea* [online] 37(3): 647-662.
- Westphalen, M.C. & SILVEIRA, R.M.B. 2013. Pileate polypores from Araucaria Forests in Southern Brazil. *Hoehnea* [online] 40(1): 77-86.

Legendas

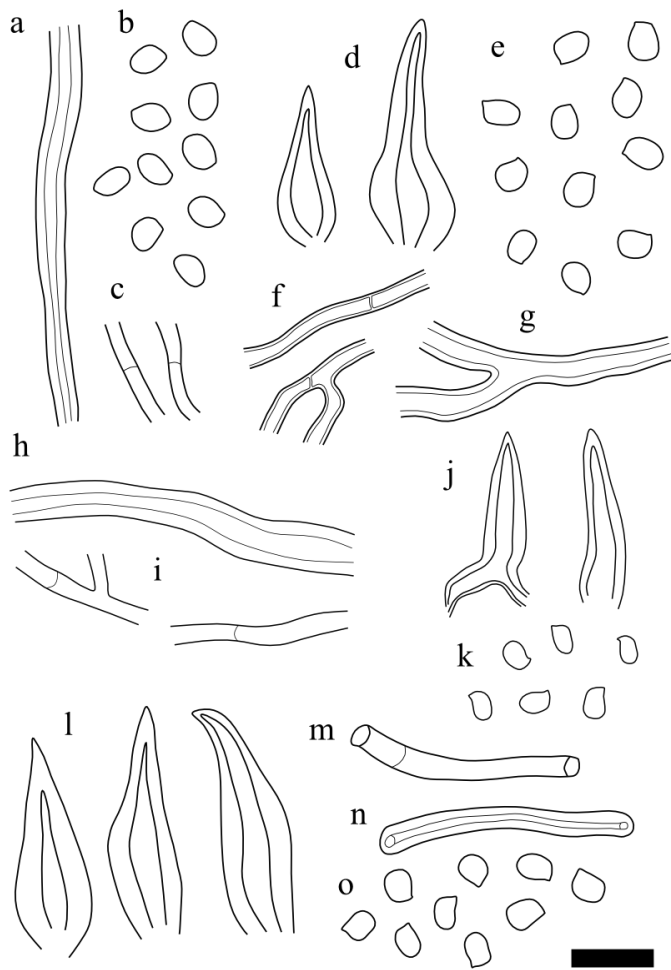


Figure 1 – a–c. *Fulvifomes melleoporus* – a. Skeletal hyphae; b. Basidiospores; c. Generative hyphae. d–g. *Fulvifomes glaucescens* – d. Hymenial setae; e. Basidiospores; f. Generative hyphae; g. Skeletal hyphae. h–k. *Fuscoporia rhabarbarina* – h. Skeletal hyphae; i. Generative hyphae; j. Hymenial setae; k. Basidiospores. l–o. *Fuscoporia chrysea* – l. Hymenial setae; m. Generative hyphae; n. Skeletal hyphae; o. Basidiospores. Scale Bar = 10 μm .

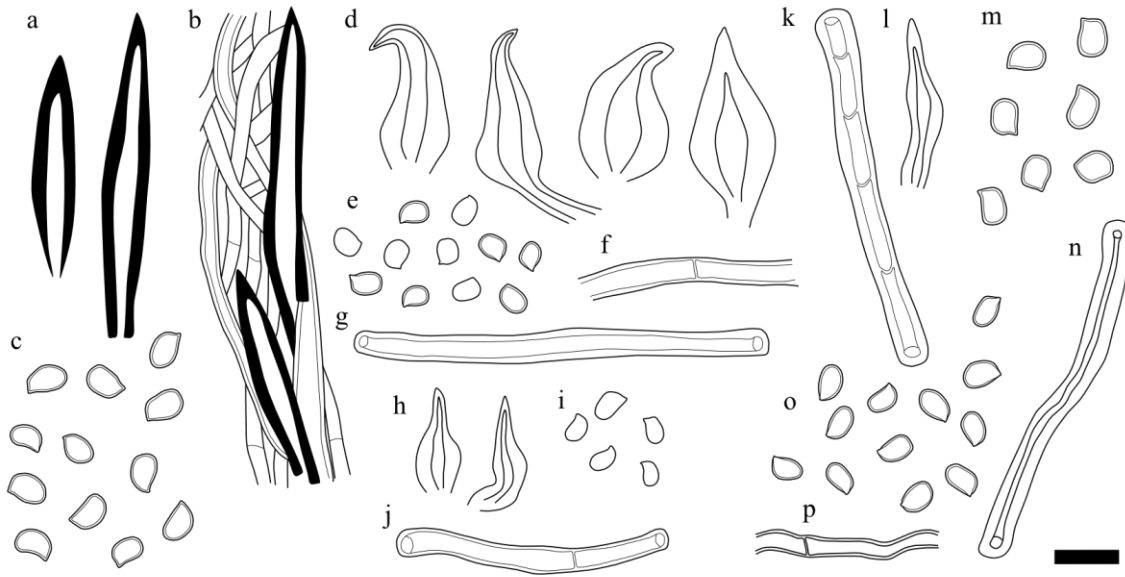


Figure 2 – a–c. *Inonotus portoricensis* – a. Setal hyphae; b. Trama; c. Basidiospores. d–g. *Phellinus undulatus* – d. Hymenial setae; e. Basidiospores; f. Generative hyphae; g. Skeletal hyphae. h–j. *Phellinus roseocinereus* – h. Hymenial setae; i. Basidiospores; j. Generative hyphae. k–m. *Inonotus linteus* – k. Skeletal hyphae; l. Hymenial setae; m. Basidiospores. n–p. *Phellinus grenadensis* – n. Skeletal hyphae; o. Basidiospores; p. Generative hyphae. Scale Bar (a–b) = 20 μm . Scale Bar (c–p) = 10 μm .



Figure 3 – a. *Fulvifomes glaucescens*. b. *Fulvifomes melleoporus*. c. *Fuscoporia chrysea*. d. *Fuscoporia rhabarbarina*. e. *Inonotus linteus*. f. *Inonotus portoricensis*. g. *Phellinus grenadensis*. h. *Phellinus roseocinereus*. i. *Phellinus undulatus*. Scale Bar = 1 cm.

CAPÍTULO 4

A new species of
Laetiporus
(Basidiomycota) and
occurrence of *L.*
gilbertsonii Burds. in
Brazil

Artigo redigido sob as normas
da revista Nova Hedwigia

A new species of *Laetiporus* (Basidiomycota) and occurrence of *L. gilbertsonii* Burds. in Brazil

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Abstract

Laetiporus squalidus is described as a new species; it is distinguished by effused-reflexed basidioma with numerous small and broadly attached pilei, upper surface cream to pale brown when fresh to light ochraceous after dry and ellipsoid to broadly ellipsoid basidiospores. Phylogenetic analysis with ITS and nLSU regions corroborate the position and identity of this species. Furthermore, *L. gilbertsonii*, a Pan-American species, is recorded for first time from Brazil, based on ITS region and a more accurate analysis of morphological characteristics.

Key words – mycodiversity, neotropical, polypores, xylophilous fungi

Introduction

Species of the genus *Laetiporus* Murrill are cosmopolitan poliporoid basidiomycetes that cause brown cubical rot in living hardwoods and conifers, as well are considered a destructive pathogen of trees (Corner 1984, Rajchenberg 1994). According to Mycobank databases (Robert et al. 2005), 18 species are currently accepted in the genus. The species are characterized by a variable shape of the fruiting body, annual, sessile to stipitate, soft and fleshy, simple septate and inflated generative hyphae and hyaline basidiospores, (Ryvarden & Johansen 1980, Corner 1984). Currently, two species of the genus *Laetiporus* has been recorded from Brazil: *L. persicinus* (Berk. & M.A. Curtis) Gilb. from Amapá, Pará, Paraná, Pernambuco, Santa Catarina and São Paulo states and *L. sulphureus* (Bull.:Fr.) Murrill from Bahia, Paraná, Pernambuco, Rio Grande do Sul, Santa Catarina and São Paulo states (Gugliotta et al. 2015).

Laetiporus sulphureus has been treated as a species complex that varies on its morphological features as basidiomes and basidiospores, its hosts-specificity on dead or living wood of gymnosperms or angiosperms and recently, molecular studies have confirmed eight well-supported clusters within *L. sulphureus* complex (Burdson & Banik 2001, Lindner & Banik 2008, Ota & Hattori 2003). Vasaitis *et al.* (2009) characterized the genetic variation and molecular relationships of *L. sulphureus* s. l. from Europe, South America, Africa and Asia. The results indicate that each resolved cluster represents a distinct taxon within *L. sulphureus* complex. Specimens from Uruguay were used like representatives from South America. The analysis showed that these specimens from Uruguay clustered strongly with the taxon currently known in North America as *L. sulphureus* (cluster E) and other ten specimens, all collected exclusively from eucalypts, grouped into a well-supported cluster with *L. gilbertsonii* Burds. (cluster F.). Surprisingly, a second taxon (cluster C) included 49 individuals of *Laetiporus* with a host range and distribution exclusively from Europe did not group with any of the *Laetiporus* species defined from North America by Lindner & Banik (2008). This discovery calls into doubt the propriety to use the European name *L. sulphureus* for the taxon occurring in North America. Further morphological studies of macro- and microscopic traits and a more details knowledge of host range and distribution of both taxon occurring in America (cluster F) and Europe (cluster C) is necessary before a definition of *L. sulphureus* s.s. can be established.

During recent surveys in Brazilian Atlantic rainforest, an interesting species of *Laetiporus* was found and here is described as new, and *Laetiporus gilbertsonii* is recorded for the first time from Brazil.

Material and Methods

Morphological analysis

Specimens were collected in areas of Atlantic rainforest in São Paulo state, between 2013 and 2014, dried and deposited at the herbarium SP (Instituto de Botânica, São Paulo, Brazil). Sections of the basidioma were studied macroscopically and described according to color, texture, size, hymenial surface, etc., and for microscopic analyses thin sections of the basidioma were mounted on microscope slides prepared with 5% KOH solution and for hyaline structures, was added 1% aqueous phloxine solution for the analysis of basidiospores, hyphal system and sterile elements. Amyloid or dextrinoid reactions were tested in Melzer's reagent (Teixeira 1995). Drawings of the microstructures were made with the aid of a camera lucida. Abbreviations and codes used for the measurements are: Dm = diameter means, $L \times W$ = length mean \times width mean, Q = range of length/width ratios, Qm = length/width mean, and $n = x/y$ (x = number of measurements of a given number (y) of specimens) (Coelho 2005).

DNA sequencing and phylogenetic analysis

DNA was extracted from fruiting bodies using Sigma-Aldrich Gen Elute™ Plant Genomic DNA Miniprep Kit. ITS region was amplified with primers ITS1 and ITS4 and nLSU region was amplified with primers LR0R and LR7 (White et al. 1990) with Sigma-Aldrich ReadMix™ Taq PCR P4600 kit (Sigma-Aldrich Corporation, St. Louis, MO, USA). The amplification cycles for ITS region were carried out using the following parameters: 1 cycle at 95°C for 2 min, 5 cycles at 95°C for 30 s, 60°C for 45 s and 72°C for 45 s where the annealing temperature decreases 1°C each cycle until it reaches 55°C under the touch-down technique (Korbie & Mattick 2008); 30 cycles at 95°C for 45 s, 55°C for 45 s, 72°C for 45 s and 72°C for 10 min. For nLSU region, the following parameters were carried out: 1 cycle at 94°C for 2 min, 5 cycles at 94°C for 45 s, 54°C for 50 s and 72°C for 1 min and 20 s where the annealing temperature decreases 1°C each cycle until it reaches 50°C under the touch-down technique (Korbie & Mattick 2008); 30 cycles at 95°C for 45 s, 50°C for 50 s, 72°C for 80 s and 72°C for 10 min. Nucleotide sequences were determined using an Applied Biosystems 3730xl DNA Analyser at the DNA Synthesis and Sequencing Facility (Macrogen, Korea), using the same primers as the amplification. Edited sequences have been deposited in GenBank.

Forward and reverse sequencing were compared and merged in Sequencher (v. 4.1.1). Sequences were aligned with MAFFT v.7 (<http://mafft.cbrc.jp/alignment/server/>), and then optimized manually with Geneious v. 8.1 (<http://www.geneious.com>, Kearse et al. 2012). Analyses with nLSU region allowed determine the position of the new species within the genus. For this analysis, eight close related genera were selected based on the recent work for the group, as well as the out-group (Binder et al. 2013, Lindner & Banik 2008) and sequences were retrieved from GenBank (NCBI) (Table 1). ITS dataset was assembled to verify the placement of the new species with regards to closely related taxa present in GenBank, to this were selected sequences of *L. sulphureus* complex and other *Laetiporus* species from GenBank (NCBI) (Table 2). As outgroup, the sister group based on the nLSU tree, *Phaeolus schweinitzii* (Fr.) Pat. was selected. Besides of the new *Laetiporus* species also were included sequences of *L. sulphureus* complex from Brazilian Atlantic rainforest.

Table 1. nLSU dataset of *Laetiporus* related genera used in the phylogenetic analyses. Published sequences are found in Wang et al. (2004)^a, Lindner & Banik (2008)^b, Tomsovsky & Jankovsky (2008)^c, Tomsovsky et al. (2010)^c, Ortiz-Santana et al. (2013)^d, Langer (GenBank, unpublished)^f and new sequences provided by this study^g.

Species	Voucher specimens	GenBank accession numbers
<i>Amyloporia carbonica</i> (Overh.) Vampola & Pouzar	Zabel-40-GLN	KC585065 ^d
<i>A. sordida</i> (Ryvarden & Gilb.) Vampola & Pouzar	L-3393-R	KC585075 ^d
<i>A. xantha</i> (Fr.) Bondartsev & Singer ex Bondartsev	ME-50	KC585086 ^d
<i>Antrodia malicola</i> (Berk & M.A. Curtis) Donk	L-15013-Sp	KC585113 ^d
<i>A. serialis</i> (Fr.) Donk	L-8012-Sp	KC585132 ^d
<i>A. variiformis</i> (Peck) Donk	L-3379-R	KC585137 ^d
<i>L. gilbertsonii</i> var. <i>pallidus</i> Burds	FP 150268	EU402529 ^b
<i>L. montanus</i> Cerny ex Tomsovsky & Jankovsky	BRNM 706688	EU884419 ^c
<i>L. persicinus</i> (Berk. & M.A. Curtis) Gilb.	HHB 9564	EU402513 ^b
<i>L. squalidus</i> Pires, Motato-Vásquez & Gugliotta	RP 232	KP765242 ^g
<i>L. sulphureus</i> (Bull.) Murrill	FH-Yang 2468	AY218414 ^a
<i>L. sulphureus</i>	BRNM 706696	EU884420 ^c
<i>Laricifomes officinalis</i> (Batsch) Kotl. & Pouzar	OKM-8050	KC585184 ^d
<i>P. schweinitzii</i> (Fr.) Pat.	FP-133218-Sp	KC585198 ^d
<i>P. schweinitzii</i>	OKM-4435-T	KC585199 ^d
<i>Sparassis brevipes</i> Krombh.	MBUH-ILKKA96-1044/ss24	AY218403 ^a
<i>S. crispa</i> (Wulfen) Fr.	RB9/6/87/ss23	AY218402 ^a
<i>S. radicata</i> Weir	TENN50232/ss32	AY218410 ^a
<i>Ceriporiopsis rivulosa</i> (Berk & M.A. Curtis) Gilb. & Ryvarden*	KCTC 6892	FJ496710 ^e
<i>Cinereomyces lindbladii</i> (Berk.) Jülich*	GEL4653	AJ406499 ^f

* Outgroup designed

Four phylogenetic analyses were performed. Bayesian analysis (BA) was performed in MrBayes 3.2.2 (Ronquist et al. 2012) based on independent Markov Chain Monte Carlo (MCMC). The run consisted of five million generations, two independent runs, and four independent chains. The

sampling frequency was every 500 generations. The first ten percent of the analysis (burn-in phase) was discarded. Posterior probabilities (PP) were determined to test the support of branches' nodes. PP values equal to or higher than 0.95 were considered statistically significant, hence, all branches supported below this value were disregarded. Best model of evolution used in BA were estimated by using JModeltest 2.c1.4 (Darriba et al. 2012), for nLSU tree, TrN+I+G and for ITS tree, SYM+I+G model. Maximum likelihood (ML), Maximum parsimony (MP) and Neighbor-Joining (NJ) analysis were performed using MEGA6 (Tamura et al. 2013). ML analysis was performed with 1000 rapid bootstrap replicates and best model of evolution estimated was Kimura 2-parameter for nLSU and ITS trees (Kimura 1980). The MP tree was obtained using the Subtree-Pruning-Regrafting (SPR) algorithm (Nei & Kumar 2000) with search level 1 in which the initial trees were obtained by the random addition of sequences (10 replicates). The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) is showed next to the branches (Felsenstein 1985). The analysis involved 20 nucleotide sequences and all positions containing gaps and missing data were eliminated. For NJ, the evolutionary distances were computed using the Maximum Composite Likelihood method (Tamura et al. 2004) and are in the units of the number of base substitutions per site. Analysis of MP and NJ involved 20 nucleotide sequences and positions containing gaps and missing data were eliminated, as well as the percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) are showed next to the branches. Trees from ML, MP and NJ analysis were compared with those resulting from the BA. Bootstrap values (above 50%) were used to support the respective nodes compatible between four trees.

