Rev Iberoam Micol. xxx (xxxx) xxx–xxx

Revista Iberoamericana de Micología

www.elsevier.es/reviberoammicol

Note

First report of *Sporothrix brasiliensis* in a Southern Giant Petrel (*Macronectes giganteus*): Implications for One Health

Vanice Rodrigues Poester [a,b,*], Mariana Rodrigues Trápaga [a,b], Jessica E. Dávila Hidalgo [a,b], Lívia Silveira Munhoz [b], Aryse Martins Melo [c], Emanoel Bartz Tapi [b], Paula Lima Canabarro [d], Theun de Groot [e,f], Bram Spruijtenburg [e,f], Eelco F.J. Meijer [e,f], Melissa Orzechowski Xavier [a,b]

[a] *Programa de Pós-Graduação em Ciências da Saúde, Faculdade de Medicina (FAMED), Universidade Federal do Rio Grande (FURG), Rio Grande Rio Grande do Sul State (RS), Brazil*
[b] *Laboratório de Micologia (FAMED-FURG), Rio Grande, RS, Brazil*
[c] *One Health Disease Control Group, Infectious Disease Epidemiology Department, Bernhard-Nocht-Institut für Tropenmedizin, Hamburg, Germany*
[d] *Centro de Reabilitação de Animais Marinhos (CRAM), Rio Grande, RS, Brazil*
[e] *Radboudumc-CWZ Center of Expertise for Mycology, Nijmegen, The Netherlands*
[f] *Department of Medical Microbiology and Immunology, Canisius-Wilhelmina Hospital (CWZ)/Dicoon, Nijmegen, The Netherlands*

ARTICLE INFO

Article history:
Received 31 January 2026
Accepted 18 March 2026
Available online xxx

Keywords:
Sporotrichosis
Sporothrix habitat
Sea birds pathogens
Zoonotic fungal disease
Emerging mycoses

ABSTRACT

Background: *Sporothrix brasiliensis* is an emerging fungal pathogen whose environmental reservoirs remain unclear. There are hypothesized reservoirs involving seabirds.
Case report: We report the first detection of *S. brasiliensis* in a *Macronectes giganteus* specimen rescued in southern Brazil. The fungus was isolated from the cloaca and identified by polymerase chain reaction (PCR) and sequencing. Short tandem repeat (STR) genotyping revealed a distinct profile of the isolate compared to previously described strains. The results revealed that the isolate possessed a wild-type profile to amphotericin B and itraconazole, and a non-wild-type profile to terbinafine.
Conclusions: Findings suggest that migratory seabirds and marine environments may influence *S. brasiliensis* dissemination, underscoring the need for broader One Health surveillance at a global level.

© 2026 The Authors. Published by Elsevier España, S.L.U. on behalf of Asociación Española de Micología. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Primer reporte de *Sporothrix brasiliensis* en un petrel gigante del sur (*Macronectes giganteus*): implicaciones para Una Sola Salud

Palabras clave:
Esporotricosis
Hábitat de *Sporothrix*
Patógenos en aves marinas
Enfermedad fúngica zoonótica
Micosis emergentes

RESUMEN

Antecedentes: *Sporothrix brasiliensis* es un patógeno fúngico emergente, cuyos reservorios ambientales siguen siendo poco claros. Algunas hipótesis apuntan a las aves marinas como posibles reservorios.
Caso clínico: Reportamos el aislamiento de *S. brasiliensis* por primera vez en un ejemplar de *Macronectes giganteus* rescatado en el sur de Brasil. El hongo fue aislado de la cloaca del animal e identificado mediante reacción en cadena de la polimerasa (PCR) y secuenciación. La genotipificación por repeticiones cortas en tándem (STR) reveló la existencia en el aislamiento de un perfil distinto en comparación con cepas previamente descritas. Se detectó un perfil de tipo silvestre para la anfotericina B y el itraconazol, y un perfil no silvestre para la terbinafina.
Conclusiones: Los hallazgos sugieren que las aves marinas migratorias y los ambientes marinos pueden influir en la diseminación de *S. brasiliensis*, lo que refuerza la necesidad de una vigilancia más amplia bajo el enfoque de Una Salud (One Health) a nivel global.

© 2026 Los Autores. Publicado por Elsevier España, S.L.U. en nombre de Asociación Española de Micología. Este es un artículo Open Access bajo la licencia CC BY (http://creativecommons.org/licenses/by/4.0/).

