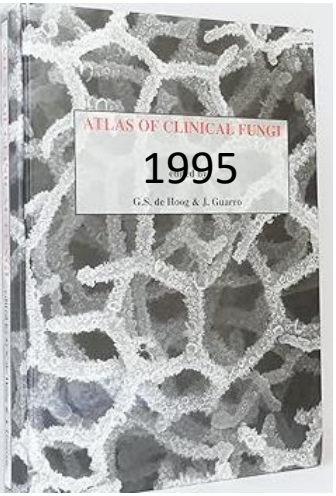
Clinical Fungi and Global Warming

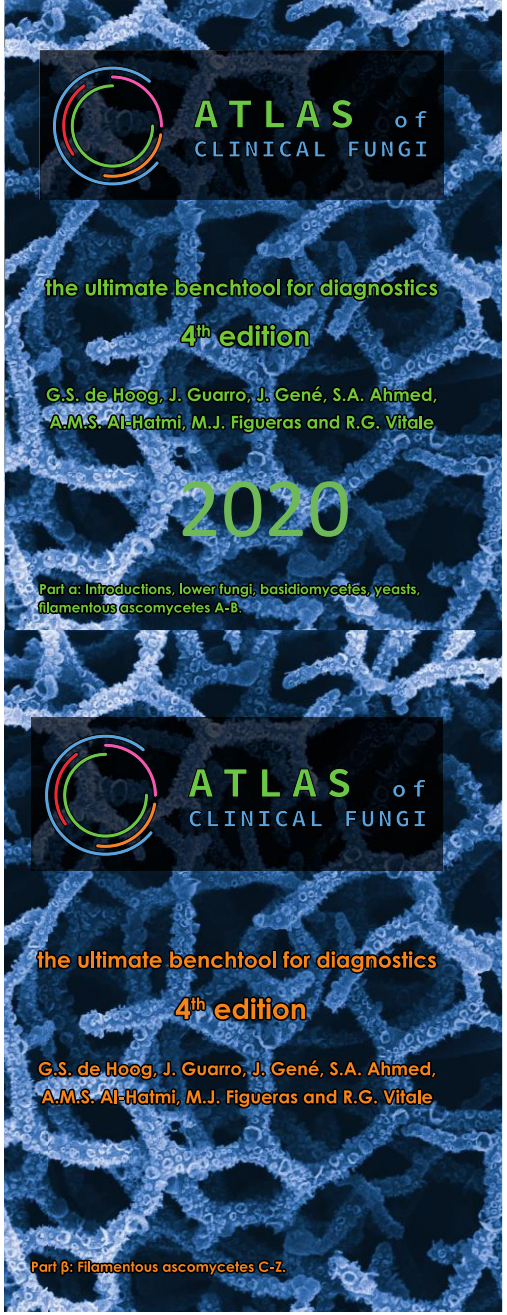
Sarah Ahmed

Center of Expertise in Mycology,
RadboudUMC / CWZ

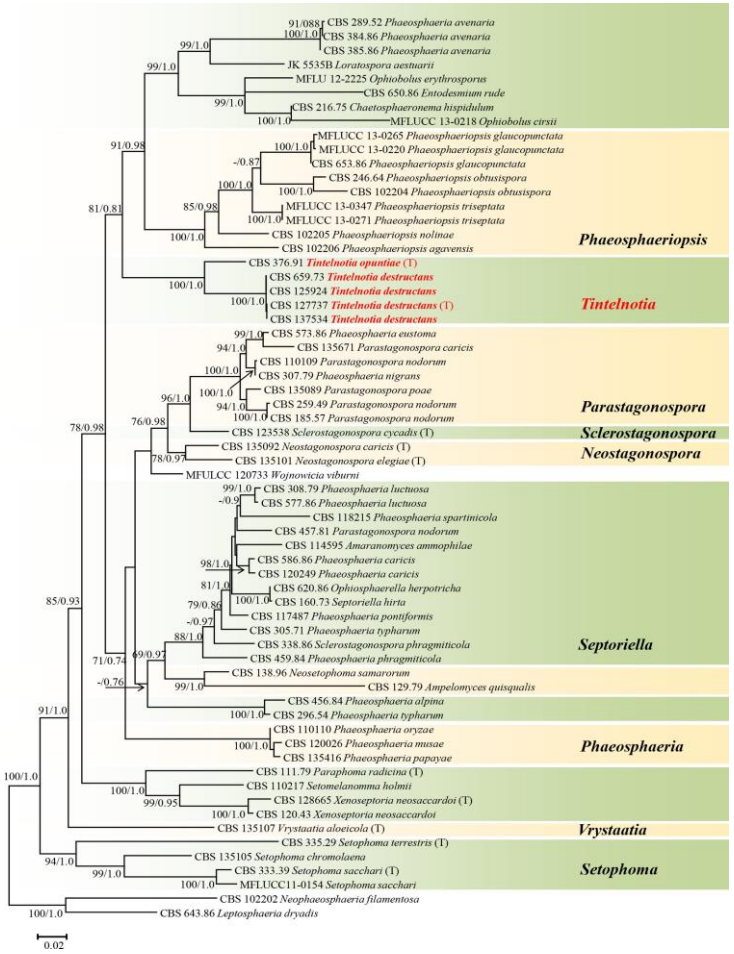
Clinically important fungi

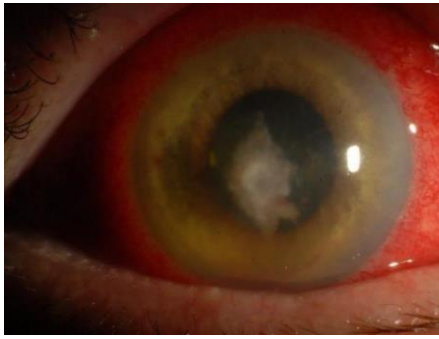


390 species



720 species





Tintelnotia, a new genus in *Phaeosphaeriaceae* harbouring agents of cornea and nail infections in humans

S. A. Ahmed[1] | W. Hofmüller[2] | M. Seibold[3] | G. S. de Hoog[4,5] | H. Harak[6] | I. Tammer[7] | A. D. van Diepeningen[4] | W. Behrens-Baumann[2]

Am J Ophthalmol Case Rep. 2020 Sep; 19: 100791.
Published online 2020 Jun 25. doi: 10.1016/j.ajoc.2020.100791
PMCID: PMC7327197
PMID: 32637731

Tintelnotia destructans as an emerging opportunistic pathogen: First case of *T. destructans* superinfection in herpetic keratitis

Med Mycol Case Rep. 2020 Mar; 27: 8–10.
Published online 2019 Dec 4. doi: 10.1016/j.mmcr.2019.12.004
PMCID: PMC6920192
PMID: 31879585

Contact lens associated keratitis due to *Tintelnotia destructans*

Shu Jin Tan,[a,*] Mariyam Nure,[a] Dianne Gardam,[a] Charlotte McKnight,[b] Peter A. Boan,[a,c] and Benjamin M. Clark[c]

Germany
Italy
Finland
The Netherlands
Belgium
Switzerland
Australia

CASE REPORT

Tintelnotia destructans Keratitis: A Clinicopathological Report and Review of the Literature

Kaufmann, Claude MD*; Arnold, Mihaela†; Schipf, Alexander MD‡; Bruderer, Vera L. VMD§; Iselin, Katja C. MD*

Author Information

Cornea 40(3):p 380-382, March 2021. | DOI: 10.1097/ICO.0000000000002550

22.12.2017 | Keratoplastik | Kasuistiken

Tintelnotia destructans: Ein neuer Feind vor dem Tore

verfasst von: K. J. Habbe, Dr. A. Frings, S. Schrader, M. Roth, C. MacKenzie, G. Walther, O. Kurzai, G. Geerling