Table 2. ITS dataset of *Laetiporus* spp. used in the phylogenetic analyses. Published sequences are found in Davoli et al. (2005)^b, Guglielmo et al. (2007)^g, Lindner & Banik (2008)^c, Ota & Hattori (2008)^d, Ota et al. (2009)^f, Vasaitis et al. (2009)^a, Lindner et al. (2012)^h, Park et al. (2012)ⁱ, Gonthier et al. (2014)^j, Song et al. (2014)^e and new sequences provided by this study^k.

Species	Voucher specimens	GenBank accession numbers
<i>L. ailaoshanensis</i> B.K. Cui & J. Song	HKAS 52508	KF951287 ^e
<i>L. ailaoshanensis</i>	Yuan 3302	KF951286 ^e
<i>L. caribensis</i> Banik & D.L. Lindner	PR6317	JN684770 ^h
<i>L. caribensis</i>	CFMR PR-6583 (Holotype)	NR119999 ^h
<i>L. cincinnatus</i> (Morgan) Burds., Banik & T.J. Volk	46-1104	EU402560 ^c
<i>L. cincinnatus</i>	WS-1	EU402559 ^c
<i>L. cincinnatus</i>	FP-101671-T	AM269786 ^g
<i>L. conifericola</i> Burds. & Banik	NV-2	EU402578 ^c
<i>L. conifericola</i>	CA-8	EU402575 ^c
<i>L. cremeiporus</i> Y. Ota & T. Hatt.	Dai 10107	KF951281 ^e
<i>L. cremeiporus</i>	Cui 10991	KF951279 ^e
<i>L. gilbertsonii</i> Burds	RP 234	KP765240 ^k

Species	Voucher specimens	GenBank accession numbers
<i>L. gilbertsonii</i>	SP307821	KP765241 ^k
<i>L. gilbertsonii</i>	RP 233	KP765239 ^k
<i>L. gilbertsonii</i>	RP 152	KP765237 ^k
<i>L. gilbertsonii</i>	CA-13	EU402549 ^c
<i>L. gilbertsonii</i> var. <i>pallidus</i> Burds	TJV2000-101	EU402553 ^c
<i>L. huroniensis</i> Burds. & Banik	HMC-1	EU402569 ^c
<i>L. huroniensis</i>	HMC-1-3	AB472641 ^f
<i>L. huroniensis</i>	MI-7-1	AB472642 ^f
<i>L. montanus</i> Cerný ex Tomsovský & Jankovský	Cui 1710	KF951275 ^e
<i>L. montanus</i>	Dai 11203	KF951276 ^e
<i>L. montanus</i>	Cui 10015	KF951273 ^e
<i>L. persicinus</i> (Berk. & M.A. Curtis) Gilb.	HHB9564	EU402579 ^c
<i>L. persicinus</i>	HHB9668	EU402580 ^c
<i>L. persicinus</i>	RLG14725	EU402581 ^c
<i>L. persicinus</i>	RLG14739	EU402582 ^c
<i>L. persicinus</i>	CBS 274.92	JQ686188 ⁱ
<i>Laetiporus</i> sp.	OLRIM117	EU840574 ^a
<i>Laetiporus</i> sp.	OLRIM1036	EU840609 ^a
<i>Laetiporus</i> sp.	6730	EU840681 ^a
<i>Laetiporus</i> sp.	L17-LI	EU840553 ^a
<i>Laetiporus</i> sp.	OLRIM1038	EU840666 ^a
<i>Laetiporus</i> sp.	KATRIN-2	EU840606 ^a
<i>Laetiporus</i> sp.	RVP4	EU840599 ^a
<i>Laetiporus</i> sp.	4628-1A	EU840653 ^a
<i>Laetiporus</i> sp.	11072A	EU840652 ^a
<i>Laetiporus</i> sp.	KR010710-07	EU840642 ^a
<i>Laetiporus</i> sp.	RV4A	EU840662 ^a
<i>Laetiporus</i> sp.	RV5A	EU840663 ^a
<i>Laetiporus</i> sp.	5032	EU840668 ^a
<i>Laetiporus</i> sp.	5067	EU840670 ^a
<i>Laetiporus</i> sp.	6677	EU840674 ^a
<i>Laetiporus</i> sp.	EUC-1	EU402545 ^c
<i>Laetiporus</i> sp.	KOA-1	EU402546 ^c
<i>Laetiporus</i> sp.	GDL-1	EU402547 ^c
<i>L. squalidus</i>	RP 232	KP765238 ^k
<i>L. sulphureus</i> (Bull.) Murrill	02089	AY835668 ^b
<i>L. sulphureus</i>	79110	AY835667 ^b
<i>L. sulphureus</i>	ERT-713	EU402564 ^c
<i>L. sulphureus</i>	CT-1	EU402565 ^c
<i>L. sulphureus</i> var. <i>miniatus</i> (Jungh.) Overeem	L43-4	AB308179 ^d
<i>L. sulphureus</i> var. <i>miniatus</i>	L42-9	AB308178 ^d
<i>L. sulphureus</i> var. <i>miniatus</i>	L66	AB308192 ^d
<i>L. versisporus</i> (Lloyd) Imazeki	WD2073	AB308161 ^d
<i>L. versisporus</i>	Dai 7268	KF951267 ^e
<i>L. zonatus</i> B.K. Cui & J. Song	HKAS 54701	KF951285 ^e
<i>L. zonatus</i>	Cui 10403	KF951282 ^e

Species	Voucher specimens	GenBank accession numbers
<i>P. schweinitzii</i> (Fr.) Pat.*	PhaoCi	KF996526 ^j
<i>P. schweinitzii</i> *	PG4	KF996525 ^j
<i>P. schweinitzii</i> *	TM2.1	KF996527 ^j

* Outgroup designed

Results

Key to the Brazilian species of *Laetiporus*

- 1 Basidioma usually some shade of brown to dark brown 2
- 1' Basidioma bright colored, usually orange, pink, or yellow 3
- 2 Basidioma effused-reflexed, cream to pale brown upper surface, basidiospores ellipsoid to broadly ellipsoid, (5.0–)6.5–7.0 × 4.0–5.0 µm *L. squalidus*
- 2' Basidioma sessile to stipitate, brown to dark brown upper surface, basidiospores broadly ovoid, 6.5–8.0 × 4.0–5.0 µm *L. persicinus*
- 3 Basidioma yellow to pale orange, pores 5–7 per mm, basidiospores 5.0–5.5 × 4.0–5.0 µm *L. gilbertsonii*
- 3' Basidioma salmon orange, pores 2–4 per mm, basidiospores slightly narrower 5.5–7.0 × (3.5–)4.0–5.0 µm *L. sulphureus*

Taxonomy

Laetiporus squalidus Pires, Motato-Vásquez et Gugliotta, **sp. nov.**

Figs 1–4; 7–8

MycoBank MB 811581

Laetiporus sulphureus (Bull.:Fr.) Murrill affinis, sed ab ea basidiosporis majoribus et poris minoribus.

Type: BRAZIL. SÃO PAULO: Parque Estadual da Serra do Mar, Núcleo Santa Virginia, Feb 11, 2014, R.M. Pires 232 (Holotype SP466047).

Etymology: *squalidus* – refers to its macromorphology and pale coloration basidioma.

Basidioma annual, effused-reflexed forming numerous narrow pileus at the margins, thin, soft when fresh to hard when dry. Pileus broadly attached, up to $2.0\text{--}2.5 \times 1.0\text{--}2.0 \times 0.4\text{--}1.0$ cm, upper surface glabrous, azonate, slightly rugose, cream (N₀₀ M₁₀ C₀₀) to pale brown (N₆₀ A₉₉ M₆₀) when fresh to light ochraceous (N₀₀ A₇₀ M₄₀) after dry. Margin undefined. Context homogeneous, azonate, up to 0.6 cm thick, concolorous with the pileus. Pore surface cream when fresh to brown (N₆₀A₉₀M₆₀) when dry, pores rounded, decurrent, 3–5 per mm, tubes concolorous with the pore surface, up to 0.2 cm deep, dissepiments entire, thin to slightly thick.

Hyphal system dimitic, tubes trama composed of generative hyphae simple-septate, hyaline, smooth and thin to thick-walled, frequently branched, $4.0\text{--}7.0$ μm wide, and skeletal hyphae hyaline, straight, thick-walled, $4\text{--}6$ μm wide. The context composed of generative hyphae simple-septate, unbranched and inflated, $(10.0\text{--})11.0\text{--}21.0\text{--}(25.0)$ μm wide, binding hyphae richly branched, hyaline, thick-walled, $(4.0\text{--})5.5\text{--}7.0$ μm wide. Basidia clavate, hyaline, 4-sterigmate, thin-walled, $16.0\text{--}20.5 \times 8.0\text{--}10.0$ μm . Basidiospores abundant, ellipsoid to broadly ellipsoid, hyaline, smooth, slightly thick-walled, usually with one or two oil drops, inamyloid, undextrinoid, $(5.0\text{--})6.5\text{--}7.0 \times 4.0\text{--}5.0$ μm ($X_m = 5.8 \times 4.4$ μm), $n = 30/1$, $Q = (1.1\text{--})1.2\text{--}1.5$, $Q_m = 1.3$.

Ecology and distribution: growing on dead decaying wood. So far, known exclusively from the Brazilian Atlantic rainforest, São Paulo state.

Comments — *Laetiporus squalidus* is a distinct species that produces effused-reflexed basidioma with numerous small and broadly attached pileus, upper surface cream to pale brown when fresh to light ochraceous after dry and ellipsoid to broadly ellipsoid basidiospores. *Laetiporus squalidus* is very similar to *L. sulphureus* complex, sharing the same hyphal system and basidiospores shape, but these can be easily distinguished by the presence of effused-reflexed basidioma that form narrow pileus at the margins in the former and the pileate to laterally stipitate basidioma in the latter; besides that, the spores are slightly narrower in *L. sulphureus* [$5.5\text{--}6.5 \times (3.5\text{--})4.0\text{--}5.0$ μm] (Burdson & Banik 2001). *Laetiporus gilbertsonii* is another species of the genus that can be differentiated macroscopically by the pileate to stipitate or with broad stipe attachment basidioma, the slightly smaller pores (5–7 per mm) and the yellowish-brown to pale orange surface and microscopically by the inflated binding hyphae in the context and the broadly ovoid basidiospores ($5.0\text{--}5.5 \times 4.0\text{--}5.0$ μm).

Laetiporus gilbertsonii Burds, Harvard Papers in Botany 6:48 (2001)

Figs 5–6; 9–10

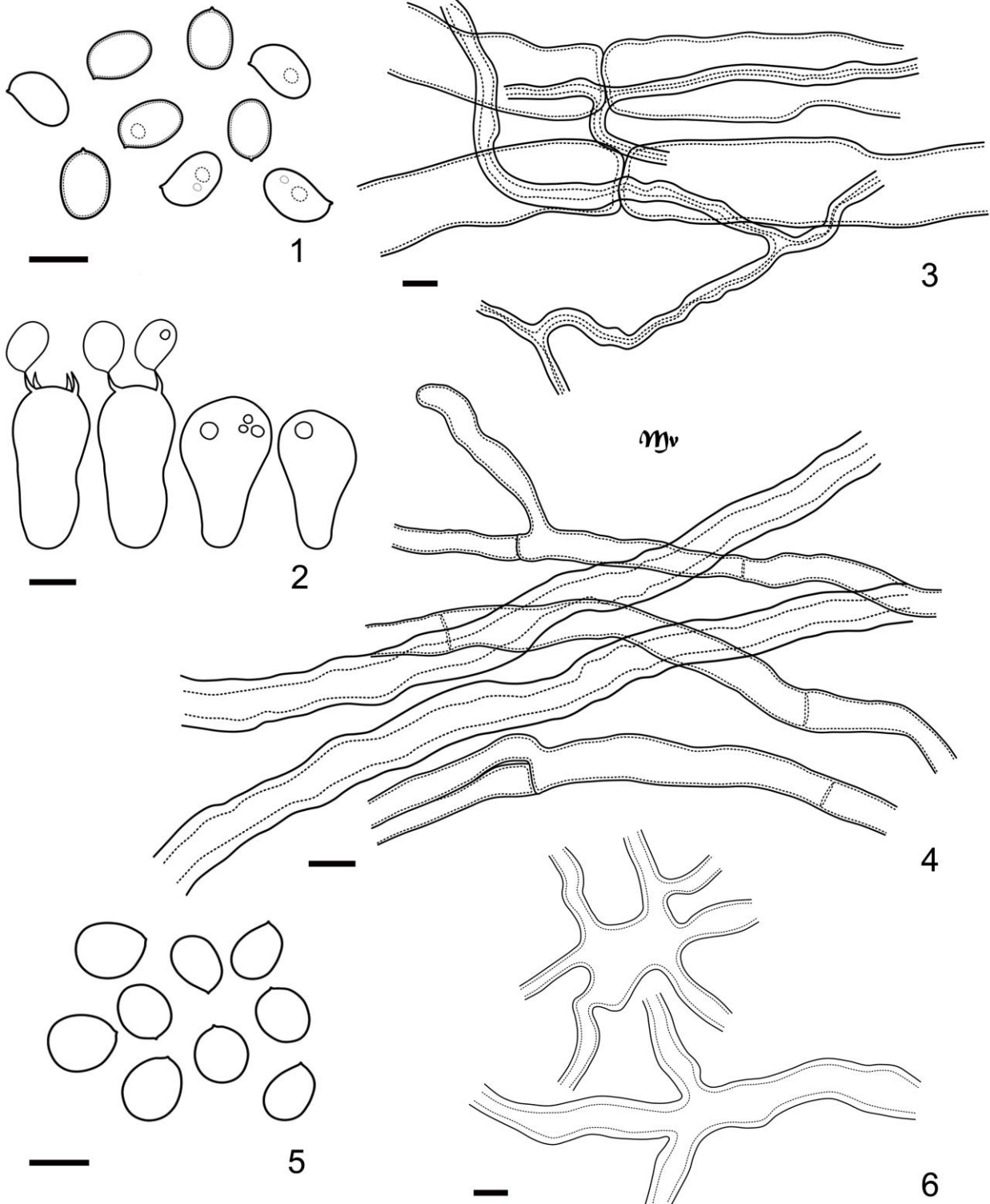
Basidioma annual, laterally stipitate, sessile or with broad stipe attachment, soft when fresh, hard when dry. Pileus dimidiate up to 5.4–14.5 × 5.8–11.1 × 0.6–2.0 cm, upper surface striated, azonate, yellow (N₃₀ A₆₀ M₈₀) to pale brown (N₆₀ A₉₉ M₆₀) when fresh and yellowish-brown (N₂₀ A₉₀ M₅₀) to pale orange (N₂₀ A₈₀ M₇₀) after dry. Margin involute. Context homogeneous, azonate, dense, up to 2.0 cm thick, cream to white. Pore surface cream to pale brown when fresh to yellowish-brown (N₆₀A₉₀M₆₀) when dry, pores rounded, decurrent on stipe, 5–7 per mm, and tubes concolorous with the pore surface, up to 0.1 cm deep, dissepiments entire, thin to slightly thick.