* Corresponding author.
E-mail address: vanicerp@gmail.com (V. Rodrigues Poester).

https://doi.org/10.1016/j.riam.2026.03.001
1130-1406/© 2026 The Authors. Published by Elsevier España, S.L.U. on behalf of Asociación Española de Micología. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Please cite this article as: V. Rodrigues Poester, M. Rodrigues Trápaga, J.E. Dávila Hidalgo et al., First report of *Sporothrix brasiliensis* in a Southern Giant Petrel (*Macronectes giganteus*): Implications for One Health, Rev Iberoam Micol., https://doi.org/10.1016/j.riam.2026.03.001

UNCORRECTED PROOF

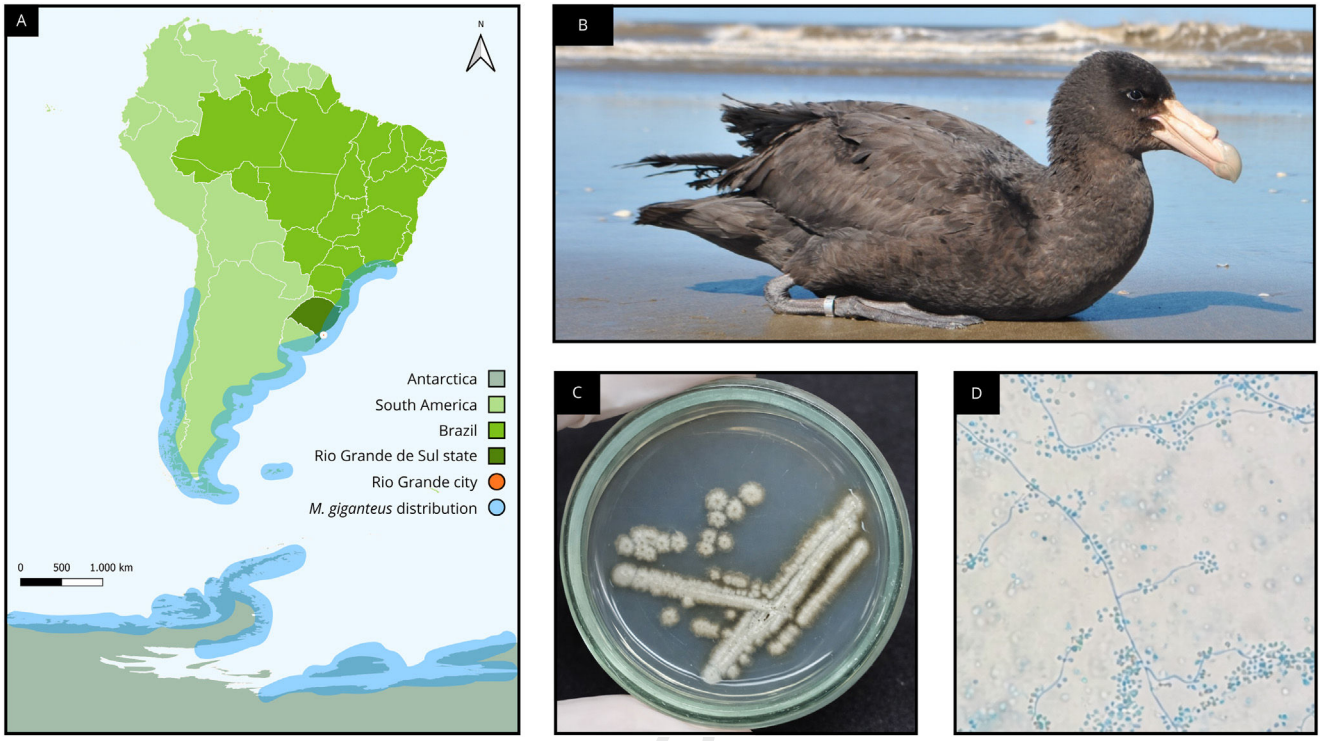

Fig. 1. (A) Map of South America highlighting the city of Rio Grande, in the state of Rio Grande do Sul, Brazil, where Cassino Beach is located, as well as the migratory route and distribution area of the Southern Giant Petrel (*Macronectes giganteus*). (B) Specimen of Southern Giant Petrel from which *Sporothrix brasiliensis* was isolated. (C) Plate showing a subculture of the *S. brasiliensis* strain isolated from the cloacal mucosa of the bird. (D) Microscopic view of the *S. brasiliensis* strain (400× magnification.).