Erschienen in: Die Ophthalmologie | Ausgabe 11/2018

Microbes and Infection 24 (2022) 104932

Contents lists available at ScienceDirect

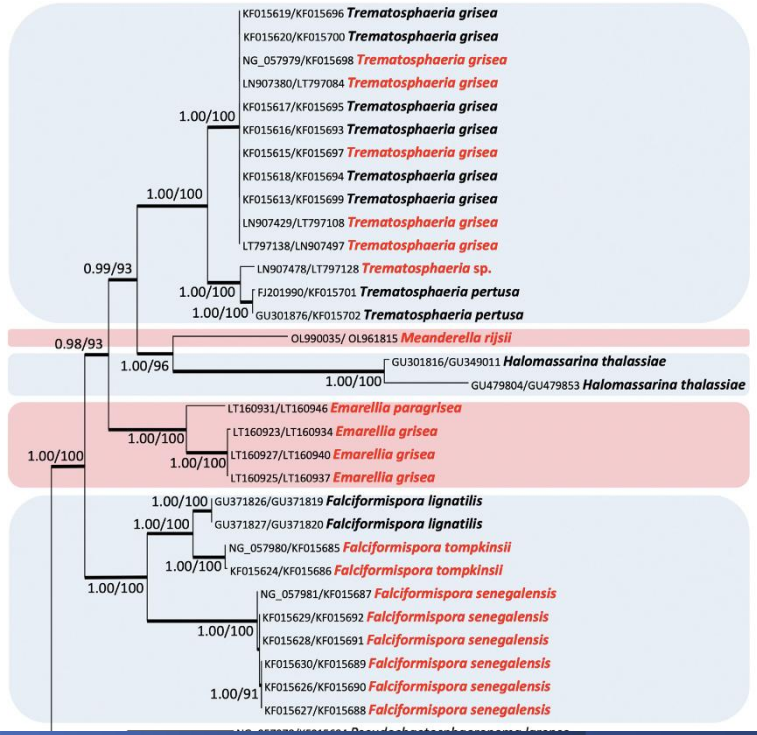
Microbes and Infection

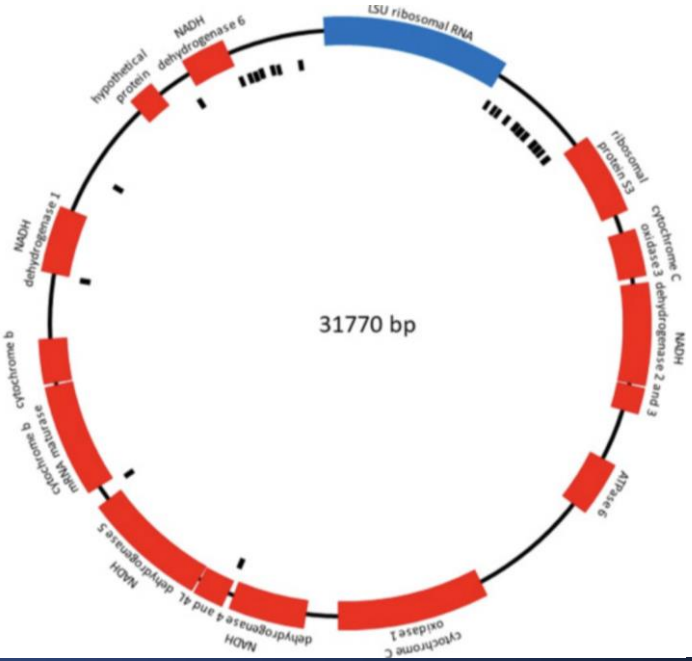
journal homepage: www.elsevier.com/locate/micinf

Original article

Meanderella rijsii, a new opportunist in the fungal order *Pleosporales*

Sarah A. Ahmed [a, b, *], Tobias Engel [c], Jan Zoll [a], Peggy C.R. Godschalk [d], Ruth Klaasen [e], Leandro Moreno [f], Henrich van der Lee [a], Paul E. Verweij [a], Sybren de Hoog [a, b, g, **]





Emerging Microbes & Infections
2020, VOL. 9
https://doi.org/10.1080/22221751.2020.1769499

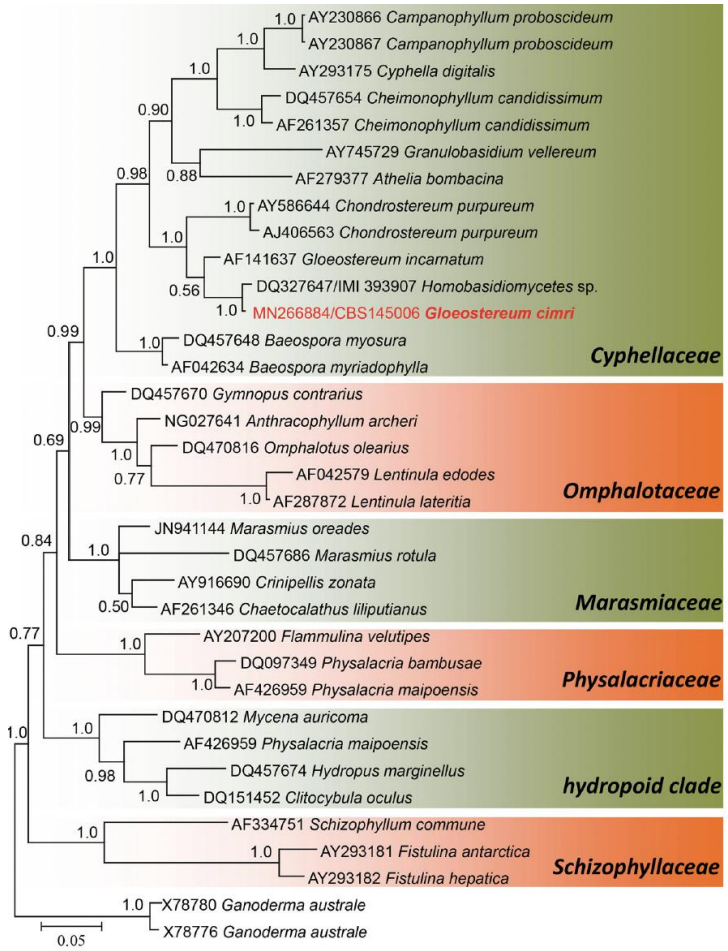
EMi Taylor & Francis
Taylor & Francis Group

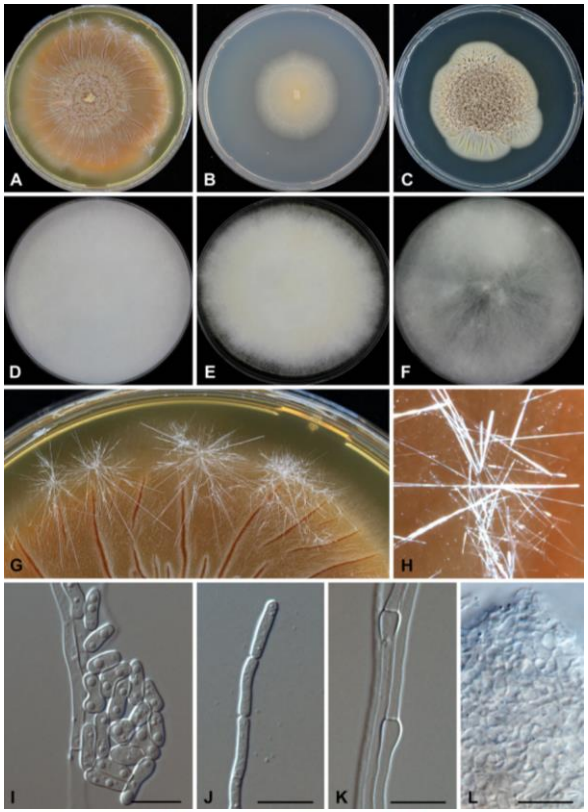
ORIGINAL ARTICLE

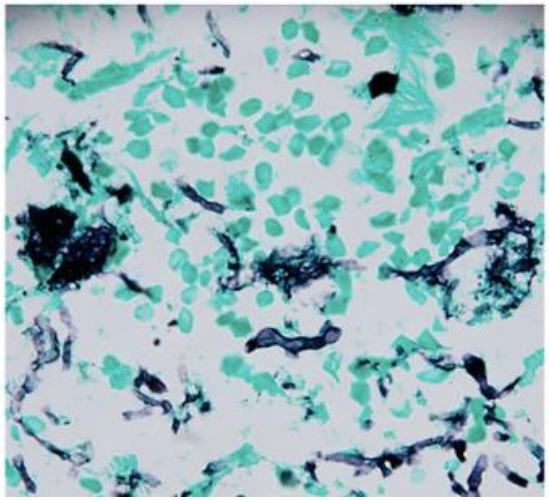
OPEN ACCESS Check for updates

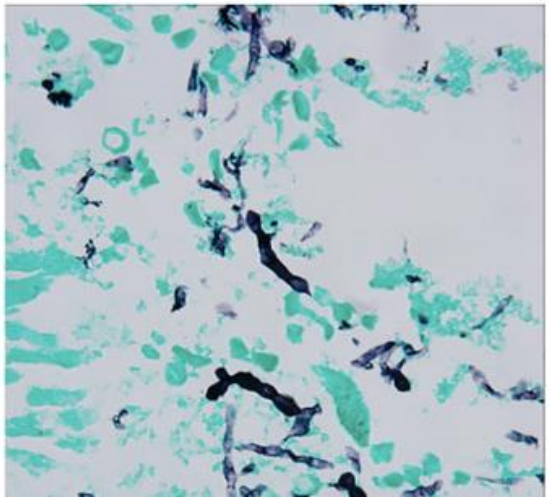
Gloeostereum cimri, a novel shelf fungus isolated from a human pulmonary cyst

Sarah A. Ahmed [a,b,c], Sybren de Hoog[a,b,d], Janet Kim[e], Jayne Crozier[f], Sarah E. Thomas[f], Benjamin Stielow[g] and David A. Stevens[h,i]