Hyphal system dimitic, pileus context with generative hyphae simple-septate, inflated, thin-walled, smooth, 10– 18(–19) µm wide, and binding hyphae hyaline, densely branched, thick-walled, 5–10(–11) µm wide. Tubes trama composed of generative hyphae simple-septate, frequently branched, parallels in arrangement, hyaline, smooth and thin-walled, 5.0–7.0 µm wide, and skeletal hyphae, hyaline, sinuous and undulating, thick-walled, 5.0–6.5 µm wide. Basidia clavate, hyaline, 4-sterigmated, thin-walled, 16.0–20.0 × 8.0–9.5 µm. Basidiospores broadly ovoid, hyaline, smooth, thin-walled, inamyloid, undextrinoid, 5.0–5.5 × 4.0–5.0 µm ($Xm = 5.2 \times 4.4 \mu\text{m}$), $n = 60/3$, $Q = 1.0$ –1.3, $Qm = 1.2$.

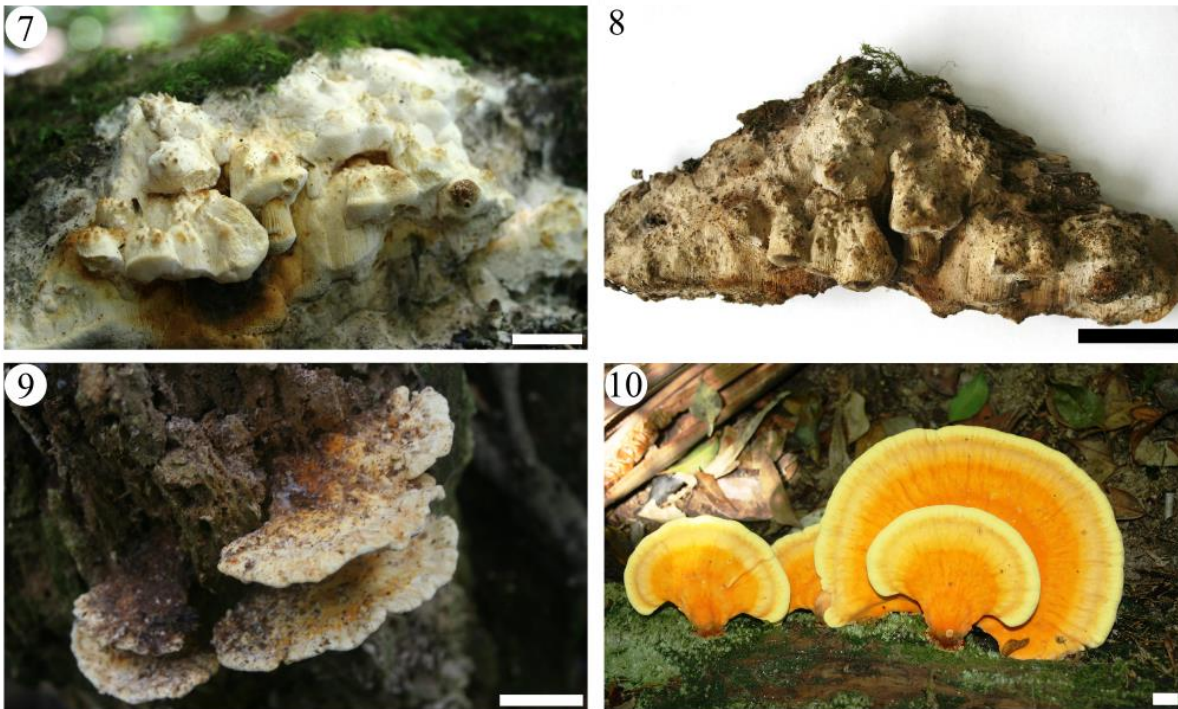
Ecology and Distribution: Occurring on living trees and dead trunks and logs. It is associated with a brown rot of *Quercus* spp. and *Eucalyptus* spp. It is reported from the United States, especially states adjacent to the Mexican border and the Pacific Ocean (Burds & Banik 2001). This is the first record of the species from Brazil.

Comments — *Laetiporus gilbertsonii* is macroscopically characterized by the basidioma pileate to stipitate yellowish-brown to pale orange with a white context and small round pores. Microscopically, the broadly ovoid basidiospores, 5–5.5 µm long, differentiate it from other species of *Laetiporus* occurring in Brazil (ellipsoid basidiospores in *L. squalidus* and *L. sulphureus*; and broadly ovoid, 6.5–8 µm long in *L. persicinus*). Our materials differ from the description presented by Burdsall & Banik (2001) in the pore size (5–7 per mm in the Brazilian material and 2–4 per mm in the type), however agree in the other macro and microscopic features and our identification is also supported by molecular data.

Material Examined: BRAZIL. SÃO PAULO: São Paulo, Represa do Guarapiranga, Ilha dos Eucaliptos, Apr 27, 1996, V.S.E. Santo (SP307821). São Luis do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virginia, Sept 30, 2013, R.M. Pires 152 (SP466044); Feb 11, 2014, R.M. Pires 233 (SP466045); R.M. Pires 234 (SP466046).



Figs. 1–4. *Laetiporus squalidus* (Holotype SP466047). **1.** Basidiospores. **2.** Basidia. **3.** Context dimitic composed of generative and binding hyphae. **4.** Tubes trama dimitic composed of generative and skeletal hyphae. **5–6.** *L. gilbertsonii* (SP466045). **5.** Basidiospores. **6.** Binding hyphae from the context. Scale bar = 5 μ m



Figs. 7–8. *Laetiporus squalidus* (Holotype SP466047). **7.** Fresh basidioma. **8.** Dried basidioma. **9–10.** *L. gilbertsonii*. **9.** Fresh basidioma (SP466044). **10.** Fresh basidioma (SP466046). Scale bar = 2 cm.

Molecular phylogeny

Analysis of nLSU region was performed in order to assess the relative position of the new taxon within the family Polyporaceae Corda. For nLSU, the final matrix consisted of nineteen sequences from GenBank and a new nLSU sequence generated (Table 1). The dataset resulted in 630 base pairs with 446 parsimony informative characters (70.79%). The strict consensus tree was yielded from the BA with average standard deviation of split frequencies = 0.003819 (Figure 11). The bootstrap a value from MP (length = 290, consistency index = 0.568548 and retention index = 0.727041), NJ (length = 0.56713132) and ML analyzes was added to the BA tree. Different genus related to *Laetiporus* (*Amyloporia* Bondartsev & Singer ex Singer, *Antrodia* P. Karst., *Laetiporus*, *Laricifomes* Kotlába & Pouzar, *Phaeolus* (Pat.) Pat., *Sparassis* Fr.) were included in this analysis to build the phylogenetic tree, based on recent works with the group (Lindner & Banik 2008, Ota et al. 2009, Binder et al. 2013, Ortiz-Santana et al. 2013). The results showed the new species forming a distinct clade close related with the *Laetiporus* group. The best bootstrap supports were produced from NJ and ML analysis (83% and 53%, respectively). BA and MP analysis had similar topology but the bootstrap values weren't high enough.

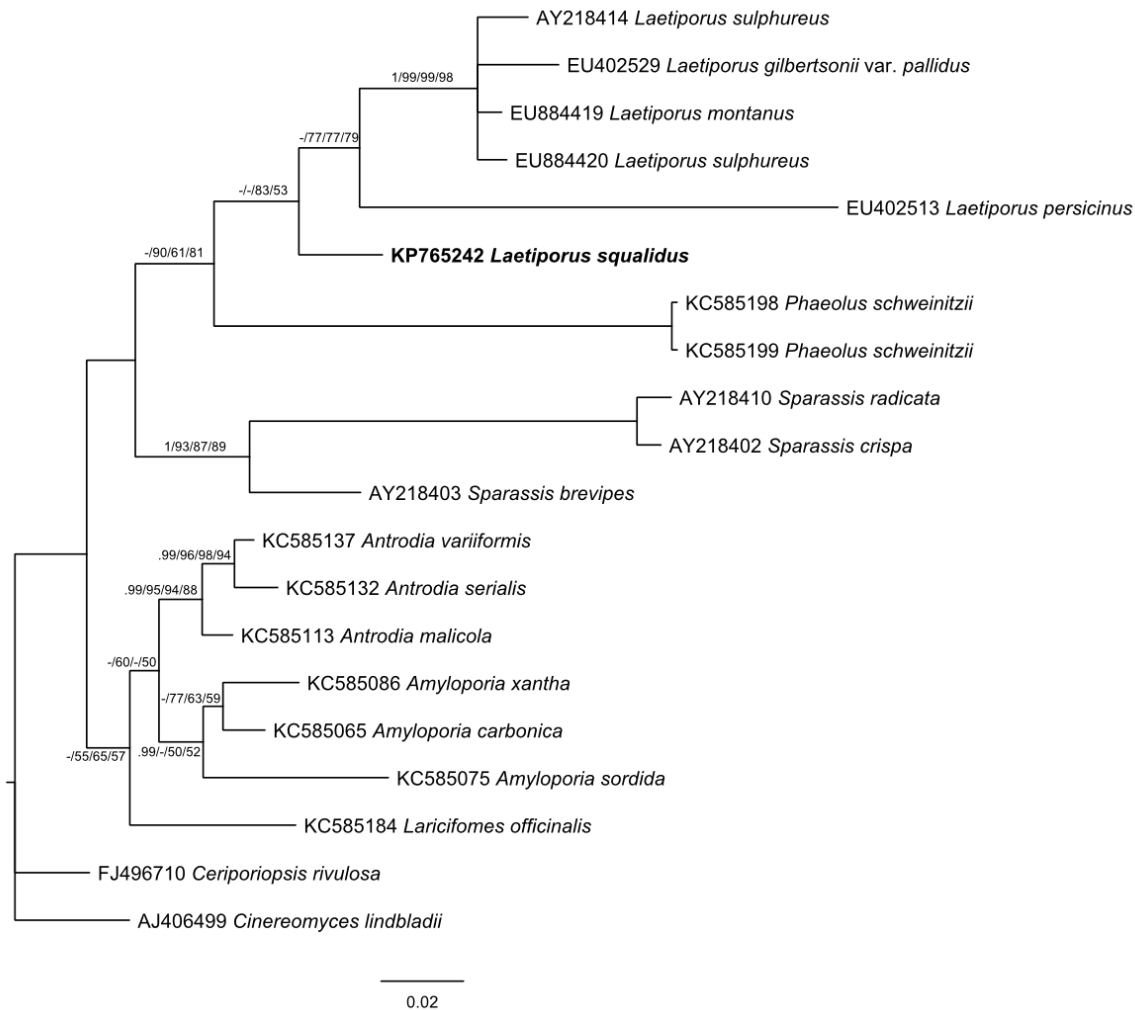


Fig. 11. Phylogenetic placement of the *Laetiporus squalidus* inferred from BA, MP, NJ and ML from nLSU sequences. Name of taxon in bold font represent the new species. Support values consist of the Bayesian posterior probability (PP) (>0.95) followed by MP, NJ and ML bootstrap values (>50%).

Phylogenetic tree of ITS region were produced with fifty-six sequences from GenBank and five new ITS sequence generated from this study (Table 2). The alignment of ITS sequences resulted in 541 base pairs with 254 parsimony informative characters (46.95%). Bayesian analysis resulted in average standard deviation of split sequences = 0.004197 (Figure 12). Parsimony analysis produced one parsimonious tree (length = 188, consistency index = 0.814607 and composite index = 0.784101). Maximum parsimony analyses as well as NJ (length = 0.41845968) and ML analysis were added to the BA tree. Sequences of *P. schweinitzii* from GenBank were used as out-group based in its close relation with *Laetiporus* genus. This phylogenetic reconstruction resulted in a distinct clade of *Laetiporus squalidus* sp. nov. with high PP in BA (1.00) and high bootstrap in MP and NJ (98 and 93, respectively), and grouped the four Brazilian *Laetiporus* species sequenced for this work with the *Laetiporus gilbertsonii* group (Clade F).

Discussion

Laetiporus squalidus sp. nov. is characterized by its pale whitish and irregular pilei, and by its large connective hyphae in the context and basidiospores $6.5\text{--}7.0 \times 4.0\text{--}5.0 \mu\text{m}$. Microscopically, *L. squalidus* is quite similar to *L. sulphureus* complex, differing mainly in its macromorphology, as the shape and color of the pileus, what is a good way to characterize the species and differs from the other species within the group. The phylogenetic analysis supported *L. squalidus* as a distinct species on both ITS and nLSU region. Lindner & Banik (2008) discuss the status of *L. persicinus*, a close related species to *L. sulphureus* complex but divergent in morphological traits, including lacking of bright orange coloration in the upper surface and tubes that stain blackish-brown. *Laetiporus squalidus* also exhibits different characteristics from other species of the genus as the pileus shape and the cream to pale brown upper surface. In this study, the sequence of *L. persicinus* obtained from GenBank databases revealed no significant similarity of this species to any known genus, although it appears related to the *L. sulphureus* complex clade in other different studies (Vasaitis et al. 2009, Ortiz-Santana et al. 2013). *Laetiporus squalidus* present the same condition, it appear close to *L. sulphureus* complex and *L. persicinus* in the phylogenetic trees. More studies are required to determine the position of *L. persicinus* within the genus *Laetiporus*, or transfer this to a different or new genus.

Laetiporus gilbertsonii (clade F) is now referred to Brazil. The phylogenetic analysis supports the Brazilian specimens within the clade F (Fig. 12) with 0.98 in BA analysis, 57% and 60% in PA and NJ analyzes, respectively. The present work including Brazilian *Laetiporus* specimens had similar results to Vasaitis et al. (2009) and intensifies its argument about of the Pan-American distribution of *L. gilbertsonii*.

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References

BURDSALL, H.H. & M.T. BANIK. 2001: The genus *Laetiporus* in North America. – Harvard Papers in Botany **6**: 43–55.

