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Cryptococcus gattii: An Emerging Disease in the Pacific Northwest

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Washington State Department of Health

Overview

- *Cryptococcus gattii*
  - Symptoms and transmission
  - Global occurrence and emergence in the Pacific Northwest
- Public health surveillance in the U.S. and Washington
  - Epidemiologic differences
- Environmental factors
- Summary

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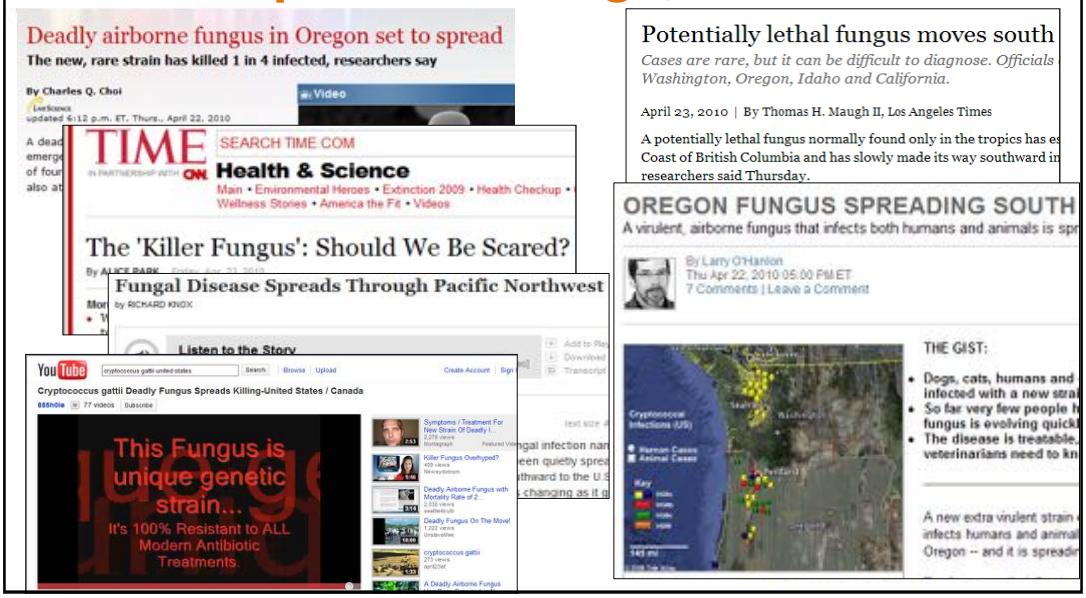
Cryptococcus gattii press coverage, 2010



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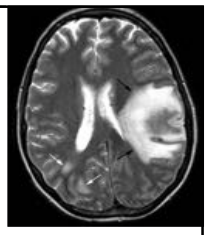

Cryptococcus gattii

- Environmental fungus associated with trees, soil
  - Previously only seen in tropical/subtropical climates; emerging in Pacific Northwest
- Can cause mild to severe disease
  - People: meningitis, pneumonia, cryptococcomas (masses)
  - Animals:
    - Nasal/sinus infection (sneezing, discharge, swelling)
    - Skin ulcerations or nodules
    - Enlarged lymph nodes
    - Respiratory tract infections
    - Ocular disease
    - Nervous system involvement (incoordination, seizures, paralysis)

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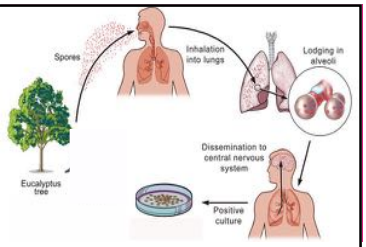

C. gattii transmission

- Inhalation of spores from environment
  - Colonization of nasal cavity, sinuses
  - Conditions for propagation not well defined
  - Not spread from animal to animal, animal to human, or human to human
- Incubation period: ~6 months (range: 2-13 mo.)
- Risk factors unclear*
  - Possible predisposing conditions: corticosteroids, lung or kidney disease, cancer
  - Might include smoking