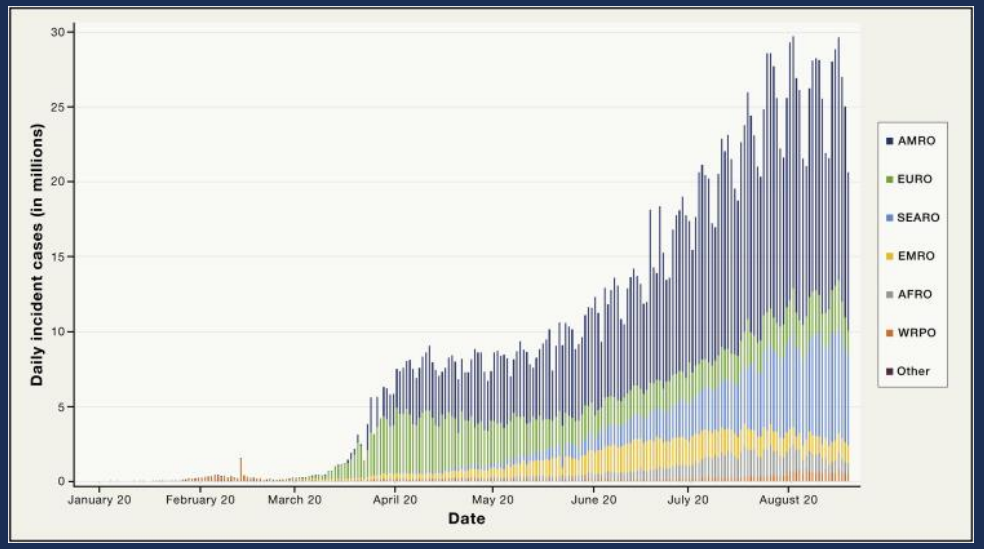






Emerging clinical fungi

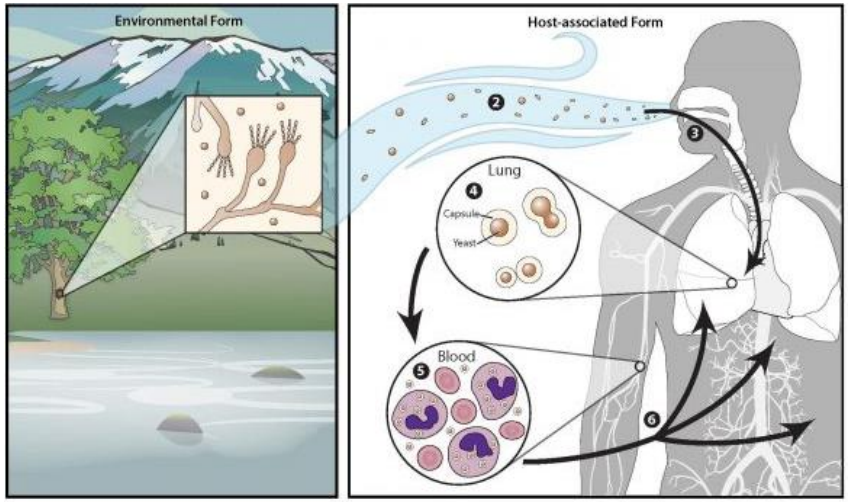
- 'emerging': According to Oxford Dictionary, means 'becoming apparent or prominent'.
- A new fungus is spotted at increasing frequency after its first discovery.
- Are we flooded by emerging pathogenic fungi?
- *Cryptococcus gattii, Candida auris, Trichophyton indotineae, Emergomyces africanus, Sporothrix brasiliensis, Pseudogymnoascus destructans.*

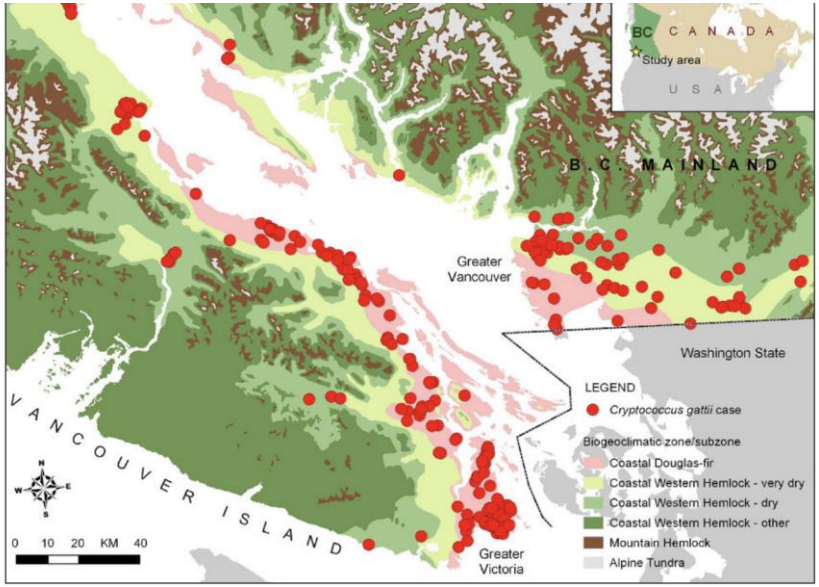


Global Daily Incident Cases of COVID-19

Emerging pathogen - *Cryptococcus gattii*

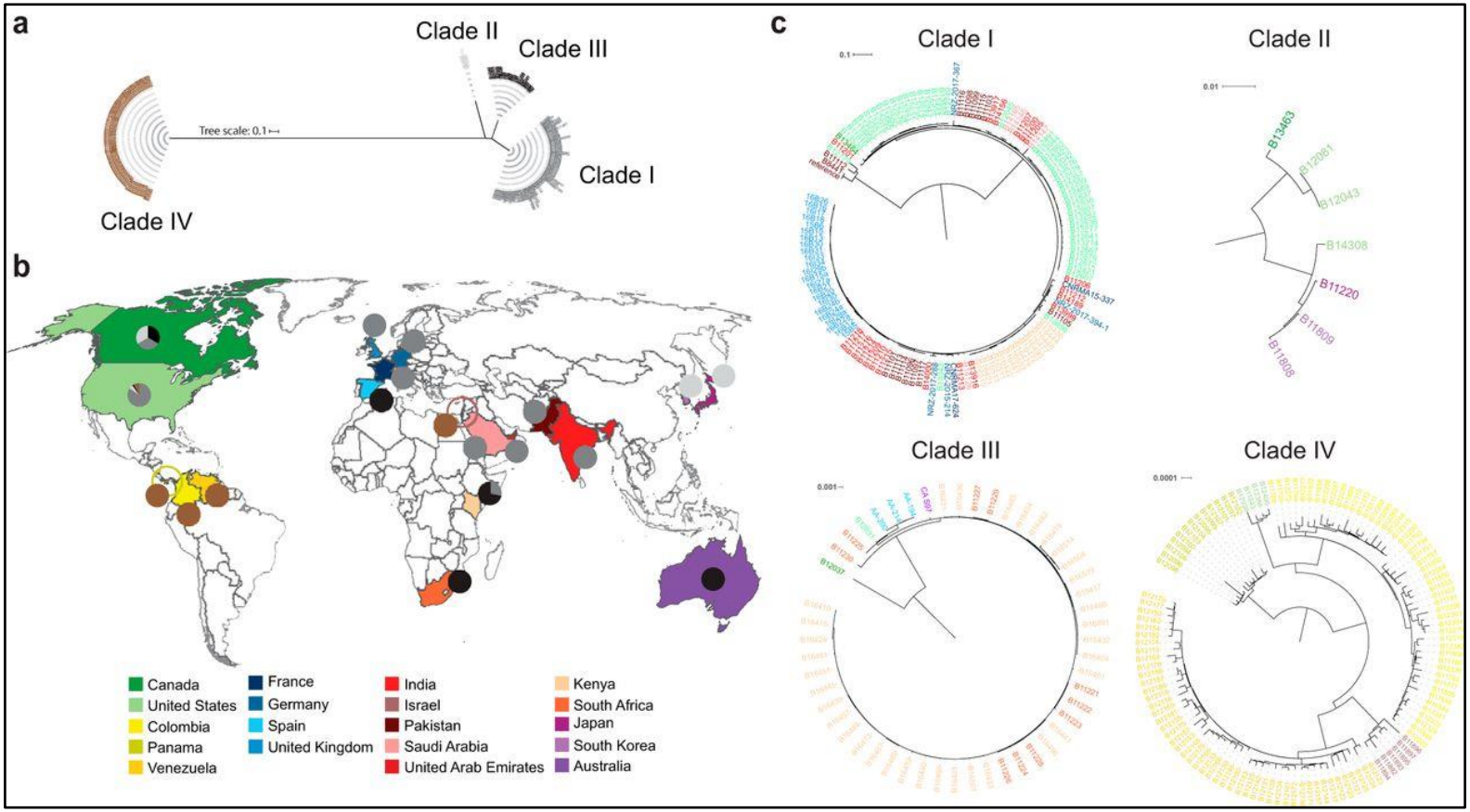
- Vancouver Island and British Columbia (1999)
- Pneumonia or meningitis 36 cases/million population/year.
- The fungus (resist, survive, dispersal) present in a high concentrations in the environment.