Q3 Sporothrix genus includes over 50 species in environmental and clinical clades.[1] The clinical clade comprises *Sporothrix brasiliensis*, *Sporothrix schenckii*, *Sporothrix globosa*, and *Sporothrix luriei*.[4] *S. brasiliensis* is primarily spread through bites and scratches from infected cats, making it a key zoonotic pathogen, while the other three species are mainly environmentally transmitted.[1,21] Zoonotic sporotrichosis outbreaks were first reported in Brazil in the 1990s, in Rio de Janeiro and Rio Grande do Sul.[2,9] It is now a major public health issue in Brazil and neighboring countries and is considered an emerging global concern.[21] Early cases in coastal areas suggest a link between *S. brasiliensis* and saline environments[12]; fish-related traumatic infections have also been documented.[7]

Despite its clinical importance, little is known about the environmental habitat of *S. brasiliensis*. Although isolated from soil in coastal and hyperendemic areas, its ecological niche remains unclear,[11,13] highlighting the need to investigate potential reservoirs, especially in marine ecosystems, and their role in its spread. Furthermore, the detection of *S. brasiliensis* DNA by metabarcoding in Antarctic soil serves to further encourage studies of this nature, thereby contributing to a One Health perspective and to a more comprehensive understanding of *S. brasiliensis* dispersion.[15] Migratory birds, particularly marine species, may disperse fungal pathogens, as seen with azole-resistant *Aspergillus*.[8] These birds can transport emerging fungi across countries and even to Antarctica. The emergence of *S. brasiliensis* in Patagonia[18] may relate to migratory routes connecting Antarctic/sub-Antarctic regions, Brazil, and Chile. Understanding coastal environmental roles in *S. brasiliensis* transmission is still needed. Here, we report the isolation of a *S. brasiliensis* strain that had colonized the cloaca of a Southern Giant Petrel (*Macronectes giganteus*) from southern Brazil.

A juvenile female Southern Giant Petrel, dehydrated and lethargic, was rescued on August 6th, 2022, at Cassino Beach, southern Brazil (Fig. 1). The animal was taken to a rehabilitation center (CRAM/FURG), where oral and cloacal swabs were collected and sent to the Mycology Laboratory – FURG. Samples were cultured on Sabouraud dextrose agar with chloramphenicol and incubated at 25 °C for 15 days. Despite intensive care, the animal deteriorated and died 24 h after admission. Necropsy showed no macroscopic lesions, but a large amount of stomach debris. Histopathology revealed marked diffuse pulmonary congestion without digestive tract alterations, yielding an inconclusive cause of death.

After five days of incubation, a filamentous colony obtained from the cloacal sample was identified as *Sporothrix* sp. based on macroscopic and microscopic features (Fig. 1). After genomic DNA extraction, species confirmation was achieved by *S. brasiliensis*-specific polymerase chain reaction and calmodulin gene sequencing[14,20] (GenBank accession number: PX939563). Sequences were aligned using MEGA 5.2.2 and confirmed by BLAST analysis. The isolate was also subjected to short tandem repeat (STR) analysis targeting tri- and hexanucleotide repeats, with copy number assessed on a 3500XL genetic analyzer[17] and compared with previously genotyped strains (Fig. 2).[5] These control strains were all clinical and had been collected from humans, cats or dogs between 2012 and 2025. Antifungal susceptibility to amphotericin B, itraconazole, and terbinafine was assessed using CLSI-M38-A2. Epidemiological cutoff values (ECVs) were 4 μg/mL, 2 μg/mL, and 0.125 μg/mL, respectively.[6] The isolate was wild-type for amphotericin B (2 μg/mL) and itraconazole (0.5 μg/mL), but non-wild-type for terbinafine (4 μg/mL).

