

Study points to opening of the Panama Canal as the gateway of *Cryptococcus gattii* migration from Brazil to Canada

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Credit: Translational Genomics Research Institute

In what is being described as "The Teddy Roosevelt effect," a deadly fungus in the Pacific Northwest may have arrived from Brazil via the Panama Canal, according to a new study led by the Translational

Genomics Research Institute (TGen).

Cryptococcus gattii—which until a 1999 outbreak in British Columbia's Vancouver Island was considered primarily a tropical fungus found in places like Brazil, New Guinea and Australia—can cause deadly lung and brain infections in both people and animals.

Researchers used genomic analysis and advanced statistics to trace the likely evolution of the disease, correlating it in time to the 1914 opening of the Panama Canal and a surge of shipping trade between Brazil and the Pacific Northwest. The results were published today in the journal *mSphere*.

C. gattii infections first appeared in Washington in 2007, and in Oregon in 2010, with isolated incidences in Idaho and California. Symptoms include cough, shortness of breath, chest pain, fever, headache, neck pain, nausea, vomiting, sensitivity to light and confusion or changes in behavior. Treatment can include months of intravenous and oral anti-fungal drugs, and in some cases surgical removal from the lungs and central nervous system.

"Understanding the emergence and continual evolution of this pathogen into a new environment is critical to the understanding of the ongoing spread of cryptococcal disease, and may be important to studying the evolution of other emerging health threats," said Dr. David Engelthaler, Director of TGen's Pathogen and Microbiome Division, TGen North, in Flagstaff, and the study's senior author.

Researchers performed whole genome sequencing on 134 *C. gattii* samples. They then estimated fungal mutation rates and used evolutionary analysis to calculate the arrival of *C. gattii* in the Pacific Northwest within the past 60 to 100 years, which the authors posit, "makes a strong case for an anthropogenic (human-caused)

introduction."

The source and timing of the emergence of *C. gattii* in the Pacific Northwest have been a challenge to public health researchers since cryptococcosis seemingly first appeared in British Columbia in 1999.

Nearly 3 million years ago, the Isthmus of Panama rose to create a land bridge between North and South America, and a barrier between the Atlantic and Pacific oceans.

The study results suggest that the completion of the Panama Canal in 1914 may have provided the perfect migratory path for the fungus. Trade between North and South America via the Panama Canal initially included hardwood lumber, minerals, coffee and rubber. However, researchers in this study propose that contaminated ballast water—which has spread animals, algae and microbes across the globe—is one hypothetical way *C. gattii* may have moved from Brazil to the Pacific Northwest. *C. gattii* fungus survives in seawater and has caused infections in marine mammals in the Pacific Northwest, and elsewhere.

"Whatever the cause of *C. gattii* to the PNW, it is clear that those populations are neither ancient nor very recent (less than 25 years) arrivals to the region," the authors state, and dispersal in the last 100 years "would strongly suggest" a human cause, rather than animal migrations, as proposed with the slower evolution and spread of Valley Fever and other disease-causing fungi. In a similar genomic-evolution study, TGen researchers last year determined that the Valley Fever fungus moved from North America to South America hundreds of thousands of years ago, after the formation of the land bridge, but well before humans were known to be in the Western Hemisphere.

"As North American populations of *C. gattii* continue to evolve and disperse, it will be useful to continually apply genomic dating to

understand the nature of these events and the expanding impact of these fungi on human and veterinary health," Dr. Engelthaler said.

More information: Chandler C. Roe et al. Dating the *Cryptococcus gattii* Dispersal to the North American Pacific Northwest, *mSphere* (2018). [DOI: 10.1128/mSphere.00499-17](https://doi.org/10.1128/mSphere.00499-17)

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