Hoang, et al. doi: 10.1016/j.clinmicnews.2011.11.003.

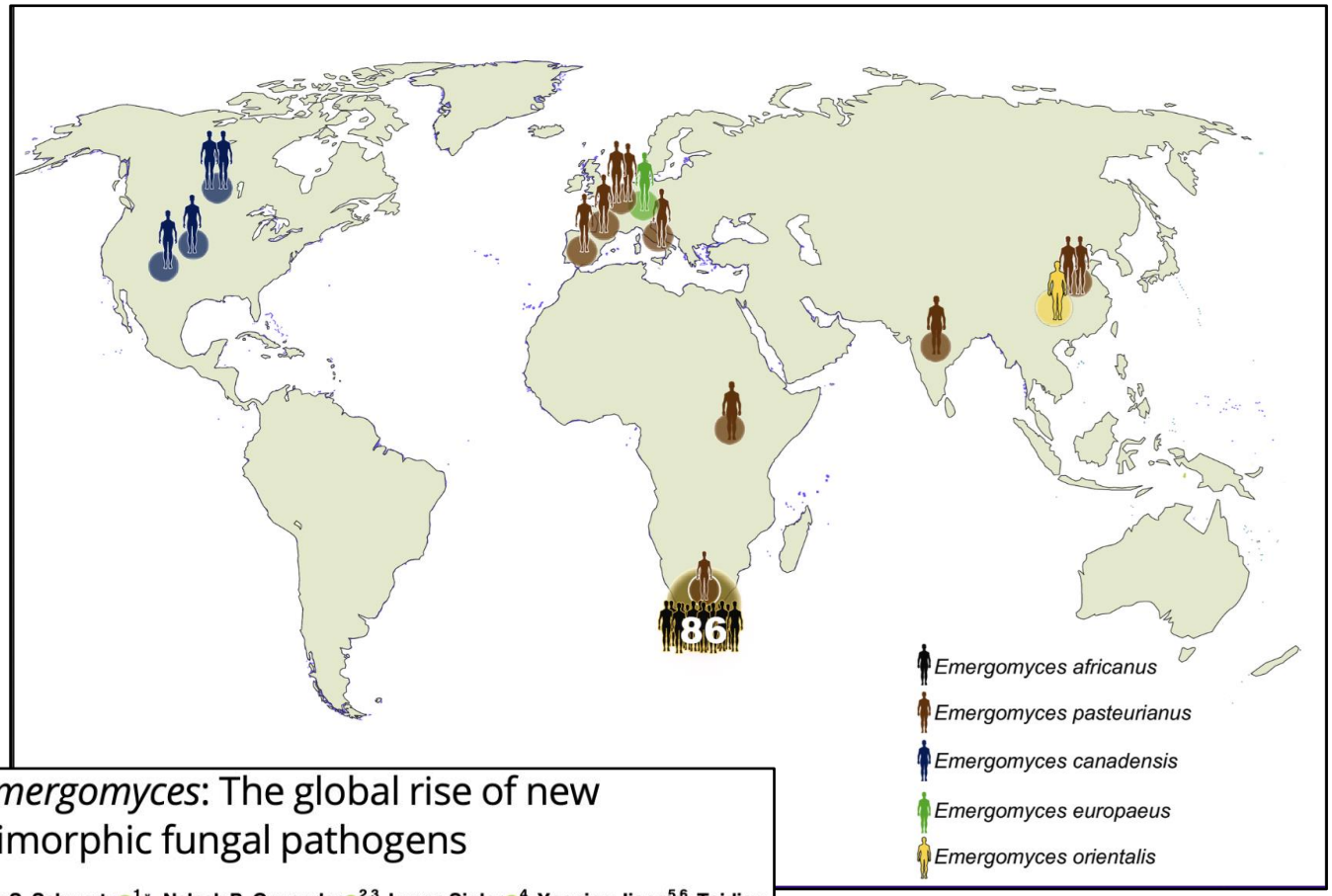
Emerging pathogens - *Candida auris*



- Emerged simultaneously in four global regions.
- Multidrug resistant.
- Discovered in 2009 from a single ear infection in Japan.

Chow NA, et al. doi: 10.1016/S1473-3099(18)30597-8

Emerging pathogens - *Emergomyces*



Emergomyces: The global rise of new dimorphic fungal pathogens

Ilan S. Schwartz[1]*, Nelesh P. Govender[2,3], Lynne Sigler[4], Yanping Jiang[5,6], Tsidiso G. Maphanga[2,7], Barbra Toplis[8], Alfred Botha[8], Karolina Dukik[5], J. Claire Hoving[9], Jose F. Muñoz[10], Sybren de Hoog[5,11], Christina A. Cuomo[10], Robert Colebunders[12], Chris Kenyon[13,14]

Kenyon et al. A Dimorphic Fungus Causing Disseminated Infection in South Africa. 2013. N Engl J Med.