The present study reports the first documented case of *S. brasiliensis* colonization in a migratory seabird, the Southern Giant Petrel,[19] thereby contributing to the expansion of knowledge regarding the dispersal of this pathogen. The finding suggests marine ecosystems may act as niches, and migratory seabirds as dispersers. Supporting this hypothesis, early outbreaks occurred along the Brazilian coast and recent cases were reported in Chilean Patagonia, regions overlapping the migratory routes of *M. giganteus*.[10,12,19,21]

Southern giant petrels are known to migrate from the Antarctic region to as far north as São Paulo, Brazil. However, their highest

UNCORRECTED PROOF

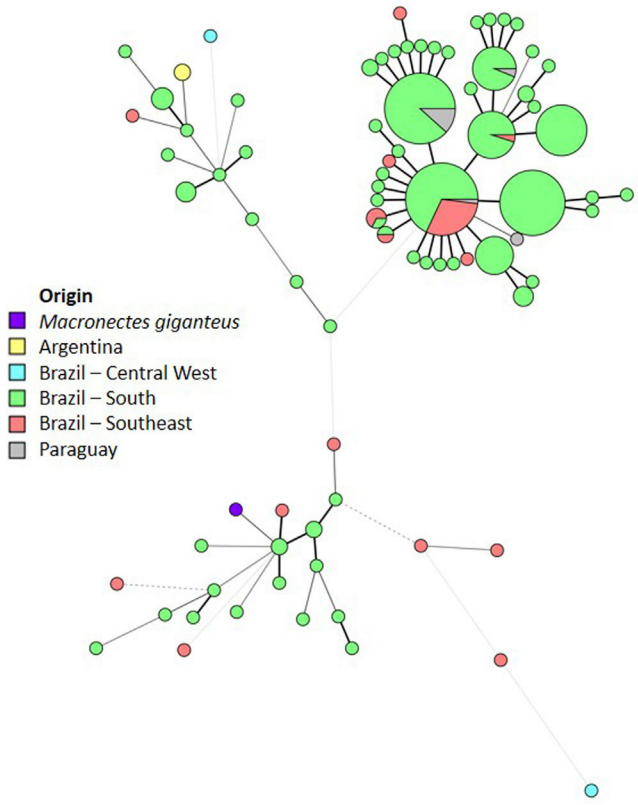

Fig. 2. Genetic comparison of the *Sporothrix brasiliensis* strain isolated from the cloaca of a *Macronectes giganteus* specimen with previously genotyped isolates, based on short tandem repeat genotyping. Minimum spanning tree illustrates the genetic relationships between the *S. brasiliensis* isolate obtained from the cloaca of the bird and other strains reported in the literature. Branch lengths indicate levels of genetic variation between isolates: thick solid lines (variation in one short tandem repeat-STR marker), thin solid lines (variation in two markers), thin dashed lines (variation in three markers), and thin dotted lines (variation in four or more markers).

incidence in Brazil occurs in the state of Rio Grande do Sul,[10,16] our region. An interesting aspect of this species is its feeding behavior. Southern giant petrels are opportunistic predators and scavengers, feeding on live vertebrate prey, as well as the carcasses of birds, fish and marine mammals.[21] They are also frequently observed following fishing boats to feed on discards. These feeding habits may bring them into close contact with a wide range of animal species and human activities, potentially influencing their microbiota.[3] This ecological behavior may help explain the potential transmission and host-switching of *S. brasiliensis* isolated from the cloaca of the petrel.

The *S. brasiliensis* isolate analyzed in this study exhibited a unique genotype when compared to previously documented strains.[5] Interestingly, it also did not cluster within the major clade described in the literature, which predominantly comprises isolates from the Brazilian states Paraná and Rio de Janeiro. Instead, it grouped more closely with isolates from the southern and southeastern regions of Brazil, including strains from Rio Grande do Sul,[17] suggesting a distinct genetic background that aligns with its geographic context and potentially brings insights of local transmission dynamics. Regarding antifungal susceptibility, the isolate was identified as non-wild-type for terbinafine. This highlights the need for future studies to investigate the mechanisms underlying the reduced terbinafine susceptibility in *S. brasiliensis*, as well as the potential role of the environment and wild animals in generating or disseminating this non-susceptibility condition.

The limitations of this study include its design as a single case report, providing data from only one animal and one sample (as the bird died within 24 h). Consequently, we lack information to support a robust interpretation of this finding, and it remains uncertain whether *S. brasiliensis* constitutes a permanent or transient part of this and other seabirds, whether in the specimen affected it was acquired through ingestion of contaminated garbage or animal carcasses, or whether it originated from Antarctic/subantarctic regions where these birds breed. Despite these limitations, the novelty of this finding serves as an alert and underscores the urgency of further studies to address these questions.