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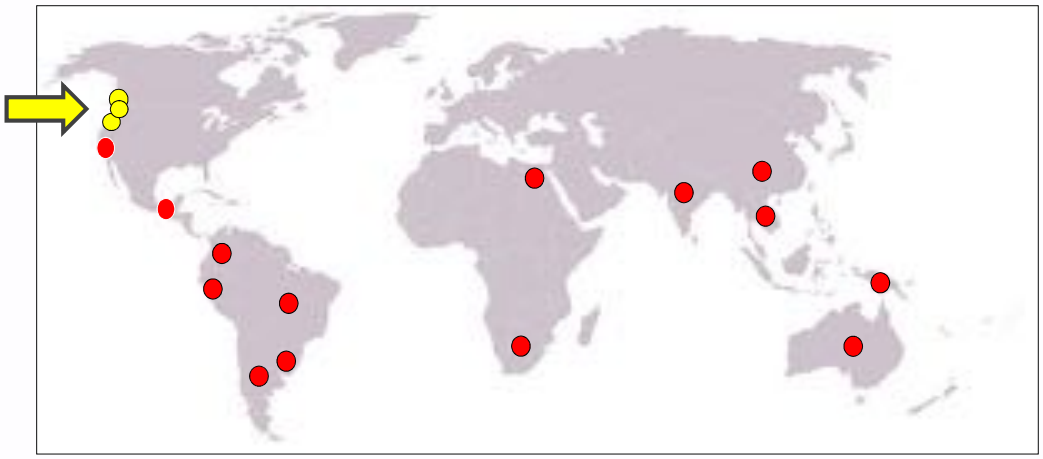
* Preliminary US and BC surveillance data (unpublished); Harris CID 2011; MacDougall EID 2011

CDC

Distribution of *C. gattii* infections, worldwide



Before 1999 1999 onwards

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Emergence in the Pacific Northwest

- *C. gattii* infections began appearing in animals and humans on Vancouver Island, British Columbia (BC) in 1999*
  - BCCDC made the infection a reportable disease in 2003
  - Case fatality rate ~8% (humans)
  - >280 human cases identified
- Outbreak has expanded into U.S.
  - Predominantly Washington and Oregon
    - >80 human cases and >50 animal cases since 2004
  - Initial cases with travel to BC; now many in-state

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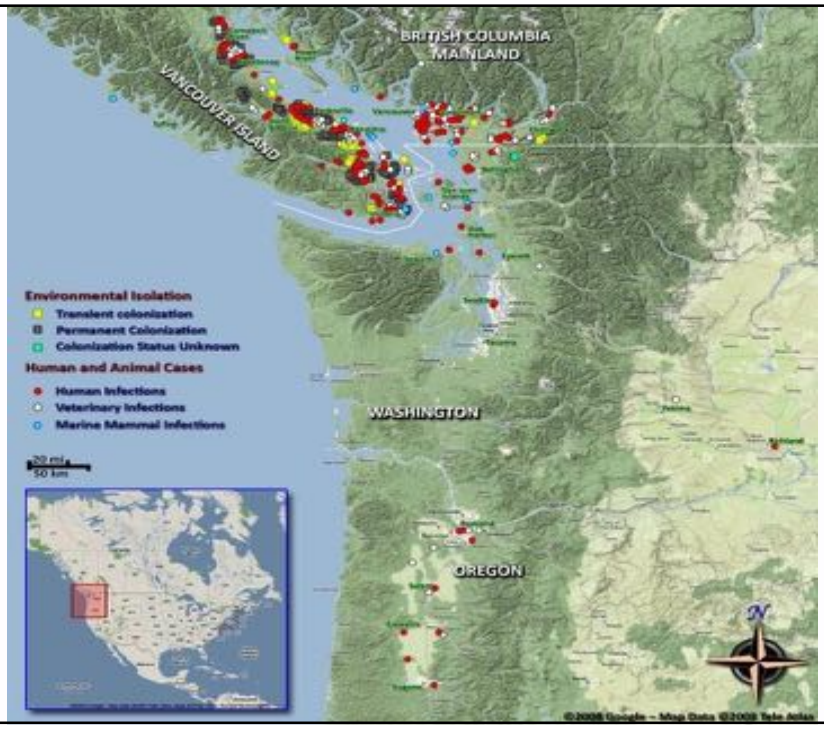
* Sources: (1) Datta Interdisc. Perspect. Inf Dis. 2008; 2) Galanis, Can J. Inf Dis Med Microbiol., 2008; (3) Datta EID 2009; (4) Galanis, EID 2010