- BINDER, M., JUSTO, A., RILEY, R., SALAMOV, A., LÓPEZ-GIRÁLDEZ, F., SJÖKVIST, E., COPELAND, A., FOSTER, B., SUN, H., LARSSON, E., LARSSON, K.H., TOWNSEND, J., GRIGORIEV, I.V. & D.S. HIBBETT. 2013: Phylogenetic and phylogenomic overview of the Polyporales. – *Mycologia* **105**: 1350–1373.
- COELHO, G. 2005: A Brazilian new species of *Auriporia*. *Mycologia* **97**(1): 263–267.
- CORNER, E.J.H. 1984: Ad Polyporaceas II & III. Beihefte zur. – *Nova Hedwigia* **78**: 1–222.
- DARRIBA, D., TABOADA, G.L., DOALLO, R. & D. POSADA. 2012: jModelTest 2: more models, new heuristics and parallel computing. *Nature Methods* **9**(8): 772–772. <http://dx.doi.org/10.1038/nmeth.2109>
- DAVOLI, P., MUCCI, A., SCHENETTI, L. & R.W. WEBER. 2005: Laetiporic acids, a family of non-carotenoid polyene pigments from fruit-bodies and liquid cultures of *Laetiporus sulphureus* (Polyporales, Fungi). – *Phytochemistry* **66**(7): 817–823.
- FELSENSTEIN, J. 1985: Confidence limits on phylogenies: An approach using the bootstrap. – *Evolution* **39**: 783–791.
- GONTHIER, P., GUGLIELMO, F., SILLO, F., GIORDANO, L. & M. GARBELOTTO. 2014: A molecular diagnostic assay for the detection and identification of wood decay fungi of conifers. – *Forest Pathology* DOI: 10.1111/efp.12132.
- GUGLIELMO, F., BERGEMANN, S.E., GONTHIER, P., NICOLOTTI, G. & M. GARBELOTTO. 2007: A multiplex PCR-based method for the detection and early identification of wood rotting fungi in standing trees. – *Journal of Applied Microbiology* **103**(5): 1490–1507.
- GUGLIOTTA, A.M., GIBERTONI, T.B., DRECHSLER-SANTOS, E.R., SILVEIRA, R.M.B., CHIKOWSKI, R.S., PIRES, R.M., MONTOYA, C.A.S., SOUZA, J.F., PALACIO, M. & D.H.C. REZENDE. 2015: Polyporales. – *In*: Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Available in: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB95380> (Accessed 05 Feb. 2015)
- KEARSE, M., MOIR, R., WILSON, A., STONES-HAVAS, S., CHEUNG, M., STURROCK, S., BUXTON, S., COOPER, A., MARKOWITZ, S., DURAN, C., THIERER, T., ASHTON, B., MENTJIES, P., & A. DRUMMOND. 2012: Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. – *Bioinformatics* **28**(12): 1647–1649.
- KIMURA, M. 1980: A simple method for estimating evolutionary rate of base substitutions through comparative studies of nucleotide sequences. – *Journal of Molecular Evolution* **16**: 111–120.
- KORBIE, D.J. & J.S. MATTICK. 2008: Touchdown PCR for increased specificity and sensitivity in PCR amplification. – *Nature Protocols* **3**: 1452–1456.
- LINDNER, D.L. & M.T. BANIK. 2008: Molecular phylogeny of *Laetiporus* and other brown rot polypore genera in North America. – *Mycologia* **100**(3): 417–430.

- LINDNER, D.L., BANIK, M.T., ORTIZ-SANTANA, B. & D.J. LODGE. 2012: A new species of *Laetiporus* (Basidiomycota, Polyporales) from the Caribbean basin. – Tomo **37(1)**: 15–21.
- NEI, M. & S. KUMAR. 2000: Molecular Evolution and Phylogenetics. – Oxford University Press, New York.
- ORTIZ-SANTANA, B., LINDNER, D.L., MIETTINEN, O., JUSTO, A. & D.S. HIBBETT. 2013: A phylogenetic overview of the antrodia clade (Basidiomycota, Polyporales). – *Mycologia* **105(6)**: 1391–1411.
- OTA, Y. & T. HATTORI. 2003: Phylogenetic relationship among *Laetiporus* spp. in Japan. – In: LAFLAMME, G., BERUBE, J.A. & G. BUSSIERES (eds), Root and Butt Rots of Forest Trees. Proceedings of the IUFRO Working Party 7.02.01 Quebec City, Canada. – Natural Resources Canada, Quebec, pp. 9–13.
- OTA, Y. & T. HATTORI. 2008: Relationships among three Japanese *Laetiporus* taxa based on phylogenetic analysis and incompatibility tests. – *Mycoscience* **49**: 168–177.
- OTA, Y., HATTORI, T., BANIK, M.T., HAGEDORN, G., SOTOME, K., TOKUDA, S. & Y. ABE. 2009: The genus *Laetiporus* (Basidiomycota, Polyporales) in East Asia. – *Mycological Research* **113(Pt 11)**: 1283–1300.
- PARK, Y.-J., KWON, O.C., SON, E.-S., YOON, D.-E., HAN, W., NAM, J.-Y., YOO, Y.-B. & C.S. LEE. 2012: Genetic diversity analysis of *Ganoderma* species and development of a specific marker for identification of medicinal mushroom *Ganoderma lucidum*. – *African Journal of Microbiology Research* **6(25)**: 5417–5425.
- RAJCHENBERG, M. 1994: A taxonomic study of the subantarctic *Piptoporus* (Polyporaceae, Basidiomycetes) I. – *Nordic Journal of Botany* **14**: 435–449.
- ROBERT, V., STEGEHUIS, G. & J. STALPERS. 2005: The MycoBank engine and related databases. <http://www.mycobank.org> (Accessed 07 Feb. 2014).
- RONQUIST, F., TESLENKO, M., VAN DER MARK, P., AYRES, D., DARLING, A., HÖHNA, S., LARGET, B., LIU, L., SUCHARD, M.A. & J.P. HUELSENBECK. 2012: MrBayes 3.3: efficient Bayesian phylogenetic inference and model choice across a large model space. – *Systematic Biology* **61**: 539–542.
- RYVARDEN, L. & I. JOHANSEN. 1980: A preliminary polypore flora of East Africa. – *Fungiflora*, Oslo: 1–636.
- SONG, J., CHEN, Y., CUI, B., LIU, H. & Y. WANG. 2014: Morphological and molecular evidence for two new species of *Laetiporus* (Basidiomycota, Polyporales) from southwestern China. – *Mycologia* **106(5)**: 1039–1050.
- TAMURA, K., NEI, M. & S. KUMAR. 2004: Prospects for inferring very large phylogenies by using the neighbor-joining method. – *Proceedings of the National Academy of Sciences (USA)* DOI:10.11030-11035.

- TAMURA, K., STECHER, G., PETERSON, D., FILIPSKI, A. & S. KUMAR. 2013: MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0. – *Molecular Biology and Evolution* **30**: 2725–2729.
- TEIXEIRA, A.R. 1995: Método para estudo das hifas do basidiocarpo de fungos poliporáceos. – São Paulo, Instituto de Botânica. – Manual n.6: 1–20.
- TOMSOVSKY, M. & L. JANKOVSKY. 2008: Validation and typification of *Laetiporus montanus*. – *Mycotaxon* **106**: 289–295.
- TOMSOVSKY, M., MENKIS, A. & R. VASAITIS. 2010: Phylogenetic relationships in European *Ceriporiopsis* species inferred from nuclear and mitochondrial ribosomal DNA sequences. – *Fungal Biology* **114(4)**: 350–358.
- VASAITIS, R., MENKIS, A., LIM, Y.W., SEOK, S., TOMSOVSKY, M., JANKOVSKY, L., LYGIS, V., SLIPPERS, B. & J. STENLID. 2009: Genetic variation and relationships in *Laetiporus sulphureus* s. lat., as determined by ITS rDNA sequences and in vitro growth rate. – *Mycological Research* **113(Pt 3)**: 326–336.
- WANG, Z., BINDER, M., DAI, Y.C. & D.S. HIBBETT. 2004: Phylogenetic relationships of *Sparassis* inferred from nuclear and mitochondrial ribosomal DNA and RNA polymerase sequences. – *Mycologia* **96(5)**: 1015–1029.
- WHITE, T.J., BRUNS, T., LEE, S. & J. TAYLOR. 1990: Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. – *In: PCR Protocols: a guide to methods and applications*. San Diego, Academic Press.

CAPÍTULO 5

Polyporales and
related genera
(Basidiomycota) from
Parque Estadual da
Serra do Mar, São
Paulo, Brazil

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Polyporales and related genera (Basidiomycota) from Parque Estadual da Serra do Mar, São Paulo, Brazil

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Abstract

This survey brings forward the first species list of the pore fungi (Polyporales and related genera) from Parque Estadual da Serra do Mar – Núcleo Santa Virgínia, the largest forest area of the Atlantic Rainforest Biome area in Brazil. A total of 70 species, 38 genera and 10 families were found in the studied area. Are cited to São Paulo state for the first time *Antrodiella luteocontexta* Ryvardeen & de Meijer, *Ceriporiopsis flavilutea* (Murrill) Ryvardeen, *Diplomitoporus navisporus* Gibertoni & Ryvardeen, *Flaviporus venustus* A. David & Rajchenb., *Grammothele fuligo* (Berk. & Broome) Ryvardeen, *Oxyporus latemarginatus* (Durieu & Mont.) Donk, *Postia subcaesia* (A. David) Jülich and *Postia tephroleuca* (Fr.) Jülich; and the species *Dichomitus campestris* (Quél.) Domanski & Orlicz, *Perenniporia cremeopora* Decock & Ryvardeen and *Postia undosa* (Peck) Jülich represents the first record to Brazil and are described here. A table with all vouchers and an identification key for the found species are provided.

Keywords

Brazilian Atlantic rainforest, Fungal diversity, Neotropics, Taxonomy

Introduction

Polypores species are characterized by presenting hymenial surface formed by parallel tubes which lead into a plane formed by pores. These organisms are extremely important for nutrient cycling, as are the main decomposers of wood present in the environment due to its lignocelulolitic enzymatic apparatus. In the forest ecosystem, they play a fundamental role by decaying of wood (Ryvarden 1991).

The order Polyporales is not fully understood until now. Three lineages previously recognized within Polyporales, 'antrodia clade', 'core polyporoid' and 'phlebioid clade' (Binder et al. 2005, Garcia-Sandoval et al. 2011, Hibbett e Donoghue 1995, Larsson et al. 2004, Miettinen et al. 2011), are supported by the work of Binder et al. (2013). On the other hand, the position of the 'residual polyporoid clade' remains uncertain and certain taxa (e.g. *Gelatoporia*, *Grifola*, *Tyromyces*) apparently did not belong to any of the main lineages of Polyporales. Families like Hydnodontaceae, Schizoporaceae and many polyporoid genera no included in Polyporales, like genus *Trichaptum* (*Incertae sedis*) are morphologically and ecologically related, and have been historically studied together. For this reason, these taxa were included in the present work.

Despite being a group still poorly studied in Brazil, some papers are found for the group, mainly in the Atlantic Rainforest (Bononi *et al.* 1981, Jesus 1993, Gugliotta 1997, Soares & Gugliotta 1998, Gugliotta & Bononi 1999, Xavier-Santos *et al.* 2004, Louza & Gugliotta 2007, Leal & Gugliotta 2008, Abrahão *et al.* 2009, Gugliotta *et al.* 2010, Gugliotta *et al.* 2011, Motato-Vásquez & Gugliotta 2013, Motato-Vásquez *et al.* 2014).

The Atlantic Rainforest originally occupied 1,315,460 km² of Brazilian territory, now holds about 8% of its original length (Fundação SOS Mata Atlântica & INPE 2009, 2011), being placed in the top five list of regions biologically richest and most threatened the planet (Hotspots) (Mittermeier *et al.* 2004). Although it was largely destroyed, endangering the survival of countless species, also houses more than 8,000 endemic species of vascular plants, amphibians, reptiles, birds and mammals. It is the second largest block of tropical forests in the country, including various types of tropical ecosystems as the coasts of the Atlantic forests of lowland and slope of the Serra do Mar, the inland forests and the forests of Araucaria (Secretaria de Estado de Meio Ambiente 1996, Fundação SOS Mata Atlântica & INPE 2009, 2011). São Paulo state is home to a significant portion of this important Atlantic forest and has 2,670,324 hectares of semi-forest, which occur mainly along its coast and on the slopes of Serra do Mar, which corresponds to 15.78% of its territory (Fundação SOS Mata Atlântica & INPE 2011).

This study aims to survey the polypores species of Polyporales and related genera present in the Núcleo Santa Virgínia of the Parque Estadual da Serra do Mar. The park is the largest

continuous area of preserved Atlantic Rainforest of Brazil, a biodiversity hotspot; however its community of fungi with pores was previously unknown. Descriptions of new records to Brazil, comments of new citations to São Paulo State and identification keys are provided.

Material and methods

The Parque Estadual da Serra do Mar (PESM) established by State Decree No. 10251, 30 August 1977, is a protected area with the largest forest zone of the Atlantic Rainforest Biome in the country with 315,390 ha, involving 11 coastal municipalities and 15 located on the Atlantic Plateau (Secretaria de Estado de Meio Ambiente 2000). Due to large territory of the Park and the heterogeneity of socio-cultural, historical and environmental features, it is managed from eight units (Secretaria de Estado de Meio Ambiente 2008).

Núcleo Santa Virgínia is one of these eight units; it is located in the counties of São Luiz do Paraitinga and Natividade da Serra, São Paulo state. It covers a total area of 17,000 ha, and is located in the geographical coordinates 45°03' W and 23°24' to 23°17' S, with altitudinal range of 860 m to 1650 m and maximum temperatures of 35°C, medium 21°C and minimum -3°C (Secretaria de Estado de Meio Ambiente 2008).

The collections in the study area were bimonthly, carried out in April 2013 to February 2015. The basidiomata found were collected whole with a knife, photographed, georeferenced, and individually packed in paper bags, observing and writing down data such as location and date of collection, collector number, microhabitat conditions, coloring and other necessary macroscopic characteristics (Fidalgo & Bononi 1984). Macroscopic analysis was performed in the laboratory and includes basidiomata: habit and habitat; pileus: shape, color, surface, margin, size; hyphal system; pores: color, shape, spacing, number per millimeter; stipe (when available): shape, color, consistency, surface, apex, base, size.

For microscopic analysis, were performed freehand cuts in cross sections to the tubes to observe the hymenium and trama structures. The sections were hydrated with KOH 5% solution and stained with 1% Phloxine; and Melzer's reagent and for evidence amyloid and dextrinoid reactions. The cuts, slide and cover slip, were analyzed in Leica DM1000 optical microscope. The structures analyzed were basidiospores: color, wall, reactions, size, Q and Q_m ; basidia: shape, color, wall, spore number, size; sterile elements: presence, type, shape, color, wall, reactions, size, context: color, hyphae. The measurements were performed in minimum of 20 structures. The measurement of length and width of basidiospores basidia (without sterigmata) and cystidia were taken; the measures of non-differentiated hyphae was considered only diameter. For basidiospores were considered Q , which represents the variation of the ratio between the length and the width of each

basidiospores and Q_m represents the average value of Q (Coelho 2005). The nomenclature used was based mainly on Fidalgo & Fidalgo (1957). The Brazilian distribution was based in Gugliotta *et al.* 2015 and Baltazar & Gibertoni (2009). The specimens are housed at Herbaria SP.