Evolution of merging pathogens

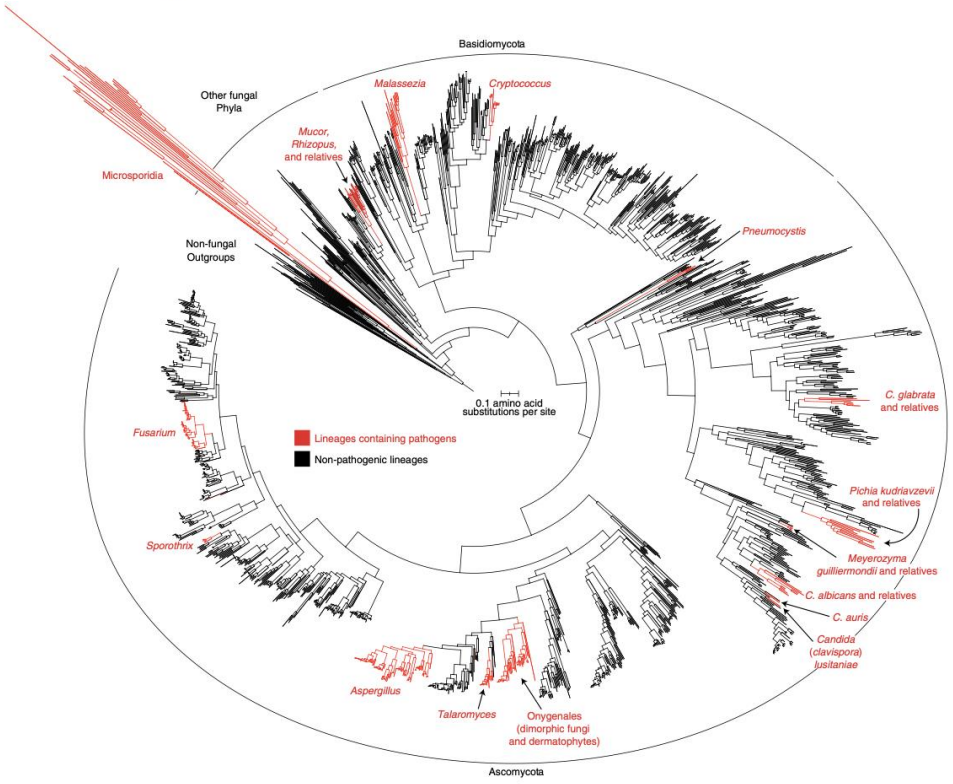
nature microbiology

REVIEW ARTICLE

https://doi.org/10.1038/s41564-022-01112-0

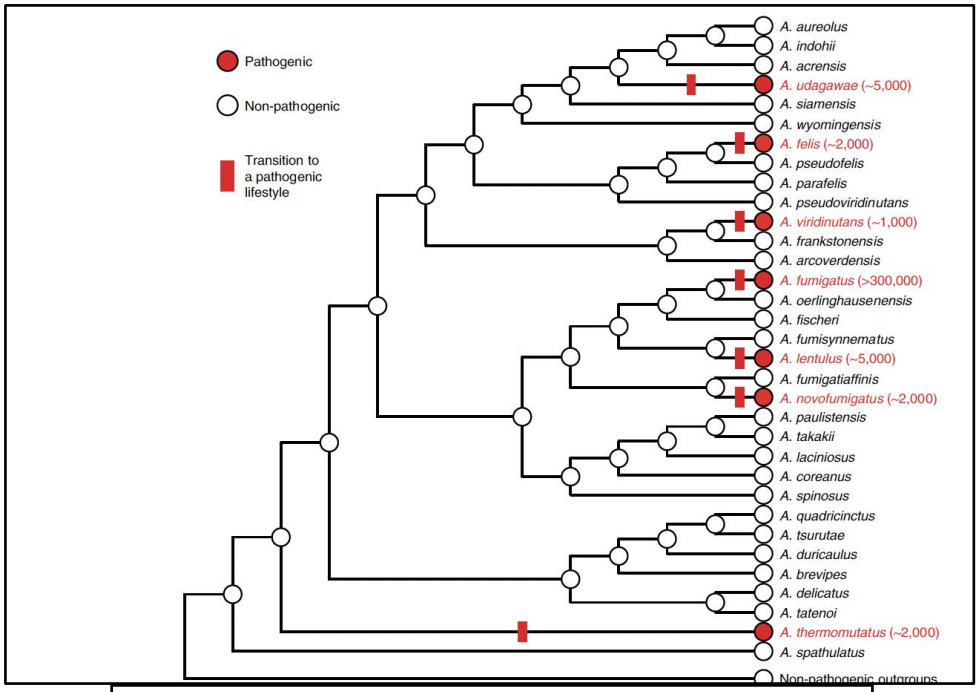
Check for updates

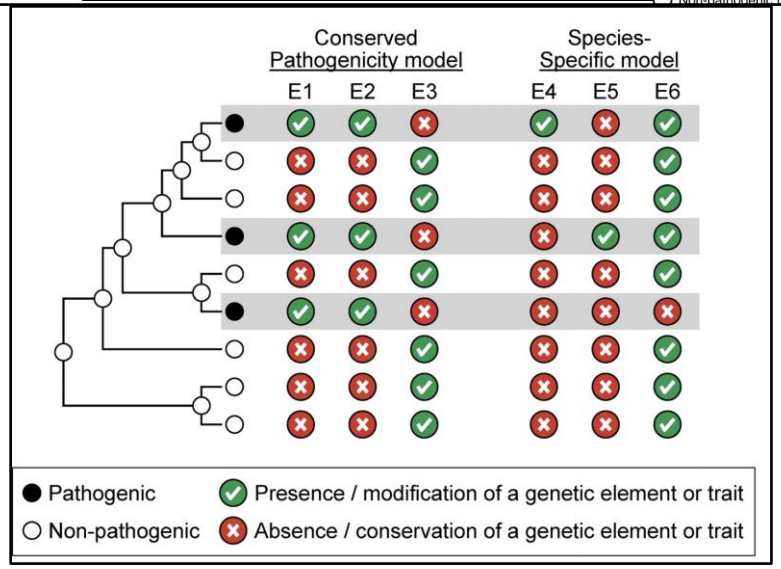
Evolution of the human pathogenic lifestyle in fungi

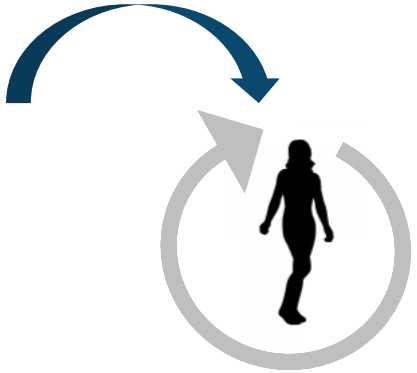


First recorded case of an aspergillosis infection in revolutionary Paris, France[120]	1789	
	1839	First report to link oral candidiasis to *Candida albicans*[121]; descriptions of the disease date back to Hippocrates in ancient Greece
First described case of mucormycosis[122]	1855	
	1874	Identification of *Malassezia* as the cause of seborrheic dermatitis by Malassez[123]
Discovery of coccidiomycosis in Argentina by a medical student[124]	1892	
	1894	Discovery of blastomycosis in Baltimore, USA[125]
		Earliest record of cryptococcosis in Germany[126]
Publication of the first clinical case of sporotrichosis[127]	1898	
	1908	First description of paracoccidioidomycosis in Brazil[128]
Proof that histoplasmosis is a fungal infection caused by *Histoplasma* fungi[129]	1934	
	1957	Demonstration that *Pneumocystis* can cause pneumonia in humans[130]
First documented case of microsporidiosis in Japan[46]	1959	
	1973	First report of talaromycosis in Southeast Asia from a patient with Hodgkin's disease[97]
First report of *Pneumocystis carinii* pneumonia in patients with AIDS[130]	1981	
	1994	Dust from landslides caused by the Northridge earthquake and its aftershocks leads to an outbreak of coccidioidomycosis in the town of Simi Valley, California[131]
		First report of emergomycosis in a patient with AIDS in Italy[113]
Beginning of zoonotic epidemic of cat-associated sporotrichosis caused by *Sporothrix brasiliensis* in Brazil[132]	1998	
	1999	Outbreak of cryptococcosis caused by *Cryptococcus gattii* on Vancouver Island, Canada[133]
Outbreak of fungal keratitis caused by *Fusarium* species associated with the use of a particular contact lens solution in multiple states of the USA[134]	2006	
	2009	Discovery of *Candida auris*, which is now known to have caused infections in more than 30 countries from six continents, including nosocomial outbreaks, and its clinical isolates exhibit resistance to all known antifungal drugs[157,158]
Outbreak of necrotizing cutaneous mucormycosis caused by the rare pathogen *Apophysomyces trapeziformis* after a tornado in Missouri, USA[135]	2011	
	2012	Outbreak of fatal infections by the fungus *Saprochaete clavata*, an organism not previously known to be a human pathogen, in multiple health care facilities in France[136]
		Outbreak of fungal meningitis primarily caused by *Exserohilum rostratum*, a very rare human pathogen, among patients that received contaminated steroid injections[137]
First reports of fungal diseases associated with the global pandemic of COVID-19, including of COVID-19 associated pulmonary aspergillosis (CAPA)[138]	2020	

Evolution of pathogenicity in *Aspergillus*

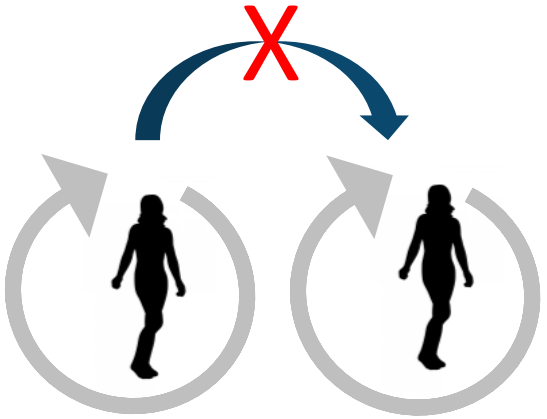






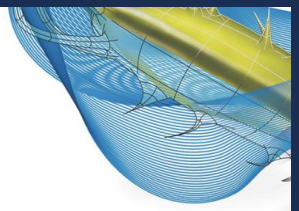
Human/animal

Opportunist:
No transmission



Rokas et al. doi: 10.1371/journal.ppat.1008315.

The hidden pathogenic potential of environmental fungi



Glauber R de S Araújo[1], Wanderley de Souza[1] & Susana Frases[*,1]
[1]Laboratório de Ultraestrutura Celular Hertha Meyer, Instituto de Biofísica Carlos Chagas Filho, Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil
* Author for correspondence: Tel.: +55 21 3938 6593; susanafrases@biof.ufrj.br

- Thermotolerance is a key step toward pathogenesis to humans.

CrossMark

Fungi between extremotolerance and opportunistic pathogenicity on humans

Cene Gostinčar[1,2] · Janja Zajc[1,3] · Metka Lenassi[4] · Ana Plemenitaš[4] · Sybren de Hoog[5,6] · Abdullah M. S. Al-Hatmi[5,6,7] · Nina Gunde-Cimerman[1]

Received: 1 June 2018 / Accepted: 22 October 2018 / Published online: 9 November 2018
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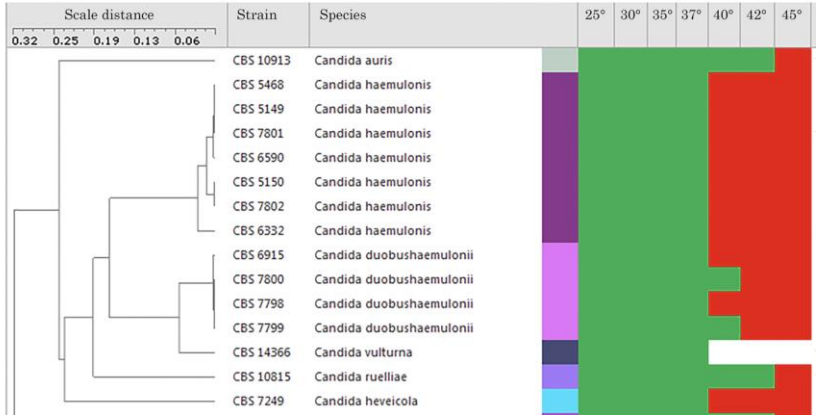
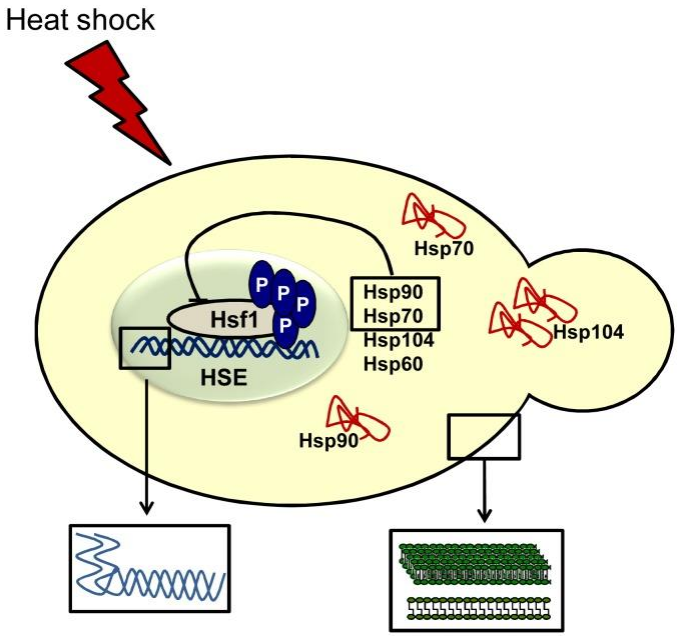
- Link between osmotolerance / stress tolerance and pathogenicity.