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WA DOH public health surveillance goals

- Identify and investigate *C. gattii* cases
  - Human case reporting provides important risk factor and exposure data
  - Animal cases also valuable sentinel indicators
  - Clinical and veterinary labs required to submit isolates (2011)
- Participate in national surveillance system (2009)
  - Standardized case reporting; describe clinical presentation
  - Characterize genetic variety
- Increase clinician and veterinarian awareness
- Environmental detection
- Identify risk factors; develop prevention messages
- Collaborate with BCCDC working group

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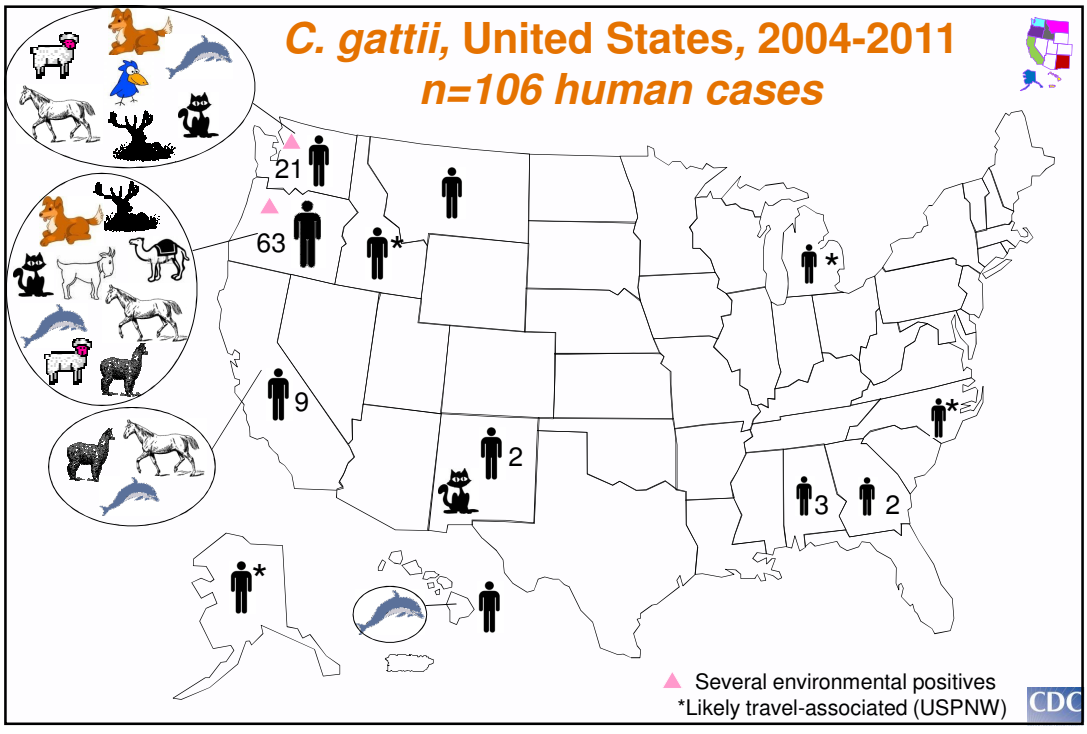