Results and discussion

A total of 70 species were found in the studied area, 38 genera and 10 families. All studied materials (Table 1) were collected by Ricardo M. Pires in the PESM-Núcleo Santa Virgínia and deposited in the Herbarium Maria Eneyda P. K. Fidalgo (SP).

Table 1- Polypores from Parque Estadual da Serra do Mar – Núcleo Santa Virgínia.

Family/ species	Voucher
FOMITOPSIDACEAE	
<i>Antrodia albida</i> (Fr.) Donk	RP95, RP137, RP177, RP187, RP287, RP311
<i>Antrodia malicola</i> (Berk. & M.A. Curtis) Donk	RP45
<i>Laetiporus gilbertsonii</i> Burds	RP152, RP233, RP234
<i>Laetiporus squalidus</i> Pires, Motato-Vásquez & Gugliotta	RP232
<i>Postia subcaesia</i> (A. David) Jülich	RP75, RP78, RP139, RP315
<i>Postia tephroleuca</i> (Fr.) Jülich	RP331
<i>Postia undosa</i> (Peck) Jülich	RP189
GANODERMATACEAE	
<i>Amauroderma sprucei</i> (Pat.) Torrend	RP195
<i>Ganoderma australe</i> (Fr.) Pat.	RP4, RP24, RP57, RP159, RP161, RP252
HYDNODONTACEAE	
<i>Trechispora regularis</i> (Murrill) Liberta	RP246, RP296, RP298
MERIPILACEAE	
<i>Henningsia brasiliensis</i> (Speg.) Speg.	RP193, RP200, RP212, RP215
<i>Rigidoporus crocatus</i> (Pat.) Ryvarden	RP127
<i>Rigidoporus lineatus</i> (Pers.) Ryvarden	RP13, RP173, RP182, RP196, RP208, RP230, RP249
<i>Rigidoporus microporus</i> (Sw.) Overeem	RP122, RP160
<i>Rigidoporus undatus</i> (Pers.) Donk	RP97
<i>Rigidoporus vinctus</i> (Berk.) Ryvarden	RP183, RP185, RP251, RP255, RP277
MERULIACEAE	
<i>Bjerkandera fumosa</i> (Pers.) P. Karst.	RP317
<i>Ceriporia xylostromatoides</i> (Berk.) Ryvarden	RP165
<i>Ceriporiopsis flavilutea</i> (Murrill) Ryvarden	RP87
<i>Flaviporus brownii</i> (Humb.) Donk	RP64
<i>Flaviporus hydrophilus</i> (Berk. & M.A.Curtis) Ginns	RP153
<i>Flaviporus liebmannii</i> (Fr.) Ginns	RP15, RP27, RP37, RP150, RP201, RP203

Family/ species	Voucher
<i>Flaviporus subhydrophilus</i> (Speg.) Rajchenb. & J.E. Wright	RP35, RP147, RP191
<i>Flaviporus subundatus</i> (Murrill) Ginns	RP332
<i>Flaviporus venustus</i> A. David & Rajchenb.	RP262
<i>Loweomyces fractipes</i> (Berk. & M.A. Curtis) Jülich	RP 197
PHANEROCHAETACEAE	
<i>Antrodiella angulatopora</i> Ryvarden	RP56, RP58, RP110, RP303, RP310
<i>Antrodiella duracina</i> (Pat.) I. Lindblad & Ryvarden	RP52, RP69, RP85, RP96, RP174, RP192
<i>Antrodiella luteocontexta</i> Ryvarden & de Meijer	RP299, RP318
<i>Antrodiella semisupina</i> (Berk. & M.A. Curtis) Ryvarden	RP41
<i>Junghuhnia carneola</i> (Bres.) Rajchenb.	RP2
<i>Junghuhnia nitida</i> (Pers.) Ryvarden	RP79
<i>Junghuhnia semisupiniformis</i> (Murrill) Ryvarden	RP62
<i>Junghuhnia undigera</i> (Berk. & M.A. Curtis) Ryvarden	RP130, RP295, RP300, RP309, RP329
POLYPORACEAE	
<i>Abundisporus subflexibilis</i> (Berk. & M.A. Curtis) Parmasto	RP124
<i>Cinereomyces dilutabilis</i> (Log.-Leite & J. E. Wright) Miettinen	RP1, RP221
<i>Corioloopsis caperata</i> (Berk.) Murrill	RP199
<i>Corioloopsis rigida</i> (Berk. & Mont.) Murrill	RP72, RP107, RP144, RP148, RP172, RP188, RP247
<i>Dichomitus campestris</i> (Quél.) Domanski & Orlicz	RP51
<i>Dichomitus cavernulosus</i> (Berk.) Masuka & Ryvarden	RP239, RP313
<i>Dichomitus cylindrosporus</i> Ryvarden	RP31, RP93
<i>Dichomitus setulosus</i> (Henn.) Masuka & Ryvarden	RP320
<i>Diplomitoporus navisporus</i> Gibertoni & Ryvarden	RP180
<i>Fomes fasciatus</i> (Sw.) Cooke	RP34, RP61, RP204
<i>Fomitella supina</i> (Sw.) Ryvarden	RP18, RP28, RP55, RP60, RP205, RP248, RP336
<i>Fuscocerrena portoricensis</i> (Fr.) Ryvarden	RP113, RP123
<i>Grammothele fuligo</i> (Berk. & Broome) Ryvarden	RP211
<i>Grammothelopsis puiggarii</i> (Speg.) Rajchenb. & J.E. Wright	RP134

Family/ species	Voucher
<i>Pachykytospora alabamae</i> (Berk. & Cooke) Ryvarden	RP146
<i>Perenniporia cremeopora</i> Decock & Ryvarden	RP120
<i>Perenniporia ochroleuca</i> (Berk.) Ryvarden	RP285, RP324
<i>Perenniporiella neofulva</i> (Lloyd) Decock & Ryvarden	RP286
<i>Polyporus ciliatus</i> Fr.	RP132, RP136, RP156, RP164
<i>Polyporus dictyopus</i> Mont.	RP170, RP241, RP264, RP301, RP334
<i>Polyporus grammacephalus</i> Berk.	RP237
<i>Polyporus guianensis</i> Mont.	RP261
<i>Polyporus tenuiculus</i> (P. Beauv.) Fr.	RP6, RP178, RP228, RP250, RP254
<i>Pycnoporus sanguineus</i> (L.) Murrill	RP70, RP71
<i>Skeletocutis nivea</i> (Jungh.) Jean Keller	RP84
<i>Spongipellis caseosus</i> (Pat.) Ryvarden	RP125
<i>Tinctoporellus epimiltinus</i> (Berk. & Broome) Ryvarden	RP20, RP105, RP211
<i>Trametes membranacea</i> (Sw.) Kreisel	RP145
<i>Trametes versicolor</i> (L.) Lloyd	RP297
<i>Trametes villosa</i> (Sw.) Kreisel	RP74, RP88, RP118
RICKENELLACEAE	
<i>Sidera lenis</i> (P. Karst.) Miettinen	RP39, RP90, RP94, RP102, RP111, RP116, RP117, RP186, RP223, RP236, RP242, RP256, RP281, RP288, RP322
SCHIZOPORACEAE	
<i>Echinoporia inermis</i> G. Coelho	RP80, RP179, RP306
<i>Oxyporus latemarginatus</i> (Durieu & Mont.) Donk	RP260
<i>Schizopora flavipora</i> (Berk. & M.A. Curtis ex Cooke) Ryvarden	RP81, RP163, RP167, RP171, RP184, RP198, RP229, RP294, RP305
<i>Schizopora paradoxa</i> (Schrad.) Donk	RP141, RP278, RP279, RP308
HYMENOCHAETALES, Incertae sedis	
<i>Trichaptum sector</i> (Ehrenb.) Kreisel	RP63, RP67

The following species, *Dichomitus campestris* (Quél.) Domanski & Orlicz, *Perenniporia cremeopora* Decock & Ryvarden and *Postia undosa* (Peck) Jülich represents the first record to Brazil.

Dichomitus campestris (Quél.) Domanski & Orlicz (**Fig. 1a**)

Description: basidiomata annual to perennial, resupinate, typically cushion-shaped with a distinctly thickened central part, oblong to oval. up to 15 mm thick in center and up to 10 cm long. Margin narrow and dirty ochraceous to blackish. Pore surface tan to straw-coloured with angular pores (1-2 per mm). Hyphal system dimitic and dextrinoid, hyaline, generative hyphae clamped and thin-walled, with 2.5-4 μm in diam; hyaline, thick-walled, straight to slightly sinuous binding hyphae, dichotomously branched, (3.5) 4-8 μm in diam. Basidiospores cylindrical, hyaline and thin-walled, negative in Melzer's reagent, 10-13 x 4.5-5.5 μm , $Q = 2-2.7$ and $Q_m = 2.4$

Remarks: The cushion-shaped basidiomata with the blackish margin are diagnostic for this species. Our material has basidiospores slightly shorter than Ryvarden & Gilbertson (1993) description (13-19 x 4-5.5 μm) but this variation may occur because they are large basidiospores.

Perenniporia cremeopora Decock & Ryvarden (**Fig. 1b**)

Description: basidiomata resupinate, adnate, up to 1.5 mm thick. Margin very narrow. Pore surface whitish to cream-coloured, pale grayish orange on bruising. Round pores 6-8 per mm. Dissepiments smooth, entire tube layer, not stratified, up to 1 mm thick, concolorous with the pore surface, corky and fibrous. Dimitic Hyphal system with clamped, hyaline, thin-walled, eventually branched generative hyphae, 2-3.5 μm wide. Trama of the tubes composed mainly of short arboriform skeleto-binding hyphae; dextrinoid. Basidiospores broadly ellipsoid, apically truncate, thick-walled with an apical germ pore, hyaline, variably dextrinoid, 4.1-5.1 x 3.2-4 μm , $Q = 1.2-1.4$ and $Q_m = 1,2$.

Remarks: Decock & Ryvarden (2000) discuss that *P. cremeopora* is separated from *P. minutopora* by its whitish pore surface and non-dextrinoid skeletal hyphae (dextrinoid in *P. minutopora*), however *P. cremeopora* can show dextrinoid skeletal hyphae. The resupinate basidiomata, small pores and small basidiospores characterize this species.

Postia undosa (Peck) Jülich (**Fig. 1c**)

Description: basidiomata annual, effused-reflexed to resupinate, with a narrow and elongated pileus, single or imbricate with numerous small pileus, pore surface decurrent. Margin of pileus characteristically undulate; upper surface white to light cream, finely adpressed velutinate becoming glabrous and smooth with age, pore surface cream coloured, pores angular to irregular, 2-3 per mm. Hyphal system monomitic and metachromatic, contextual hyphae rarely to frequently branched, with abundant clamps, thick-walled, 3.5-7 μm wide, generative hyphae in the subhymenium rather thin-walled and 2-4 μm wide. Cylindrical to allantoid, hyaline and smooth basidiospores, negative in Melzer's reagent, 4-5 x 1.5-2.1 μm , $Q = 2.2-2.9$ and $Q_m = 2.5$.

Remarks: The undulate margin and large pores are good field characteristics (Ryvarden & Gilbertson 1994). Furthermore, the cylindrical to allantoid basidiospores and metachromatic generative hyphae are important characteristics to consider. Widely distributed in the Northern Hemisphere, found on gymnosperms or rarely on angiosperms from southern Canada and the northern half of the U. S., and in Europe; associated with a brown rot (Lowe 1966). However, in Africa only observed in angiosperms (Ryvarden & Johansen 1980). Our specimen was collected in a dead trunk, preventing identification of the plant.

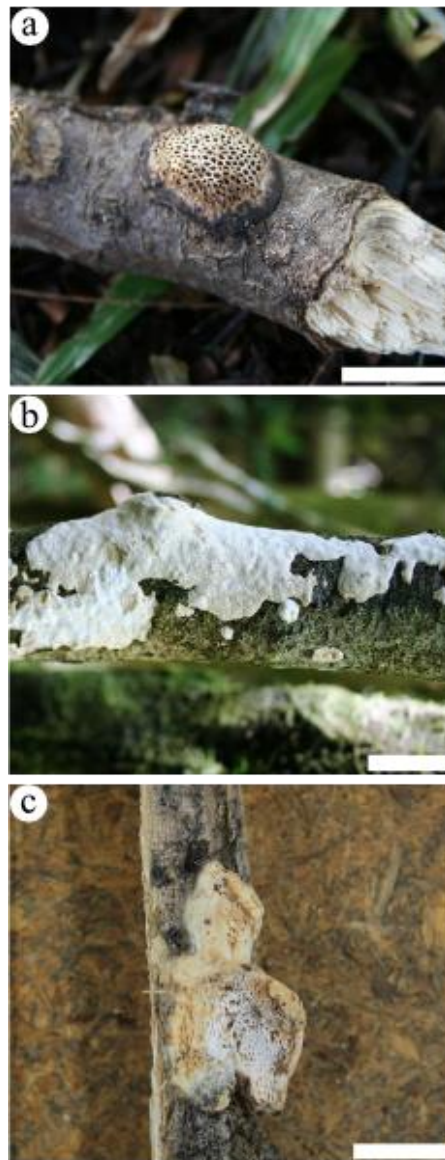


Figure 1 – Basidiomata in field condition. **a.** *Dichomitus campestris* (Quél.) Domanski & Orlicz. **b.** *Perenniporia cremeopora* Decock & Ryvarden. **c.** *Postia undosa* (Peck) Jülich. Scale Bar = 1 cm.

Furthermore, the species *Antrodiella luteocontexta* Ryvarden & de Meijer, *Ceriporiopsis flavilutea* (Murrill) Ryvarden, *Diplomitoporus navisporus* Gibertoni & Ryvarden, *Flaviporus venustus* A. David & Rajchenb., *Grammothele fuligo* (Berk. & Broome) Ryvarden, *Oxyporus*

latemarginatus (Durieu & Mont.) Donk, *Postia subcaesia* (A. David) Jülich and *Postia tephroleuca* (Fr.) Jülich are cited to São Paulo state for the first time.

Antrodiella luteocontexta Ryvarden & de Meijer (**Fig. 2a-c**)

Description: Ryvarden & Meijer (2002).

Remarks: This species has pileate and annual basidiomata with imbricate, broadly sessile and gregarious pileus. It is characterized by the yellow basidiomata, the large round to angular pores (1-2 per mm), the short cylindrical basidiospores (3-3.5 x 1.4-2.0 μm) and the yellow context.

Brazilian distribution: Paraná and São Paulo.

Ceriporiopsis flavilutea (Murrill) Ryvarden (**Fig. 2d**)

Description: Lowe (1966).

Remarks: *C. flavilutea* is recognized by its basidiomata annual, small, up to 1 mm thick; margin white and cottony. The small, thin-walled angular pores (6-8 per mm) and the small basidiospores (4.5-5 x 3-4 μm) characterize this species.

Brazilian distribution: Rio Grande do Norte and São Paulo.

Diplomitoporus navisporus Gibertoni & Ryvarden (**Fig. 2e**)

Description: Gibertoni *et al.* (2004).

Remarks: This species has perennial and resupinate basidiomata; trimitic hyphal system and fusoid cystidioles. The navicular basidiospores with 4.1-5 x 2-2.7 μm and the 7-9 regular pores per mm are diagnostic characteristics.

Brazilian distribution: Pernambuco and São Paulo.

Flaviporus venustus A. David & Rajchenb. (**Fig. 2f**)

Description: David & Rajchenberg (1985).