Successful pathogens

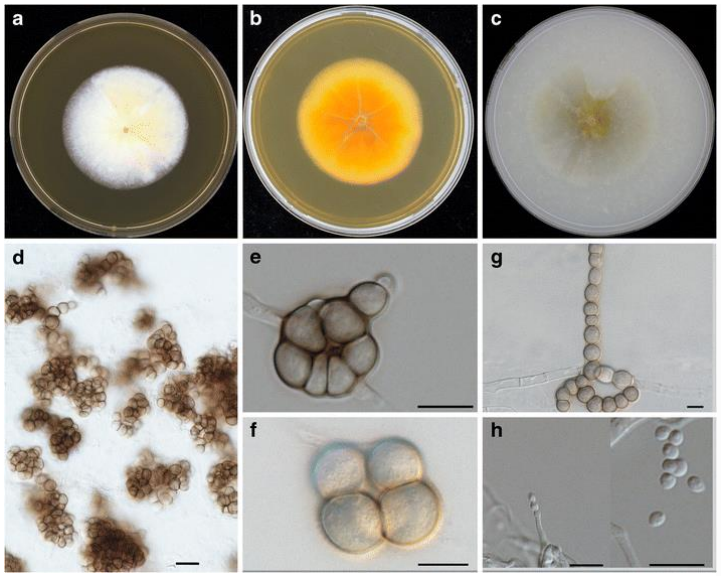
- Able to grow at 37°C or above: Only 6% of species in environment can tolerate 37°C.

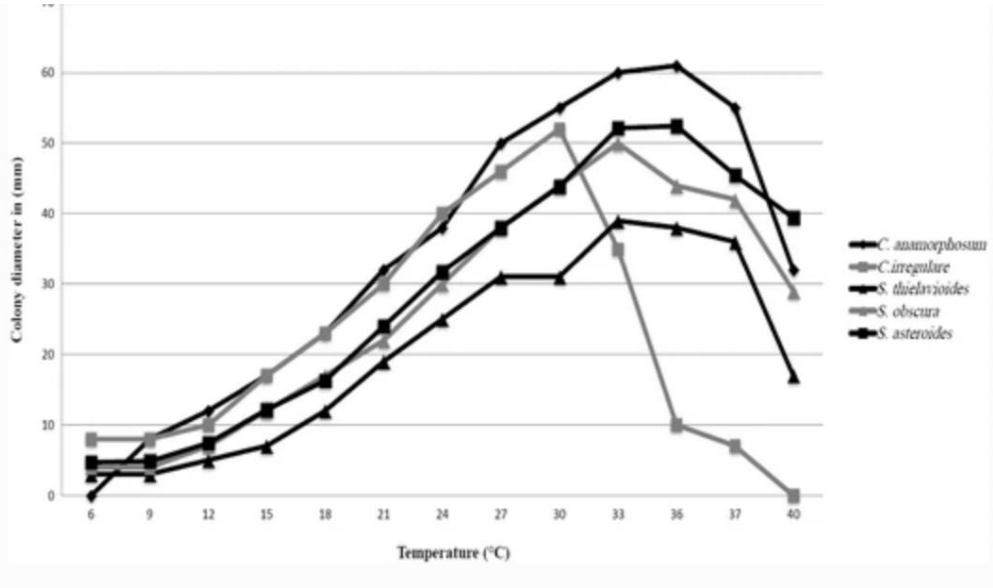




- ***Saccharomyces cerevisiae*** clinical isolates are able to grow at higher temperatures.

Successful pathogens





Fungal Diversity (2016) 76:11–26
DOI 10.1007/s13225-015-0338-5

CrossMark

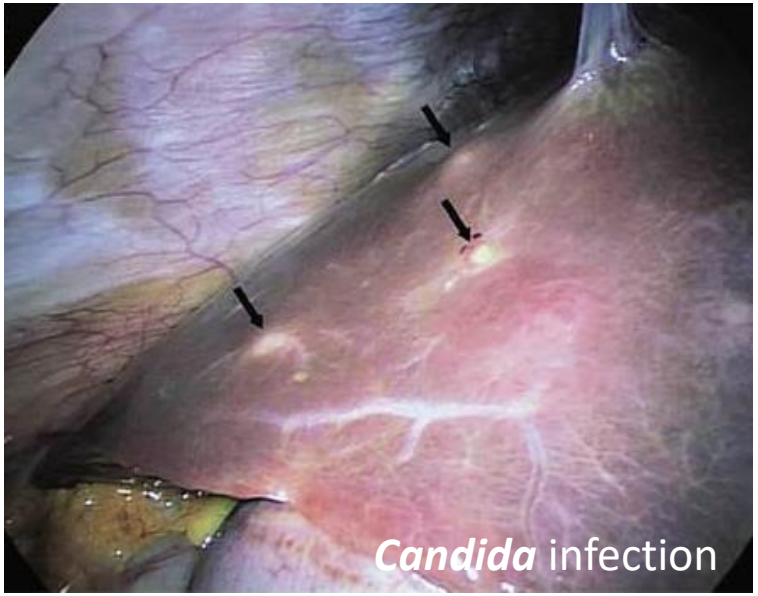
Chaetomium-like fungi causing opportunistic infections in humans: a possible role for extremotolerance

Sarah A. Ahmed[1,2,3] · Ziauddin Khan[4] · Xue-wei Wang[2,5] · Tarek A. A. Moussa[6,7] · Hassan S. Al-Zahrani[6] · Omar A. Almaghrabi[6] · Deanna A. Sutton[8] · S. Ahmad[4] · Johannes Z. Groenewald[2] · A. Alastruey-Izquierdo[9] · Anne van Diepeningen[2] · S. B. J. Menken[3] · M. J. Najafzadeh[10] · Pedro W. Crous[2] · Oliver Cornely[11] · Axel Hamprecht[12] · Maria J. G. T. Vehreschild[11] · A. J. Kindo[13] · G. Sybren de Hoog[2,3,6,14,15,16,17]