Epidemiologic differences in human cases

- Geographic comparisons between countries*

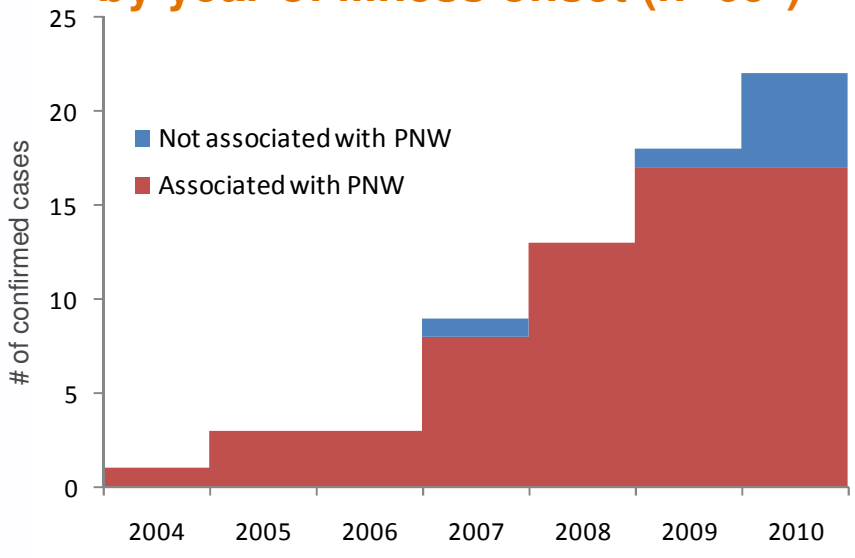
Patient characteristic	U.S.	B.C.	Australia
Male	53%	56%	70-77%
Predominant infecting strain genotype	VGIIa & VGIIc	VGIIa	Mostly VGI
Age (years): median (range)	56 (15-95)	62 (2-92)	Early/mid-40s
Clinical presentation	Respiratory > CNS	CNS, Respiratory	Mostly CNS
Pre-existing condition	73%**	38%	0-13%
Hospitalized	91%	46%	no data
Died from or with *C. gattii*	32%	9%	0%

- Strain-specific comparisons among U.S. cases

Patient characteristic	VGIIa/b/c 'outbreak strains'	Other genotypes
Respiratory symptoms	76%	43%
CNS (neurologic) symptoms	34%	100%
Pre-existing condition	78%	43%
Died of or with *C. gattii*	33%	20%

* Galanis, 2010; Speed, 1995; Chen, 2000; Harris 2011.; US & BC surveillance data (unpublished). ** When limited to conditions considered in BC, only 61%.

Human cases of *C. gattii* in the U.S. by year of illness onset (n=69*)



*Onset year is reported for 56 patients and is estimated by initial report year for 13 patients for whom onset date was not available. 2010 data is incomplete; data are typically lagged by several months.

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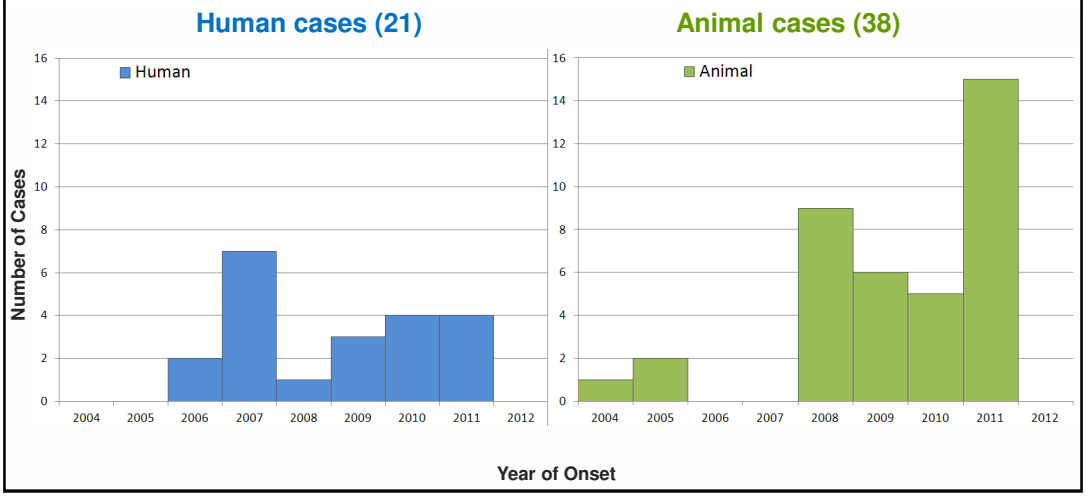
C. gattii cases in Washington, 1/2004-2/2012