Remarks: The species is recognized by the large, whitish pink basidiocarps shrinking considerable when dried becoming rigid and horny and the small basidiospores, 3.5-4.5 x 2.5-3.2 μm . Monomitic hyphal system, with hyphae deeply immersed in a resinous substance, making it difficult to observe them.

Brazilian distribution: Paraná, Santa Catarina, Rio Grande do Sul and São Paulo.

Grammothele fuligo (Berk. & Broome) Ryvarden (**Fig. 2g**)

Description: Reck & Silveira (2009).

Remarks: The species presents basidiomata annual, resupinate, widely effused and strongly adnate and can be recognized by its association with monocotyledons and blue grayish colour. *G. fuligo* is separated from other species of the genus, by its host and the small pores (7-10 per mm).

Brazilian distribution: Pará, Roraima, Santa Catarina and São Paulo.

Oxyporus latemarginatus (Durieu & Mont.) Donk (**Fig. 2h**)

Description: Montagne (1856).

Remarks: *Oxyporus latemarginatus* is recognized by the basidiomata resupinate and white to straw-coloured; generative hyphae monomitic and simple septate, rather small apically encrusted cystidia, 13-30 x 4-7 µm (Ryvarden & Johansen 1980), and ellipsoid basidiospores, 3.8-4.8 x 2.6-3.2 µm.

Brazilian distribution: Paraná, Santa Catarina, Rio Grande do Sul and São Paulo.

Postia subcaesia (A. David) Jülich (**Fig. 2i**)

Description: Ryvarden & Gilbertson (1994).

Remarks: Macroscopically, *P. subcaesia* has soft and watery basidiomata when fresh, white to ochraceous pileus with slight grayish to bluish tints in spots and streaks and pubescent pileus surface. Also, allantoid and slightly amyloid in Melzer's reagent basidiospores and metachromatic generative hyphae assist in identification.

Brazilian distribution: Paraná, Santa Catarina, Rio Grande do Sul and São Paulo.

Postia tephroleuca (Fr.) Jülich (**Fig. 2j**)

Description: Ryvarden & Gilbertson (1994).

Remarks: The species is similar to *Tyromyces leucomallus* (Berk. & Curt.) Murril which however causes a white rot, and has a velvety to tomentose pileus and slightly smaller spores. The metachromatic generative hyphae and monomitic hyphal system are good diagnostic characters together with the cylindrical to allantoid basidiospores.

Brazilian distribution: Paraná, Rio Grande do Sul and São Paulo.



Figure 2 – Basidiomata in field condition. **a-c.** *Antrodiella luteocontexta* Ryvarden & de Meijer. **d.** *Ceriporiopsis flavilutea* (Murrill) Ryvarden. **e.** *Diplomitoporus navisporus* Gibertoni & Ryvarden. **f.** *Flaviporus venustus* A. David & Rajchenb. **g.** *Grammothele fuligo* (Berk. & Broome) Ryvarden. **h.** *Oxyporus latemarginatus* (Durieu & Mont.) Donk. **i.** *Postia subcaesia* (A. David) Jülich. **j.** *Postia tephroleuca* (Fr.) Jülich. Scale Bar = 1 cm.

Identification key to species of Polyporales and related genera (Basidiomycota) from Núcleo Santa Virginia of the Parque Estadual da Serra do Mar

- | | |
|---|------------------------------|
| 1a. Double basidiospore-wall, endospore ornamented and yellow to brown, exospore smooth and hyaline | 2 |
| 1b. Simple basidiospore-wall | 3 |
| 2a. Stipitate basidiomata | <i>Amauroderma sprucei</i> |
| 2b. Sessile basidiomata | <i>Ganoderma australe</i> |
| 3a. Simple septate generative hyphae | 4 |
| 3b. Clamped generative hyphae | 15 |
| 4a. Dimitic hyphal system | 5 |
| 4b. Monomitic hyphal system | 8 |
| 5a. Resupinate basidiomata | <i>Flaviporus subundatus</i> |

5b. Pileate basidiomata	6
6a. Pores 7-10 per mm, yellow to rusty brown basidiospores, basidiomata wood hard	
.....	<i>Fomes fasciatus</i>
6b. Pores up to 7 per mm, hyaline basidiospores, not wood hard basidiomata	7
7a. Effused-reflexed basidiomata, cream to pale brown upper surface	<i>Laetiporus squalidus</i>
7b. Pileate basidiomata, yellow to pale orange upper surface	<i>Laetiporus gilbertsonii</i>
8a. Resupinate basidiomata	9
8b. Pileate basidiomata	13
9a. Cystidia absent	10
9b. Cystidia present	11
10a. Pores 3–4 per mm	<i>Ceriporia xylostromatoides</i>
10b. Pores 6-8 per mm	<i>Rigidoporus crocatus</i>
11a. Pores 1-3 per mm, ellipsoid basidiospores	<i>Oxyporus latemarginatus</i>
11b. Pores smaller, globose to subglobose basidiospores	12
12b. Pinkish to brown-orange pore surface when fresh, becoming brownish to blackish in dried specimens, subglobose basidiospores 4-5 x 3-4 μm	<i>Rigidoporus vinctus</i>
12b. Isabelline to ochraceous pores surface, almost unchanging when dry, globose basidiospores (4)5.5-6 μm	<i>Rigidoporus undatus</i>
13a. Cystidia present	<i>Rigidoporus lineatus</i>
13a. Cystidia absent	14
14a. Gloeopleurous hyphae present	<i>Henningsia brasiliensis</i>
14a. Gloeopleurous hyphae absent.....	<i>Rigidoporus microporus</i>
15a. Basidioma completely resupinate	16
15b. Basidioma effused-reflexed to pileate	34
16a. Ornamented basidiospores	17
16b. Smooth basidiospores	18
17a. Striate basidiospores, longer than 10 μm	<i>Pachykytospora alabamae</i>
17b. Asperulate basidiospores, less than 5 μm	<i>Trechispora regularis</i>
18a. Dextrinoid skeletal hyphae	19
18b. Non dextrinoid skeletal hyphae	26
19a. Basidiospores with 17-20 x 10-12 μm	<i>Grammothelopsis puiggarii</i>
19b. Smaller and thinner basidiospores	20
20a. Whitish to creamy pore surface	21
20b. Greyish-blue to lilac pore surface	25
21a. Pores 6-8 per mm and basidiospores with 4-5 x 3.2-3.8 μm	<i>Perenniporia cremeopora</i>
21b. Larger pores and larger basidiospores	22
22a. Basidiospores 8-10 x 2.5-3 μm	<i>Dichomitus cylindrosporus</i>
22b. Larger Basidiospores, 11-19 μm length	23
23a. Cushion-shaped basidiomata with a distinct blackish margin	<i>Dichomitus campestris</i>

23b. Effused basidiomata, narrow margin, white to cream	24
24a. Pores 1-3 per mm, hyphal pegs present	<i>Dichomitus setulosus</i>
24b. Pores (2) 4-5 per mm, hyphal pegs absent	<i>Dichomitus cavernulosus</i>
25a. Basidiospores 4-5 (5.5) x 2.5-3 μm , dendrohyphidia absent	<i>Tinctoporellus epimiltinus</i>
25b. Basidiospores (5.5) 6-8 x 3-3.5 μm , dendrohyphidia present.....	<i>Grammothele fuligo</i>
26a. Navicular basidiospores	<i>Diplomitoporus navisporus</i>
26b. Different shape of basidiospores	27
27a. Basidiospores (8) 9.5 -14 x 3.5 - 5 (6) μm	<i>Antrodia albida</i>
27b. Basidiospores up to 6.5 μm long	28
28a. Cylindrical to allantoid basidiospores	29
28b. Ellipsoid basidiospores	30
29a. Basidiospores 3.5-4 (5) x 1-2 μm , hyphal top with rosette-shaped crystals	<i>Sidera lenis</i>
29b. Basidiospores 4.5-5.5 x 2.5-3 μm , crystals absent	<i>Cinereomyces dilutabilis</i>
30a. Basidiomata yellowish, becoming red when bruised	<i>Junghuhnia carneola</i>
30b. Basidiomata unchanging when bruised	31
31a. Cystidia or encrusted hyphae with crystals absent	<i>Ceriporiopsis flavilutea</i>
31b. Coarsely encrusted skeletocystidia or encrusted hyphae with granular crystals present.....	32
32a. Pores 6-10 per mm and pinkish pore surface	<i>Junghuhnia nitida</i>
32b. Up to 7 pores per mm, whitish to cream pore surface	33
33a. Pores 2-3 (4) per mm, basidiospores (4.5) 5-6.5 x 3-4 (5) μm	<i>Schizopora paradoxa</i>
33b. Pores 5-6 (7) per mm, basidiospores 3-4.5 (5) x (2) 2.5-3 μm	<i>Schizopora flavipora</i>
34a. Distinctly stipitate basidiomata	35
34b. Sessile to effused-reflex basidiomata	38
35a. Dark brown to black stipe, not concolorous with the pileus	36
35b. Cream to brown stipe, concolorous with the pileus	37
36a. Pores 1-2 per mm, tan to beige pileus surface.....	<i>Polyporus guianensis</i>
36b. Pores 5-7 (10) per mm, dark brown to black pileus surface	<i>Polyporus dictyopus</i>
37a. Pores (4) 5-7 per mm, pileus margin usually ciliate.....	<i>Polyporus ciliatus</i>
37b. Pores 2-2 per mm, pileus margin non-ciliate	<i>Polyporus tenuiculus</i>
38a. Monomitic hyphal system	39
38b. Di-trimitic hyphal system.....	42
39a. Pileus upper surface white when fresh, becoming ochraceous to straw coloured with age and when dried	<i>Loweomyces fractipes</i>
39b. Pileus upper surface buff to wood-coloured, or pale pinkish to salmon pinkish, unchanging with age and when dried	40
40a. Basidiospores subglobose, 3.5-4.3 x 2.5-3.2 μm	<i>Flaviporus venustus</i>
40b. Basidiospores ellipsoid to cylindrical, and bigger	41
41a. Ellipsoid to broad ellipsoid basidiospores, 4.6-6 x 3.3-4.3 μm , with thickened walls, pores 1-3 per mm	<i>Spongipellis caseosus</i>

- 41b. Short-cylindrical basidiospores, straight, 5.5-7 x 2.5-3.5 μm , thin-walled, pores 2-5 per mm
 *Bjerkandera fumosa*
- 42a. Encrusted cystidia present 43
- 42b. Encrusted cystidia absent 47
- 43a. Pores 8-10 per mm 44
- 43b. Pores up to 7 per mm 45
- 44a. Pore surface sulphurous yellow when fresh, paler when dry, basidiospores 2.6-2.8 x 1.8-2 μm
 *Flaviporus brownii*
- 44b. Pore surface pale tan to pale straw-coloured, often darker in older specimens, basidiospores
 2.5-3.5 x 1.5-2.5 μm *Flaviporus liebmannii*
- 45a. Cystidia 15-20 μm length *Trichaptum sector*
- 45b. Cystidia 40-100 μm length 46
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Thus, this work extended the knowledge of fungi of São Paulo, with the survey of species polypores of Atlantic Forest of the Serra do Mar, São Paulo, supplying deficiencies in existing databases and gave subsidies to identify the species present in the area.

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References

- Abrahão MC, Gugliotta AM, Gomes E (2009) Poliporóides (Basidiomycota) em fragmentos de mata no perímetro urbano de São José do Rio Preto, São Paulo, Brasil. *Revista Brasileira de Botânica* 32: 427-440.
- Baltazar, JM, Gibertoni, TB (2009) A checklist of the aphylloroid fungi (Basidiomycota) recorded from the Atlantic Rain Forest. *Mycotaxon* 109: 439-442.
- Binder M, Hibett DS, Larsson KH, Larsson E, Langer E, Langer G (2005) The phylogenetic distribution of resupinate forms across the major clades of mushroom-forming fungi (homobasidiomycetes). *Syst. Biodivers.* 3:113–157.
- Binder M, Justo A, Riley R, Salamov A, López-Giráldez F, Sjökvist E, Copeland A, Foster B, Sun H, Larsson E, Larsson KH, Townsend J, Grigoriev IV, Hibbett DS (2013) Phylogenetic and phylogenomic overview of the Polyporales. *Mycologia* 105: 1350–1373.
- Bononi VLR, Trufem SFB, Grandi RAP (1981) Fungos macroscópicos do Parque Estadual das Fontes do Ipiranga, depositados no Herbário do Instituto de Botânica. *Rickia* 9:37-53.
- Coelho G (2005) Brazilian new species of *Auriporia*. *Mycologia* 97:266-270.
- David A, Rajchenberg M (1985) Pore fungi from French Antilles and Guiana. *Mycotaxon* 22(2):285-325.
- Decock, C, Ryvarden L (2000) Studies in neotropical polypores. 6. New resupinate *Perenniporia* species with small pores and small basidiospores. *Mycologia* 92(2):354-360.
- Fidalgo O, Bononi VLR (1984). Técnicas de coleta, preservação e herborização de material botânico. São Paulo, Instituto de Botânica. (Manual n.4).
- Fidalgo O, Fidalgo MEPK (1957) Revisão de Fungi São Paulensis. *Arquivos do Museu Nacional* 43:157-188.
- Fundação SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais - INPE (2009) Atlas dos remanescentes florestais da Mata Atlântica, Período 2005 a 2008. Disponível em: <http://www.sosma.org.br>. (acesso em 06.09.2014).
- Fundação SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais - INPE (2011) Atlas dos remanescentes florestais da Mata Atlântica, Período 2008 a 2012. Disponível em: <http://www.sosma.org.br>. (acesso em 06.09.2014).

- Garcia-Sandoval R, Wang Z, Binder M, Hibbett DS (2011) Molecular phylogenetics of the Gloeophyllales and relative ages of clades of Agaricomycotina producing a brown rot. *Mycologia* 103:510–524.
- Gibertoni TB, Ryvardeen L, Queiros Cavalcanti MA (2004) Studies in neotropical polypores 18 New species from Brazil. *Synop. Fungorum* 18:44-56.
- Gugliotta AM (1997) Polyporaceae de mata ciliar da Estação Experimental e Reserva Biológica de Moji-Guaçu, SP, Brasil. *Hoehnea* 24:89-106.
- Gugliotta AM, Bononi VLR (1999) Polyporaceae do Parque Estadual da Ilha do Cardoso, São Paulo, Brasil. *Boletim do Instituto de Botânica* 12: 1-112.
- Gugliotta AM, Fonsêca MP, Bononi VLR (2010) Additions to the knowledge of aphyllorphoroid fungi (Basidiomycota) of Atlantic Rain Forest in São Paulo State, Brazil. *Mycotaxon* 112: 335-338.
- Gugliotta, AM, Gibertoni, TB, Drechsler-Santos, ER, Silveira, RMB, Chikowski, RS, Pires, RM, Montoya, CAS, Souza, JF, Palacio, M, Rezende, DHC (2015) Polyporales. *In* Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Available: <<http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB92526>>. Access: 11 Mar. 2015.
- Gugliotta AM, Poscolere GD, Campacci TVS (2011) Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. *Fungos*, 10: Ganodermataceae *Hoehnea* 38(4): 687-695.
- Hibbett DS, Donoghue MJ (1995) Progress toward a phylogenetic classification of the Polyporaceae through parsimony analyses of ribosomal DNA sequences. *Can. J. Bot.* 73 (Suppl. 1):S853–S861.
- Jesus MA (1993) Basidiomicetos lignocelulolíticos de floresta nativa e de *Pinus elliottii* Engelm. do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Hoehnea* 20:119-126.
- Larsson KH, Larsson E, Kõljalg U, (2004) High phylogenetic diversity among corticioid homobasidiomycetes. *Mycol. Res.* 108:983–1002.
- Leal GR, Gugliotta, AM (2008) Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Fungos*, 9: Meripilaceae. *Hoehnea* 35(1): 99-110.
- Louza GSG, Gugliotta AM (2007) *Polyporus* Fr. (Polyporaceae) no Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. *Hoehnea* 34: 365-382.
- Lowe JL (1966) Polyporaceae of North America. The genus *Poria*. Technical Publication of the State University College of Forestry at Syracuse University. 90:1-183.
- Miettinen O, Larsson E, Sjökvist E, Larsson KL (2011) Comprehensive taxon sampling reveals unaccounted diversity and morphological plasticity in a group of dimitic polypores (Polyporales, Basidiomycota). *Cladistics* 28:251–7270.