In conclusion, our study reports novel insights on the potential transmission dynamics of *S. brasiliensis*, the main emerging agent of sporotrichosis. It underscores the urgent need for a One Health approach to expand both animal and environmental surveillance efforts, including Antarctic/Subantarctic regions, to better understand the ecology and transmission of *S. brasiliensis*. Additionally, it emphasizes the importance of investigating other marine animals as potential reservoirs and/or dispersers of this pathogen, including strains with wild-type and non-wild-type susceptibility profiles to antifungal drugs.

ORCID ID

Mariana Rodrigues Trápaga: 0000-0003-1407-8135
Jessica E. Dávila Hidalgo: 0009-0003-3178-0943
Lívia Silveira Munhoz: 0000-0002-3538-5006
Aryse Martins Melo: 0000-0002-6655-8715
Paula Lima Canabarro: 0009-0001-5413-5301
Theun de Groot: 0000-0001-5841-6461
Bram Spruijtenburg: 0000-0002-6734-361X
Eelco F.J. Meijer: 0000-0002-0226-024X
Melissa Orzechowski Xavier: 0000-0002-3883-0080

Authors' contributions

Conceptualization: Vanice Rodrigues Poester, Mariana Rodrigues Trápaga and Melissa Orzechowski Xavier; Methodology: Mariana Rodrigues Trápaga, Jessica E. Dávila Hidalgo, Lívia Silveira Munhoz, Aryse Martins Melo, Emanoel Bartz Tapi, Paula Lima Canabarro, and Bram Spruijtenburg; Formal analysis: Vanice Rodrigues Poester, Mariana Rodrigues Trápaga, Paula Lima Canabarro, Bram Spruijtenburg and Melissa Orzechowski Xavier; Writing – original draft preparation: Vanice Rodrigues Poester and Mariana Rodrigues Trápaga; Writing – review and editing: Theun de Groot, Bram Spruijtenburg, Eelco F.J. Meijer, and Melissa Orzechowski Xavier. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest pertaining to this work.

Acknowledgements

The authors are grateful to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ), Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (FAPERGS number: 24/2551-0000720-2; 25/2551-0000888-3, and 25/2551-0002804-3), and Pesquisa Ecológica de Longa Duração no Estuário da Lagoa dos Patos e Costa Marinha Adjacente.