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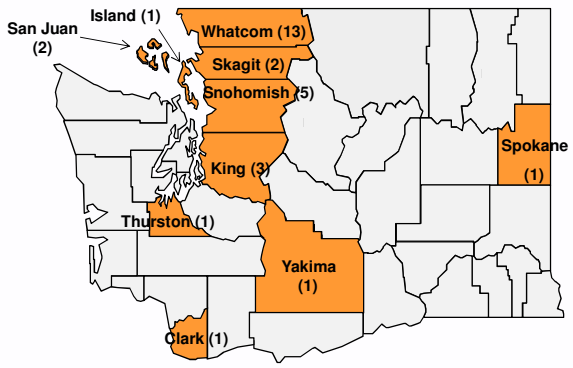
Animal cases, Washington, 1/2004-2/2012

Animal type	# cases
Bird	1
Canine	7
Feline	23
Porpoise	4
Elk	1
Horse	1
Sheep	1
All	**38**



Mapped by county of residence.
Not shown on map: migratory elk and porpoises.

Environmental investigations, 2007-2011

- Sampling mostly around animal cases; some human cases too
  - Typically select cases with no/minimal travel
  - Collect samples around homes, nearby parks, ferries
- Wide range of specimens collected
  - Swabs of trees, cut logs, fence posts, gravel, pavement, wheel wells
  - Soil, water, and air samples
- Completed 12 regional sampling investigations
  - >700 environmental samples collected and tested
- 2 positives found by WA DOH
  - 2 positives found by BC researchers

A stable ecological niche?

- Emergence in a temperate climate is new and surprising
- Documented presence in the Pacific Northwest
  - Environmental detections in BC, WA, OR
  - Many cases without travel to Vancouver Island
- Environmental investigations on Vancouver Island, BC*
  - Isolated from >10 native tree species, soil, air samples
  - Most early human and animal cases had contact with certain trees and the Coastal Douglas fir climatic zone

* Sources: Kidd S, EID 2007; MacDougall L, EID 2007; Bartlett KH, Curr Inf Dis Rep 2008; Datta K, Interdisc. Perspectives on ID, 2009.

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Many questions

- Has *C. gattii* always been here or recently introduced?
- Has the organism adapted?
  - How does that change pathogenesis, clinical presentation, ecological preferences?
- What are preferred ecological characteristics?
  - Have environmental conditions become more favorable?
  - Why was Vancouver Island colonized so well?
  - Do they differ by strain (genotype)?