- Mittermeier RA, Gil PR, Hoffmann M, Pilgrim J, Brooks T, Mittermeier CG, Lamoreux J, Fonseca GAB (2004) Hotspots Revisited. CEMEX, Cidade do México.
- Montagne JFC (1856) Sylloge generum specierumque plantarum cryptogamarum. 1-498.
- Motato-Vásquez V, Gugliotta AM (2013) Polypores from an Atlantic rainforest area in southeast Brazil: resupinate species. *Brazilian Journal of Botany* 36 (3), 211-221. DOI: 10.1007/s40415-013-0031-4.
- Motato-Vásquez V, Pires RM, Gugliotta AM (2014) Polypores from an Atlantic rainforest area in southeast Brazil: pileate species. *Brazilian Journal of Botany* 37 (3), 1-16. DOI: 10.1007/s40415-014-0109-7.
- Reck MA, Silveira RMB da (2009) *Grammothele* species from southern Brazil. *Mycotaxon* 109:361–372.
- Ryvarden L (1991) Genera of Polypores. Nomenclature and taxonomy. *Synopsis Fungorum* 5. Oslo, Fungiflora.
- Ryvarden L, Gilbertson RL (1993). European polypores. Part 1. *Synop. Fungorum* 6:1-387.
- Ryvarden L, Gilbertson RL (1994) European polypores – Part 2. *Synop. Fungorum* 7:394-743.
- Ryvarden L, Johansen I (1980) A preliminary polypore flora of East Africa. 1-636.
- Ryvarden L, Meijer AAR de (2002) Studies in neotropical polypores 14. New species from the state of Paraná, Brazil. *Synop. Fungorum* 15:34-69.
- Secretaria de Estado de Meio Ambiente (1996) Atlas das Unidades de Conservação Ambiental do Estado de São Paulo – parte I litoral. São Paulo, SMA.
- Secretaria de Estado de Meio Ambiente (2000) Atlas das Unidades de Conservação Ambiental do Estado de São Paulo. São Paulo, SMA.
- Secretaria de Estado de Meio Ambiente (2008) Plano de manejo do PESM. São Paulo, SMA.
- Soares SCS, Gugliotta AM (1998) Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Fungos*, 7: Aphyllophorales (Hymenochaetaceae). *Hohenea* 25: 11-31.
- Xavier-Santos S, Carvalho CC, Bonfá M, Silva R, Capelari M, Gomes E (2004) Screening for Pectinolytic Activity of Wood-Rotting Basidiomycetes and Characterization of the Enzymes. *Folia Microbiologica* 49 (1): 46–52.

CONSIDERAÇÕES FINAIS

Este trabalho ampliou o conhecimento dos fungos do estado de São Paulo, com o levantamento das espécies de políporos de área de Mata Atlântica da Serra do Mar, estado de São Paulo, suprimindo deficiências nos bancos de dados existentes. Foram fornecidas descrição, ilustrações e chaves de identificação para espécies pertinentes, bem como sequências gênicas (ITS e LSU) de espécimes de políporos que auxiliaram na taxonomia e reconhecimento de espécies novas, subsidiando a identificação destas espécies, suprimindo lacunas existentes no GenBank.

Portanto esse estudo contribuiu de forma significativa para ampliar a documentação da biodiversidade paulista, ressaltando a importância de trabalhos como esse, que buscam conhecer as espécies presentes na natureza. Ainda aponta que, mesmo a mata atlântica sendo um dos domínios morfoclimáticos mais estudados para o grupo em questão, ainda existe muito para ser conhecido de sua riqueza e diversidade, visto que foram encontrados muitos registros novos para o estado, para o país e duas novas espécies para ciência.

REFERÊNCIAS

- Abrahão, M.C., Gugliotta, A.M. & Gomes, E. 2009. Poliporóides (Basidiomycota) em fragmentos de mata no perímetro urbano de São José do Rio Preto, São Paulo, Brasil. *Revista Brasileira de Botânica* 32: 427-440.
- Aguiar, A., Ferraz, A., Contreras, D. & Rodríguez, J. 2007. Mecanismo e aplicações da reação de Fenton assistida por compostos fenólicos redutores de ferro. *Química Nova* 30(3): 623-628.
- Alexopoulos, C.J. & Mims, C.W. 1979. *Introductory mycology*. 3. ed. New York, John Wiley, 632p.
- Amalfi, M.; Yombiyeni, P.; Decock, C. Fomitiporia in sub-Saharan Africa: morphology and multigene phylogenetic analysis support three new species from the Guineo-Congolian rainforest. *Mycologia*, v. 102, n. 6, p. 15, 2010.
- Arantes, V. Baldochi, C. & Milagres, A.M.F. 2006. Degradation and decolorization of a biodegradable-resistant polymeric dye by chelator-mediated Fenton reactions. *Chemosphere* 63: 1764–1772.
- Ayaz, F.A., Torun, H., Özel, A., C, Sesli, E. & Colak, A. 2011. Nutritional value of some wild edible mushrooms from the Black Sea region (Turkey). *Turkish Journal of Biochemistry* 36 (4): 385–393.384.
- Bigarella, J.J. 1991. Aspectos Físicos da Paisagem. In: Fundação S.O.S. Mata Atlântica. 1991. Fundação S.O.S. Mata Atlântica e Editora Index, Rio de Janeiro. p. 65-87.
- Binder, M., Justo, A., Riley, R., Salamov, A., López-Giráldez, F., Sjökvist, E., Copeland, A., Foster, B., Sun, H., Larsson, E., Larsson, K.H., Townsend, J., Grigoriev, I.V. & Hibbett, D.S. 2013. Phylogenetic and phylogenomic overview of the Polyporales. *Mycologia* 105: 1350–1373.
- Binder, M., Justo, A., Riley, R., Salamov, A., López-Giráldez, F., Sjökvist, E., Copeland, A., Foster, B., Sun, H., Larsson, E., Larsson, K.H., Townsend, J., Grigoriev, I.V. & D.S. Hibbett. 2013: Phylogenetic and phylogenomic overview of the Polyporales. *Mycologia* 105: 1350–1373.
- Binder, M.; Hibett, D.S.; Larsson, K.H.; Larsson, E.; Langer, E.; Langer, G. 2005. The phylogenetic distribution of resupinate forms across the major clades of mushroom-forming fungi (homobasidiomycetes). *Syst. Biodivers.* 3:113–157.
- Blanchette, R. A., Crueler, W.E., Height, D.E., Akhtar, M. & Akin, D.E. 1997. Cell wall alterations in loblolly pine wood decayed by the white-rot fungus, *Ceriporiopsis subvermispora*. *Journal of Biotechnology* 53: 203–213.
- Boddy, L. 1991. Importance of wood decay fungi in forest ecosystems. In Arora, D.K., Rai, B., Mukerji, K.G. & Knudsen, G.R. (eds.). *Handbook of Applied Mycology. Volume 1: Soil and Plants*. New York, Marcel Dekker et al. p. 507-540.
- Boddy, L., Frankland, J.C. & van West, P. 2008. *Ecology of Saprotrophic Basidiomycetes*. London, Academic Press. 372p.

- Bononi, V.L.R. 1979. Basidiomicetos do Parque Estadual da Ilha do Cardoso: II. Hymenochaetaceae. *Rickia* 8:85-99.
- Bononi, V.L.R. 1984a. Basidiomicetos do cerrado da reserva Biológica de Moji-Guaçu. *Rickia* 11: 1-25.
- Bononi, V.L.R. 1984b. Basidiomicetos do Parque Estadual da Ilha do Cardoso: IV. Adições às famílias Hymenochaetaceae, Stereaceae e Thelephoraceae. *Rickia* 11:43-52.
- Bononi, V.L.R., Trufem, S.F.B. & Grandi, R.A.P. 1981. Fungos macroscópicos do Parque Estadual das Fontes do Ipiranga, depositados no Herbário do Instituto de Botânica. *Rickia* 9:37-53.
- Boominathan, K. & Reddy, A. 1992. Fungal Degradation of Lignin: Biotechnological Applications. In Arora, D.K., Elander, R.P. & Mukeji, K.G. (eds.). *Handbook of Applied Mycology*. New York, Marcel Dekker. v.4. p.763-822.
- Capelari, M. & Gugliotta, A.M. 2006. Macromicetos no sudeste do Brasil. *In: 57 Congresso Nacional de Botânica, 2006, Gramado. Anais 57 Congresso Nacional de Botânica, v. cd.*
- Capelari, M., Gugliotta, A.M. & Figueiredo, M.B. 1998. O estudo dos fungos macroscópicos no estado de São Paulo. *In* Bicudo, C.E. de M. & Shepherd, G.J. (eds.). *Biodiversidade do estado de São Paulo. Síntese do conhecimento ao final do século XX. 2: fungos macroscópicos e plantas*. São Paulo, FAPESP. p.9-23.
- Coelho G. 2005. Brazilian new species of *Auriporia*. *Mycologia* 97: 266-270.
- Corner, E.J. H. 1932. A *Fomes* with two system of hyphae. *Trans. Br. Mycol. Soc.* 17:51-81.
- Darriba, D., Taboada, G.L., Doallo, R. & D. Posada. 2012: jModelTest 2: more models, new heuristics and parallel computing. *Nature Methods* 9(8): 772-772. <http://dx.doi.org/10.1038/nmeth.2109>
- Desai, S.S. & Nityanand, C. 2011. Microbial lacases and their applications: A Review. 2011. *Asian Journal of Biotechnology* 3(2): 98-124
- Fernandez-Fueyo, E., Ruiz-Duenñas, F. J., Ferreira, P., Floudas, D., Hibbett, D. S., Canessa, P., Larrondo, L. F., James, T. Y., Seelenfreund, D., Lobos, S. et al. 2012. Comparative genomics of *Ceriporiopsis subvermispora* and *Phanerochaete chrysosporium* provide insight into selective ligninolysis. *Proc. Natl. Acad. Sci. U.S.A.* 109, 5458-5463
- Fidalgo, O. & Bononi, V.L.R., coords. 1984. Técnicas de coleta, preservação e herborização de material botânico. São Paulo, Instituto de Botânica. 62p. (Manual n.4).
- Fidalgo, O. & Fidalgo, M.E.P.K. 1957. Revisão de Fungi São Paulensis. *Arquivos do Museu Nacional* 43:157-188.
- Floudas D, Binder M, Riley R, Barry K, Blanchette RA, Henrissat B, Marti'nez AT, Otilar R, Spatafora JW, Yadav JS, Aerts A, Benoit I, Boyd A, Carlson A, Copeland A, Coutinho PM, de Vries RP, Ferreira P, Findley K, Foster B, Gaskell J, Glotzer D, Go'recki P, Heitman J, Hesse C, Hori C, Igarashi K, Jurgens JA, Kallen N, Kersten P, Kohler A, Ku'es U, Kumar TK, Kuo A, LaButti K, Larrondo LF, Lindquist E, Ling A, Lombard V, Lucas S, Lundell T, Martin R, McLaughlin DJ, Morgenstern I, Morin E, Murat C, Nagy LG, Nolan M, Ohm RA,

- Patyshakuliyeva A, Rokas A, Ruiz-Duen~as FJ, Sabat G, Salamov A, Samejima M, Schmutz J, Slot JC, St John F, Stenlid J, Sun H, Sun S, Syed K, Tsang A, Wiebenga A, Young D, Pisabarro A, Eastwood DC, Martin F, Cullen D, Grigoriev IV, Hibbett DS. 2012. The Paleozoic origin of enzymatic lignin decomposition reconstructed from 31 fungal genomes. *Science*, 336:1715–1719.
- Fundação Florestal. 2012. Unidades de Coservação. Disponível em: <http://www.fflorestal.sp.gov.br/hotsites/hotsite/sobre.php> (acesso em 04/09/2012).
- Fundação SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais - INPE. 2009. Atlas dos remanescentes florestais da Mata Atlântica, Período 2005 a 2008. Disponível em: <http://www.sosma.org.br>. (acesso em 06.09.2012).
- Fundação SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais - INPE 2011. Atlas dos remanescentes florestais da Mata Atlântica, Período 2008 a 2012. Disponível em: <http://www.sosma.org.br>. (acesso em 06.09.2012).
- Garcia-Sandoval, R.; Wang, Z.; Binder, M.; Hibbett, D.S. 2011. Molecular phylogenetics of the Gloeophyllales and relative ages of clades of Agaricomycotina producing a brown rot. *Mycologia* 103:510–524.
- Gibertoni, T.B., Gomes-Silva, A.C., Lira, C.R.S., Melo, G.S.N., Silva, V.F., Araújo Neta, L. & Drechsler-Santos, E.R. 2012. Hymenochaetales. *In* Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/2012/FB000017> (acesso em 05.09.2012).
- Glazer, A.N. & Nikaido, H. 1995. *Microbial biotechnology: fundamentals of applied microbiology*. New York, W.H. Freeman and Company. 660p.
- Goodell, B., Jellison, J., Lui, J., Daniel, G., Paszcynski, A., Fekete, F., Krishnamurthy, S., Jun, L. & Xu, G. 1997. Low molecular weight chelators and phenolic compounds isolated from wood decay fungi and their role in the fungal biodegradation of wood. *Journal of Biotechnology* 53: 133-162.
- Gugliotta, A.M. & Abrahão, M.C. 2012. Polyporales *in* Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/2012/FB000023> (acesso em 05.09.2012).
- Gugliotta, A.M. 1997. Polyporaceae de mata ciliar da Estação Experimental e Reserva Biológica de Moji-Guaçu, SP, Brasil. *Hoehnea* 24:89-106.
- Gugliotta, A.M. Fonsêca, M.P. & Bononi, V.L.R. 2010. Additions to the knowledge of aphyllorphoroid fungi (Basidiomycota) of Atlantic Rain Forest in São Paulo State, Brazil. *Mycotaxon* 112: 335-338.
- Gugliotta, A.M. & Bononi, V.L.R. 1999. Polyporaceae do Parque Estadual da Ilha do Cardoso, São Paulo, Brasil. *Boletim do Instituto de Botânica* 12: 1-112.
- Gugliotta, A.M., Gibertoni, T.B., Drechsler-Santos, E.R., Silveira, R.M.B., Chikowski, R.S., Pires, R.M., Montoya, C.A.S., Souza, J.F., Palacio, M., Rezende, D.H.C. 2015. Polyporales. *In*