CORRECTED PROOF

References

1. Almeida-Paes R, Gutierrez-Galhardo MC, Zancopé-Oliveira RM. Sporotrichosis. In: Zaragoza Ó, Casadevall A, editors. Encyclopedia of mycology. Elsevier; 2021. p. 676–86, http://dx.doi.org/10.1016/B978-0-12-809633-8.21012-1.
2. Barros MBL, Schubach TM, Galhardo MC, de Oliviera Schubach A, Monteiro PC, Reis RS, et al. Sporotrichosis: an emergent zoonosis in Rio de Janeiro. Mem Inst Oswaldo Cruz. 2001;96:777–9, http://dx.doi.org/10.1590/s0074-02762001000600006.
3. BirdLife International. Southern giant petrel *Macronectes giganteus*. BirdLife species factsheet; 2004. Retrieved from: https://datazone.birdlife.org/species/factsheet/southern-giant-petrel-macronectes-giganteus/refs.
4. de Beer ZW, Duong TA, Wingfield MJ. The divorce of *Sporothrix* and *Ophiostoma*: solution to a problematic relationship. Stud Mycol. 2016;83:165–91, http://dx.doi.org/10.1016/j.simyco.2016.07.001.
5. do Prado C, Spruijtenburg B, Razzolini E, Chiyo L, Santi C, Martins C, et al. *Sporothrix brasiliensis* treatment failure without initial elevated itraconazole MICs in felids at border of Brazil. Emerg Infect Dis. 2025;31:1783–92, http://dx.doi.org/10.3201/eid3109.250156.
6. Espinel-Ingroff A, Abreu DPB, Almeida-Paes R, Brilhante RSN, Chakrabarti A, Chowdhary A, et al. Multicenter, international study of MIC/MEC distributions for definition of epidemiological cutoff values for *Sporothrix* species identified by molecular methods. Antimicrob Agents Chemother. 2017;61, http://dx.doi.org/10.1128/AAC.01057-17, e01057-17.
7. Haddad VJ, Miot HA, Bartoli LD, Cardoso Ade C, de Camargo RM. Localized lymphatic sporotrichosis after fish-induced injury (*Tilapia* sp.). Med Mycol. 2002;40:425–7, http://dx.doi.org/10.1080/mmy.40.4.425.427.
8. Melo AM, Stevens DA, Tell LA, Veríssimo C, Sabino R, Xavier MO. Aspergillosis, avian species and the One Health perspective: the possible importance of birds in azole resistance. Microorganisms. 2020;8, http://dx.doi.org/10.3390/microorganisms8122037, 2037.
9. Nobre M, Potter-de-Castro A, Caetano D, Leonardo-de-Souza L, Araujo-Meireles MC, Ferreiro L. Recurrence of sporotrichosis in cats with zoonotic involvement. Rev Ibero Micol. 2001;18:137–40.
10. Petry MV, de Souza Petersen E, Scherer JDFM, Krüger L, Scherer AL. Notas sobre a ocorrência e dieta de *Macronectes giganteus* (*Procellariiformes: Procellariidae*) no Rio Grande do Sul, Brasil. Rev Brasil Ornitol. 2010;18.
11. Poester VR, Mendes JF, Von Groll A, Klafke GB, Brandolt TM, Xavier MO. *Sporothrix* spp. evaluation in soil of a hyperendenic area for sporotrichosis in southern Brazil. Ciênc Anim Brasil. 2018;19.
12. Rabello VBS, Almeida MA, Bernardes-Engemann AR, Almeida-Paes R, de Macedo PM, Zancopé-Oliveira RM. The historical burden of sporotrichosis in Brazil: a systematic review of cases reported from 1907 to 2020. Braz J Microbiol. 2022;53:231–44, http://dx.doi.org/10.1007/s42770-021-00658-1.
13. Rabello VBS, Almeida-Silva F, Scramignon-Costa BS, Motta BDS, de Macedo PM, Teixeira MM, et al. Environmental isolation of *Sporothrix brasiliensis* in an area with recurrent feline sporotrichosis cases. Front Cell Infect Microbiol. 2022;12, http://dx.doi.org/10.3389/fcimb.2022.894297, 894297.
14. Rodrigues AM, de Hoog GS, de Camargo ZP. Molecular diagnosis of pathogenic *Sporothrix* species. PLoS Neglect Trop Dis. 2015;9, http://dx.doi.org/10.1371/journal.pntd.0004190.
15. Rosa LH, da Silva TH, Ogaki MB, Pinto OHB, Stech M, Convey P, et al. DNA metabarcoding uncovers fungal diversity in soils of protected and non-protected areas on Deception Island, Antarctica. Sci Rep. 2020;10, http://dx.doi.org/10.1038/s41598-020-78934-7, 21986.
16. Somenzari M, Amaral PP, Cueto VR, Guaraldo AC, Jahn AE, Lima DM, et al. An overview of migratory birds in Brazil. Pap Avulsos Zool. 2018;58, http://dx.doi.org/10.11606/1807-0205/2018.58.03, e20185803.
17. Spruijtenburg B, Bombassaro A, Meijer EFJ, Rodrigues AM, Grisolia ME, Vicente VA, et al. *Sporothrix brasiliensis* genotyping reveals numerous independent zoonotic introductions in Brazil. J Infect. 2023;86:610–3, http://dx.doi.org/10.1016/j.jinf.2023.02.034.
18. Thomson P, González C, Blank O, Ramírez V, Río CD, Santibáñez S, et al. Sporotrichosis outbreak due to *Sporothrix brasiliensis* in domestic cats in Magallanes, Chile: a One-Health-Approach study. J Fungi (Basel). 2023;9:226, http://dx.doi.org/10.3390/jof9020226.
19. Van Perlo B. A field guide to the birds of Brazil. Nova Iorque: Oxford University Press; 2009. p. 465.
20. Woods JP, Kersulyte D, Goldman WE, Berg DE. Fast DNA isolation from *Histoplasma capsulatum*: methodology for arbitrary primer polymerase chain reaction-based epidemiological and clinical studies. J Clin Microbiol. 1993;31:463–4, http://dx.doi.org/10.1128/jcm.31.2.463-464.1993.
21. Xavier MO, Poester VR, Trápaga MR, Stevens DA. *Sporothrix brasiliensis*: epidemiology, therapy, and recent developments. J Fungi (Basel). 2023;9:921, http://dx.doi.org/10.3390/jof9090921.

UNCORRECTED PROOF