Successful pathogens

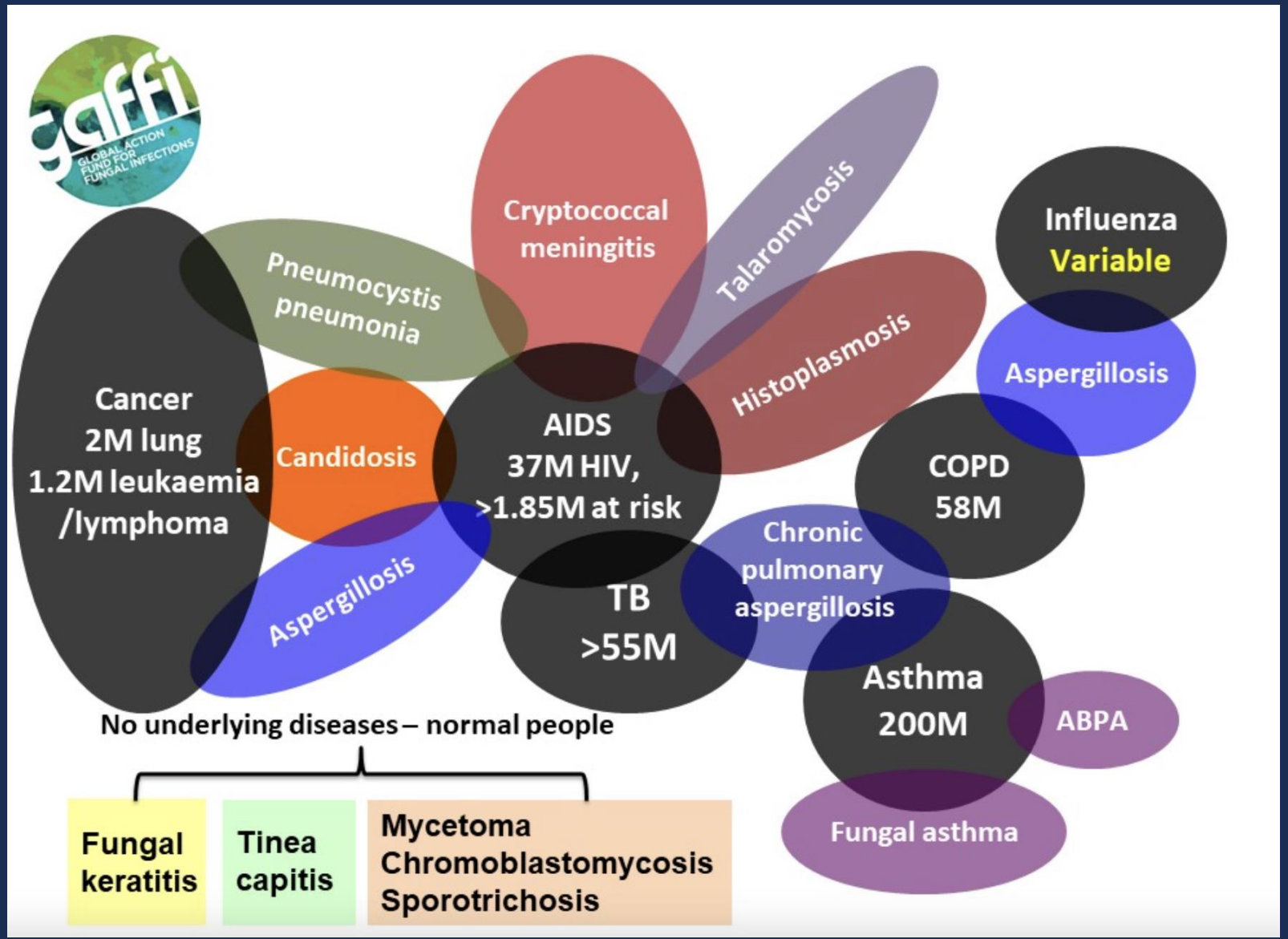
- Able to grow at 37℃ or above.
  - Emergence of mammals as the dominant land species (endothermy and homeothermy). (**Casadevall**: **fungal infection-mammalian selection**)
- Able to breakthrough the barriers and invade human host.
- Able to survive inside human body (lysis/absorption).
- Resist the immune system.

Fusarium disseminated infection



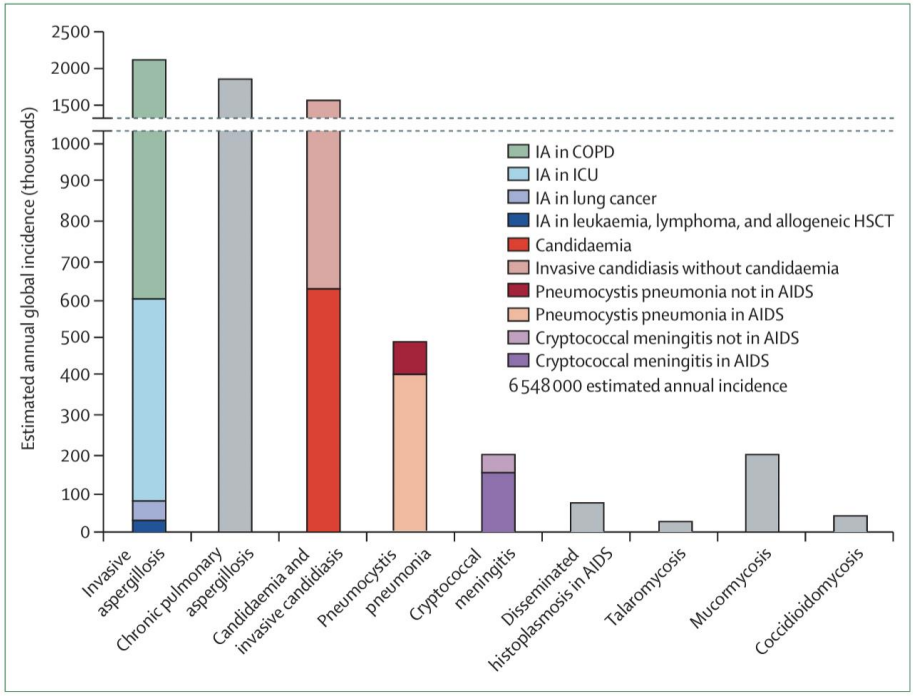
Candida infection

Fungal infections in humans

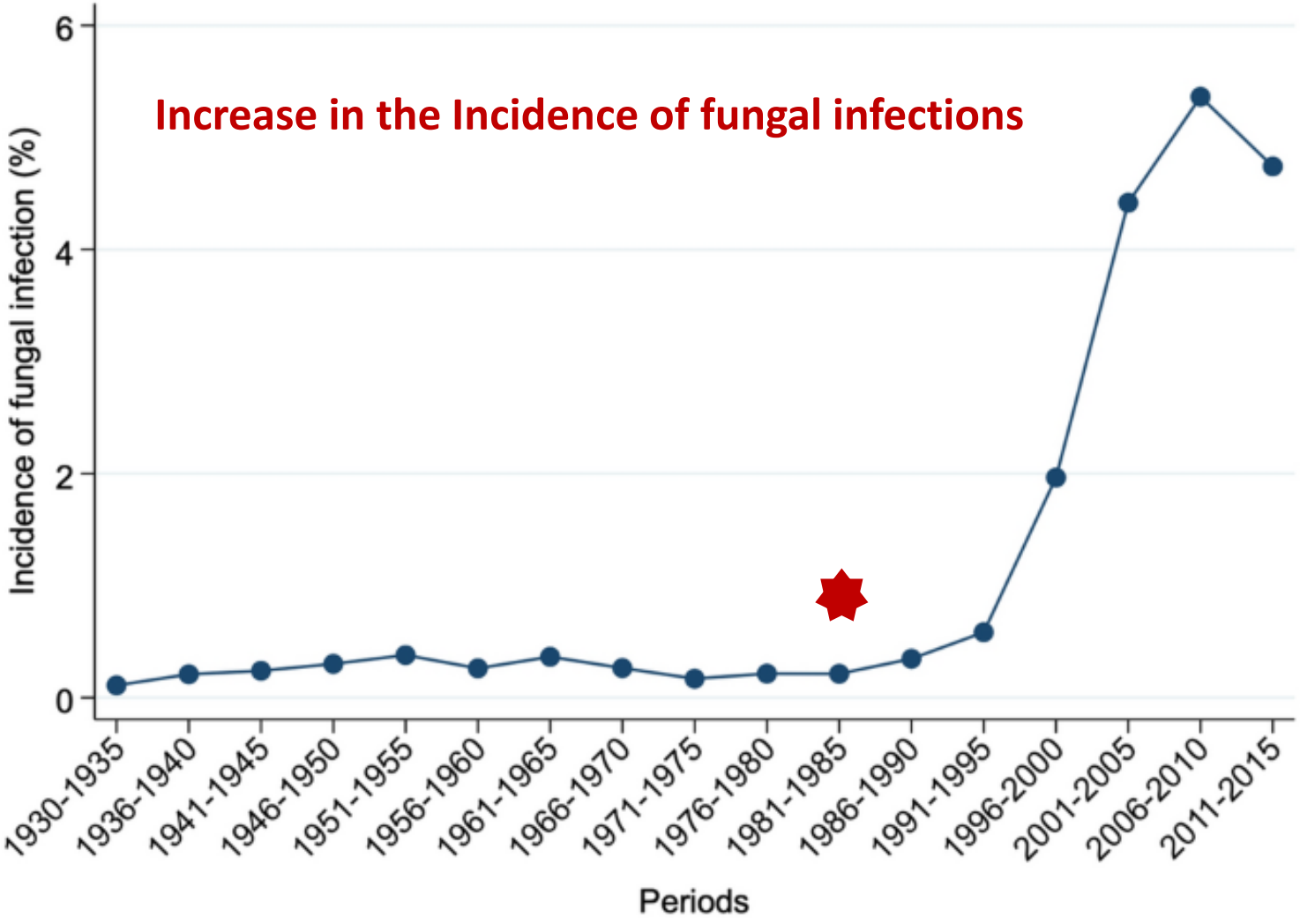


Burden of fungal diseases

- App. 6.5 million invasive fungal infections / year.
- Fungal disease mortality 3.8 million > **malaria and TB**.



Burden of fungal infections



Dantas KC, et al. doi: 10.1038/s41598-021-83587-1.