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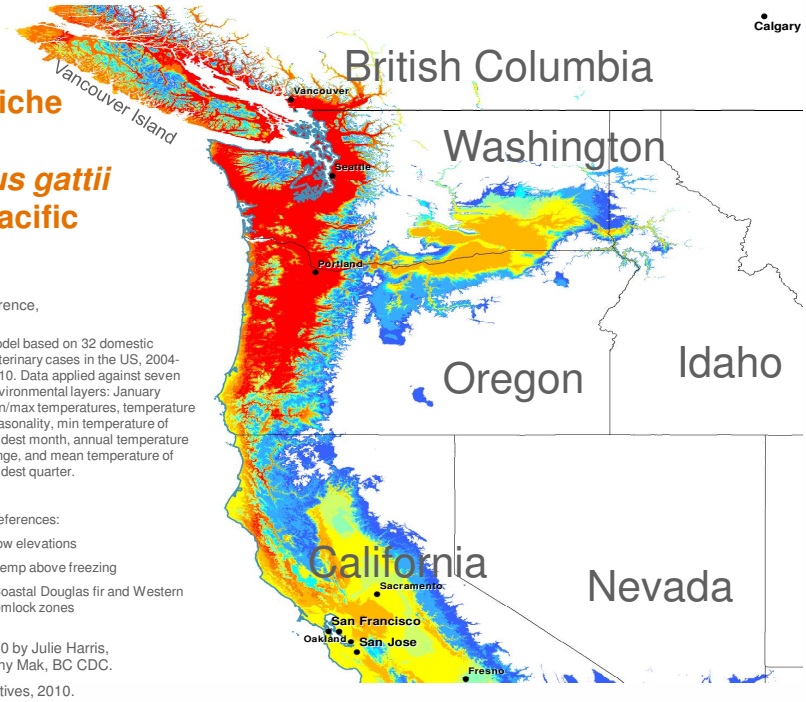
Ecological niche modeling of *Cryptococcus gattii* in the U.S. Pacific Northwest



Likelihood of species occurrence, as per the ENM:

- 91-100%
- 81-90%
- 71-80%
- 61-70%
- 51-60%
- 41-50%
- 31-40%
- 21-30%
- 11-20%
- 1-10%
- 0%

Model based on 32 domestic veterinary cases in the US, 2004-2010. Data applied against seven environmental layers: January min/max temperatures, temperature seasonality, min temperature of coldest month, annual temperature range, and mean temperature of coldest quarter.

Preferences:

-Low elevations

- Temp above freezing

- Coastal Douglas fir and Western Hemlock zones

Map created November 23, 2010 by Julie Harris, CDC, with assistance from Sunny Mak, BC CDC.

Mak, et al, Env. Health Perspectives, 2010.

More questions

- Additional physical, ecological niches than currently known?
  - Limited detections in U.S. but more clonal diversity
- Is the organism being distributed/spread?
  - Animals (migratory birds); ships/ferries (imported trees, passengers); vehicles; people (shoes, clothes, camping gear); wind or water currents
- Do activities that promote aerosolization contribute to exposure and/or distribution?
  - Commercial (large scale) logging, excavation, and forestry
  - Small scale gardening, landscaping, vehicle travel on dirt roads, chopping trees or making wood chips
  - Some studies of tree cutting, ↑ air concentrations

Sources: Bartlett KH, Curr Inf Dis Rep 2008; Kidd S, EID 2007; Duncan C, JAVMA 2006.; Taylor (unpublished); Datta EID 2009; MacDougall EID 2010

Summary

- *C. gattii* in the U.S. is still a new, emerging disease whose epidemiology is poorly understood
  - Still learning about risk factors for infection, different clinical presentation, exposure sources, etc.
- Many genetic and ecological investigations to study origin of infections and predict future path
- Fungi are environmentally sensitive
  - Potential for climate change to impact organism in environment; thus potential to influence human and animal infections

Acknowledgements

- Washington State Department of Health
  - Ron Wohrle, DVM – Public Health Veterinarian
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- Local health investigators and health officers in WA State
  - Whatcom County – Dr. Greg Stern
  - All other counties that have investigated cases and assisted in environmental sampling
- Physicians, veterinarians, and labs who have reported cases/isolates
- CDC and PNW *C. gattii* Working Group
  - Julie Harris, Shawn Lockhart, Tom Chiller
- BCCDC, UBC, and other partners

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Questions?

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