- Lista de Espécies, da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Disponível em: <<http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB92526>>. Acesso em: 12 Mar. 2015
- Gugliotta, A.M., Poscolere, G.D. & Campacci, T.V.S. 2011. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. *Fungos*, 10: Ganodermataceae *Hoehnea* 38(4): 687-695.
- Hall T.A. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symp. Ser.* 41: 95–98.
- Hibbet, D.S. *et al.* 2007. A higher-level phylogenetic classification of the Fungi. *Mycological Research* 111: 509-547.
- Hibbett, D.S.; Donoghue, M.J. 1995. Progress toward a phylogenetic classification of the Polyporaceae through parsimony analyses of ribosomal DNA sequences. *Can. J. Bot.* 73 (Suppl. 1): S853–S861.
- Hibbett, D.S.; Donoghue, M.J. 2001. Analysis of character correlations among wood decay mechanisms, mating systems, and substrate ranges in homobasidiomycetes. *Syst Biol* 50: 215–42.
- INCT – Herbário Virtual da Flora e dos Fungos. 2015. Lacunas de conhecimento da flora e dos fungos do Brasil <http://lacunas.inct.florabrasil.net/index>. (acesso em 05.03.2015).
- Jesus, M.A. 1993. Basidiomicetos lignocelulolíticos de floresta nativa e de *Pinus elliottii* Engelm. do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Hoehnea* 20:119-126.
- Justo, A.; Hibbett, D. S. 2011. Phylogenetic classification of *Trametes* (Basidiomycota, Polyporales) based on a five-marker dataset. *Taxon*, v. 60, n. 6, p. 17.
- Kirk, P.M., Cannon, P.F., Minter, D.W. & Stalpers, J.A. 2008. *Dictionary of the Fungi*. 10th ed., CABI Publishing, Wallingford. 771p.
- Korbie, D.J. & J.S. Mattick. 2008: Touchdown PCR for increased specificity and sensitivity in PCR amplification. *Nature Protocols* 3: 1452–1456.
- Küppers, H. 2002. *Atlas de los colores*. Blume, Barcelona.
- Larsson K.H.; Larsson, E.; Kõljalg, U. 2004. High phylogenetic diversity among corticioid homobasidiomycetes. *Mycol. Res.* 108:983–1002.
- Larsson, K.H. Parmasto, E., Fischer, M., Langer, E., Nakasone, K.K., Redhead, S.A. 2006. "Hymenochaetales: a molecular phylogeny for the hymenochaetoid clade". *Mycologia* 98: 926–936. doi:10.3852/mycologia.98.6.926
- Leal, G.R. & Gugliotta, A.M. 2008. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Fungos*, 9: Meripilaceae. *Hoehnea* 35(1): 99-110.
- Lesage-Meessen, L. *et al.* 2011. Phylogeographic relationships in the polypore fungus *Pycnoporus* inferred from molecular data. *Research Letter*, v. 325, p. 12,
- Lodge, D.J., Ammirati, J. O'Dell, T.E., Mueller, G.M., Huhndorf, S.M., Wang, C., Stokland, J.N., Schimit, J.P., Ryvardeen, L., Leacock, P.R., Mata, M., Umaña, L., Wu, Q. & Czederpiltz, D.L. 2004. Terrestrial and lignicolous macrofungi. *In*: Mueller, G.M., Bills, G.F. & Foster,

- M.S. (Eds.) Biodiversity of Fungi: Inventory and monitoring methods. Elsevier Academic Press, San Diego, pp. 127-172.
- Louza, G.S.G. & Gugliotta, A.M. 2007. *Polyporus* Fr. (Polyporaceae) no Parque Estadual das Fontes do Ipiranga, São Paulo, SP, Brasil. *Hoehnea* 34: 365-382.
- Lundell, T.K., Mäkelä, M.R. & Hildén, K. 2010. Lignin-modifying enzymes in filamentous basidiomycetes – ecological, functional and phylogenetic review. *Journal of Basic Microbiology* 50: 5-20.
- Lyra, E.S., Moreira, K.A., Porto, T.S., Carneiro da Cunha, M.N., Paz Júnior, F.B., Neto, B.B., Lima-Filho, J.L., Cavalcanti, M.A.Q., Converti, A. & Porto, A.L.P. 2009. Decolorization of synthetic dyes by basidiomycetes isolated from woods of the Atlantic Forest (PE), Brazil. *World Journal of Microbiology and Biotechnology* 25:1499-1504.
- Machado, K.M.G., Compart, L.C.A., Morais, R.O., Rosa, L.H. & Santos, M.H. 2006. Biodegradation of reactive textile dyes by basidiomycetous fungi from Brazilian ecosystems. *Brazilian Journal of Microbiology* (2006) 37:481-487
- Machado, K.M.G., Matheus, D.R., Monteiro, R.T.R. & Bononi, V.L.R. 2005. Biodegradation of pentachlorophenol by tropical basidiomycetes in soils contaminated with industrial residues. *World Journal of Microbiology & Biotechnology* 21: 297-301.
- Machuca, A.E.H. 1995. Produção e caracterização parcial de um composto de baixa massa molecular, com atividade fenoloxídásica, de *Thermoascus aurantiacus*. Tese de Doutorado em Bioquímica, Universidade Estadual de Campinas, Campinas.
- Martinez D, Larrondo LF, Putnam N, Gelpke MD, Huang K, Chapman J, Helfenbein KG, Ramaiya P, Detter JC, Larimer F, Coutinho PM, Henrissat B, Berka R, Cullen D, Rokhsar D. 2004. Genome sequence of the lignocellulose-degrading fungus *Phanerochaete chrysosporium* strain RP78. *Nat Biotechnol.* 22:695–700.
- Martinez, D., Challacombe, J., Morgenstern, I., Hibbett, D., Schmoll, M., Kubicek, C. P., Ferreira, P., Ruiz-Duenas, F. J., Martinez, A. T., Kersten, P., Hammel, K. E., Vanden Wymelenberg, A., Gaskell, J., Lindquist, E., Sabat, G., Bondurant, S. S., Larrondo, L. F., Canessa, P., Vicuna, R., Yadav, J., Doddapaneni, H., Subramanian, V., Pisabarro, A. G., Lavín, J. L., Oguiza, J. A., Master, E., Henrissat, B., Coutinho, P. M., Harris, P., Magnuson, J. K., Baker, S. E., Bruno, K., Kenealy, W., Hoegger, P. J., Kües, U., Ramaiya, P., Lucas, S., Salamov, A., Shapiro, H., Tu, H., Chee, C. L., Misra, M., Xie, G., Teter, S., Yaver, D., James, T., Mokrejs, M., Pospisek, M., Grigoriev, I. V., Brettin, T., Rokhsar, D., Berka, R., and Cullen, D. 2009. Genome, transcriptome, and secretome analysis of wood decay fungus *Postia placenta* supports unique mechanisms of lignocellulose conversion. *Proc. Natl. Acad. Sci. U.S.A.* 106, 1954–1959
- Matheus, D.R. & Okino, L.K. 1998. Utilização de Basidiomicetos em processos biotecnológicos. *In: Bononi, V.L.R. (org.). Zigomicetos, Basidiomicetos e Deuteromicetos: noções básicas de taxonomia e aplicações biotecnológicas.* São Paulo: Instituto de Botânica. p. 106-139.

- Matheus, D.R., Bononi, V.L.R. & Machado, K.M.G. 2000. Biodegradation of hexachlorobenzene by basidiomycetes in soils contaminated with industrial residues. *World Journal of Microbiology and Biotechnology* 16: 415-421.
- Miettinen O, Larsson E, Sjökvist E, Larsson KL. 2011. Comprehensive taxon sampling reveals unaccounted diversity and morphological plasticity in a group of dimitic polypores (Polyporales, Basidiomycota). *Cladistics* 28:251–7270.
- Miettinen, O., Rajchenberg, M. 2012. *Obba* and *Sebipora*, new polypore genera related to *Cinereomyces* and *Gelatoporia* (Polyporales, Basidiomycota). *Mycol. Prog.* 11:131–147.
- Milagres, A.M.F., Arantes, V., Medeiros, C.L. & Machuca, A. 2002. Production of metal chelating compounds by white and brown-rot fungi and their comparative abilities for pulp bleaching. *Enzyme and Microbial Technology* 30: 562-565.
- Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. 2004. Hotspots Revisited. CEMEX, Cidade do México.
- Moncalvo, J.-M.; Buchanan, P. K. 2008. Molecular evidence for long distance dispersal across the Southern Hemisphere in the *Ganoderma applanatum-australe* species complex (Basidiomycota). *Mycological research*, v. 112, p. 12.
- Moreno, G.; Blanco, M.N.; Checa, J.; Platas, G.; Peláez, F. 2011. Taxonomic and phylogenetic revision of three rare irpicoid species within the Meruliaceae. *Mycol. Prog.* 10: 481–491.
- Motato-Vásquez, V., Gugliotta, A.M. 2013. Polypores from an Atlantic rainforest area in southeast Brazil: resupinate species. *Brazilian Journal of Botany* 36 (3), 211-221. DOI: 10.1007/s40415-013-0031-4.
- Motato-Vásquez, V., Pires, R.M., Gugliotta, A.M. 2014. Polypores from an Atlantic rainforest area in southeast Brazil: pileate species. *Brazilian Journal of Botany* 37 (3), 1-16. DOI: 10.1007/s40415-014-0109-7.
- Nei, M. & S. Kumar. 2000: *Molecular Evolution and Phylogenetics*. – Oxford University Press, New York.
- Nilsson, R. H. et al. 2006. Taxonomic Reliability of DNA Sequences in Public Sequence Databases: A Fungal Perspective. *PLoS ONE*, v. 1, n. 1, p. 4.
- Okino, L.K., 1996. Atividade ligninolítica de basidiomicetos brasileiros. Rio Claro. Dissertation MSc—Universidade Estadual Paulista ‘Júlio de Mesquita Filho’.
- Okino, L.K., Machado, K.M.G., Fabris, C. & Bononi, V.L.R. 2000. Ligninolytic activity of tropical rainforest basidiomycetes. *World Journal of Microbiology & Biotechnology* 16: 889-893.
- Okino, L.K., Machado, K.M.G., Fabris, C. & Bononi, V.L.R. 2000. Ligninolytic activity of tropical rainforest basidiomycetes. *World Journal of Microbiology and Biotechnology* 16: 889-893.
- Ortiz-Santana, B., Lindner, D.L., Miettinen, O., Justo, A., Hibbet, D.S. 2013. A phylogenetic overview of the antrodia clade (Basidiomycota, Polyporales). *Mycologia* 105(6): 1391-1411.
- Prado, J., Marcelli, M.P., Gugliotta, A.M., Bicudo, C.E.M., Bicudo, D.C., Yano, O. & Peralta D.F. 2008. Criptógamas. *In*: Rodrigues, R R. & Bononi, V.L.R. (orgs.) *Diretrizes para a*

- Conservação e Restauração da Biodiversidade no Estado de São Paulo. São Paulo: Instituto de Botânica. 110-121.
- Rajchenberg M. 2006. Los Políporos (Basidiomycetes) de los Bosques Andino Patagónicos de Argentina. *Biblioteca Mycologica* 201: 1-300.
- Rajchenberg, M. 2006. Los Políporos (Basidiomycetes) de los Bosques Andino Patagónicos de Argentina. *Bibliotheca Mycologica*, pp. 1- 295.
- Rayner, A.D.M. 1995. Fungi, a vital component of ecosystem function in woodland. *In*: Allsopp, D., Colwell, R.R. & Hawksworth, D.L. (eds.). *Microbial Diversity and Ecosystem Function*. Cambridge, University Press. p. 231-251.
- Robert, V., Stegehuis, G. & J. Stalpers. 2005. The MycoBank engine and related databases. <http://www.mycobank.org> (Accessed 07 Feb. 2014).
- Ronquist F, Teslenko M, van der Mark p, Ayres D, Darling A, Höhna S, Larget B, Liu L, Suchard MA, Huelsenbeck JP. 2012. MrBayes 3.3: efficient Bayesian phylogenetic inference and model choice across a large model space. *Syst. Biol.* 61: 539–542. <http://dx.doi.org/10.1093/sysbio/sys029>
- Ryvarden, L. 1991. Genera of Polypores. Nomenclature and taxonomy. *Synopsis Fungorum* 5. Oslo, Fungiflora. 363p.
- Schwyn, B. & Neilands, J.B. 1997. Universal chemical assay for the detection and determination of siderophores. *Anal. Biochem.* 160: 46-56.
- Secretaria de Estado de Meio Ambiente. 1996. Atlas das Unidades de Conservação Ambiental do Estado de São Paulo – parte I litoral. São Paulo, SMA. 30p. + 7 mapas.
- Secretaria de Estado de Meio Ambiente. 2000. Atlas das Unidades de Conservação Ambiental do Estado de São Paulo. São Paulo, SMA. 64p. + 19 mapas.
- Singer, R. 1986. *The Agaricales in modern taxonomy*, 4th ed. Koenigstein: Koeltz Scientific Books. 981 p. + 88 pl.
- Smith, D. & Onions, A.H.S. 1994. *Preservation and Maintenance of Living Fungi*. 2nd ed. Wallingford, CAB International, UK, pp. 1-122.
- Soares, S.C.S. & Gugliotta, A.M. 1998. Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. Fungos, 7: Aphyllophorales (Hymenochaetaceae). *Hohenaea* 25: 11-31.
- Stalpers, J.A. 1978. Identification of Wood-inhabiting Aphyllophorales in pure culture. *Studies in mycology* 16: 1-248. (Disponível em <http://www.cbs.knaw.nl/publications/1016/full%20text.htm>).
- Stamatakis, S. 2006. RaxML-VI-HPC: Maximum likelihood-based phylogenetic analysis with thousands of taxa and mixed models. *Bioinformatics* 22: 2688–2690.
- Tamura, K., Nei, M. & S. Kumar. 2004: Prospects for inferring very large phylogenies by using the neighbor-joining method. *Proceedings of the National Academy of Sciences (USA)* DOI:10.11030-11035.

- Tamura, K., Stecher, G., Peterson, D., Filipiński, A. & S. Kumar. 2013: MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0. *Molecular Biology and Evolution* 30: 2725–2729.
- Vlasák, J.; Kout, J.; Dvořák, D. 2010. Taxonomical position of polypore *Dichomitus albidofuscus*: *Donkioporia albidofusca* comb. nov. *Mycol Progress*, v. 9, p. 4.
- Webster, J. & Weber, R.W.S. 2007. *Introduction to Fungi*. Cambridge, Cambridge University Press. 3rd ed. 841p.
- Welti, S., Moreau, P.-A., Favel, A., Courtecuisse, R., Haon, M., Navarro, D., Taussac, S. & Lesage-Meessen, L. 2012. Molecular phylogeny of *Trametes* and related genera, and description of a new genus *Leiotrametes*. *Fungal Diversity* 55:47–64. DOI 10.1007/s13225-011-0149-2
- White, T.J., Bruns, T., Lee, S. & J. Taylor. 1990: Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *In: PCR Protocols: a guide to methods and applications*. San Diego, Academic Press.
- Xavier-Santos, S. 2003. Isolamento, identificação e perfil enzimático de fungos decompositores de madeira da Estação Ecológica do Noroeste Paulista - São José do Rio Preto/Mirassol, SP. Tese de Doutorado, Universidade Estadual Paulista, Rio Claro.
- Xavier-Santos, S., Carvalho, C.C., Bonfá, M., Silva, R., Capelari, M. & Gomes, E. 2004. Screening for Pectinolytic Activity of Wood-Rotting Basidiomycetes and Characterization of the Enzymes. *Folia Microbiologica* 49 (1): 46–52.