Challenges in Mycology

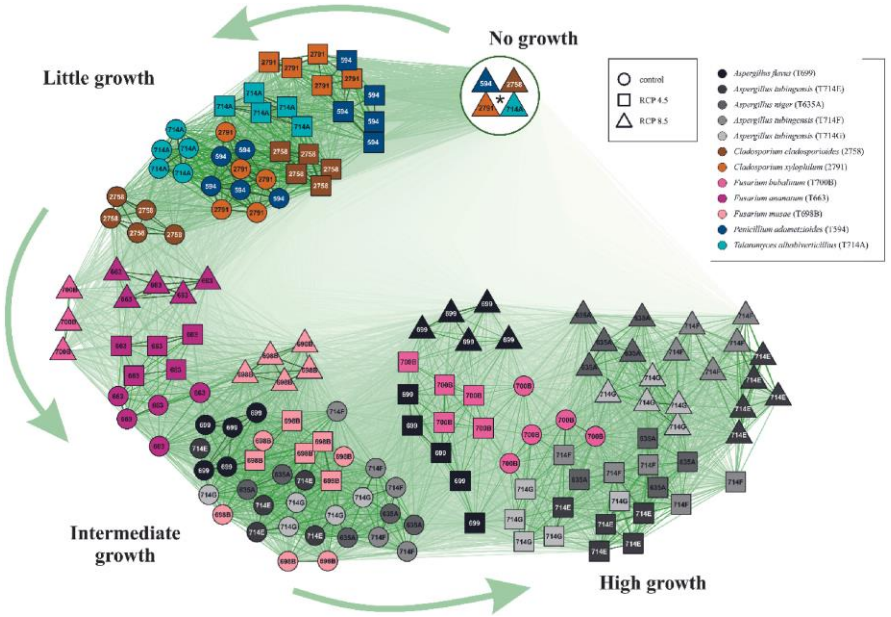
Population at risk

Diversity of clinical fungi

Resistant fungal species

Global warming: emergence of fungal pathogens

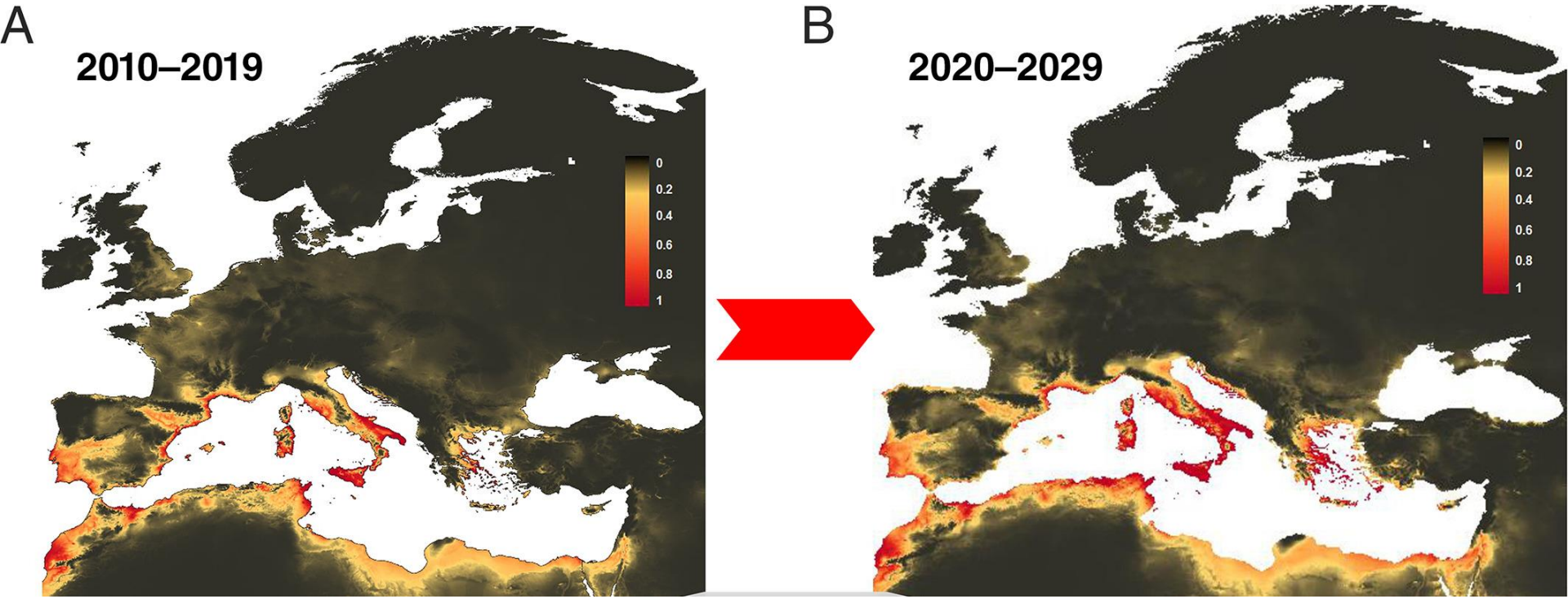
- Fungal distribution.
- Higher level of thermal tolerance.
- More virulent and resistance.



Survival and growth of microscopic fungi derived from tropical regions under future heat waves in the Pannonian Biogeographical Region

Zsófia Tischner [a], Anna Páldy [b], Sándor Kocsubé [c], László Kredics [c], Csaba Dobolyi [a], Rózsa Sebők [a], Balázs Kriszt [a], Bence Szabó [d], Donát Magyar [b]

Global warming and future outbreak

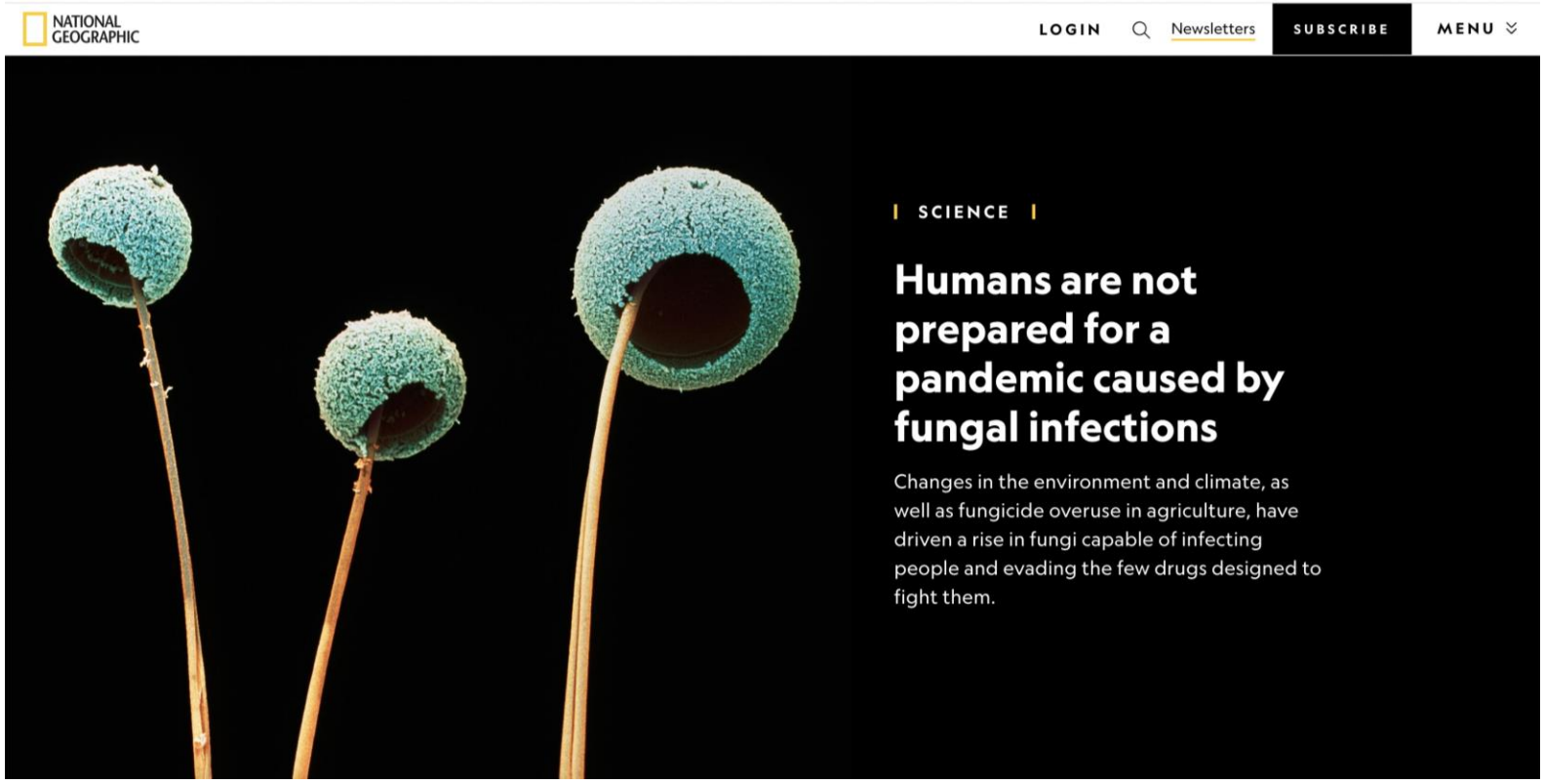


Global warming impact on the expansion of fundamental niche of *Cryptococcus gattii* VGI in Europe

- Niche modelling of *Cryptococcus gattii* VGI in Europe and Mediterranean.

Global warming and future outbreak

Are we prepared?



THE
LAST
OF US

Thank you for your attention