WHITE-NOSE SYNDROME (WNS)

Animal Group(s) Affected	Transmission	Clinical Signs	Severity	Treatment	Prevention and Control	Zoonotic
Any bat that hibernates in a cave or mine in WNS affected areas is considered at risk for the disease Microscopic lesions visible in European bats w/out mass mortality	Aerosol, direct contact, environmental exposure	Abnormal hibernation activity (more frequent arousal, daytime flights during winter, congregating at or near cave openings) White mold (fungal hyphae) on muzzle, wings, or both may be present but <u>is neither necessary nor specific for WNS</u>	North America: 90-100% mortality in some hibernacula. Population-wide losses in the northeastern US are >80% since introduction. Recovery has been documented experimentally and in wild, banded bats. Europe: Disease present with little noted morbidity or mortality	Supportive care (warmth, fluid & food supplement-ation)	Biosecurity: limit human access to affected areas, decontaminate after visiting affected areas	Not likely. Other *Geomyces* spp. rarely induce superficial infections of the skin and nails in humans.

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Susceptible animal groups: Cave and mine hibernating bats in North America. Currently affected species include: little brown bat (*Myotis lucifugus*), tri-colored bat (*Perimyotis subflavus*), northern long-eared bat (*Myotis septentrionalis*), big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), Indiana bat (*Myotis sodalis*), and gray bat (*Myotis grisescens*).

Causative organism: *Pseudogymnoascus (Geomyces) destructans*

Zoonotic potential: Not likely; psychrophilic character of fungus makes warm hosts unsuitable although other *Geomyces* species have been known to rarely induce superficial infection of the skin and nails in humans.

Distribution: Since its discovery in a New York cave in early 2007, WNS has continued its spread across eastern North America with newly affected sites regularly being identified. At this sheet completion, it affects 22 states and 5 Canadian provinces, and can be found as far west as Missouri, in northern Quebec, and south to Alabama. Up-to-date distribution maps can be found at: http://whitenosesyndrome.org/resources/map

Incubation period: Naturally occurring WNS is detected seasonally with the earliest confirmed case occurring in late September, and major mortality events beginning in the end of January, with peak mortality

events about 180 days after bats first enter hibernacula. Experimentally induced infections cause progressive increases in the frequency of periodic arousals, although there is no effect on duration of arousals. Mortality in experimental infections occurs as early as 88 days post infection.

Clinical signs: WNS was named after characteristic white fungal mold growth on the muzzles and wings of bats in caves and often associated with high mortality. However, this finding is neither specific for the disease nor necessary, as other non-pathologic fungal growth may have a similar appearance and sites where WNS has been present for multiple seasons may lack the characteristic finding although histologic evidence of disease may be present in resident bats. Bats heavily infected with *Geomyces destructans* may present with obvious damage to wing membranes with increased fragility, decreased elasticity, irregular pigmentation, and tears or holes in the wings through early summer. Abnormal roosting behaviors associated with WNS include movement to roosting areas near cave entrances or other exposed sites and diurnal flying from hibernacula during mid-winter. Progressive increases in the frequency of periodic arousals are also observed, and may account for the premature depletion of fat reserves seen in infected individuals. Research is currently underway to define other mechanisms by which the organism causes mortality, with hypotheses including potential disruption of hydration, electrolyte balance, circulation, and thermoregulation.

Post mortem, gross, or histologic findings: Visible white fungal material on the muzzle and wings is usually lost when a bat is removed from the cave environment. Infected wings usually look normal during hibernation but areas of 'contraction' or tears can be seen on the wings at the end of hibernation. Bats that die naturally from WNS have little subcutaneous fat. Pectoral muscle is tacky to the touch suggesting ante-mortem dehydration. Microscopic findings are characterized by dense aggregations of Periodic acid Schiff (PAS)-positive hyphae eroding through epidermis forming distinctive 'cups' filled with fungus. Invasion may continue into the connective tissue of wing membrane or muzzle. Hyphae are often seen replacing adnexal structures, filling skin glands and follicles. Curved conidia may be present on the surface of infected skin. Cellular inflammation is usually not present during hibernation but can become intense following arousal as the bats return to homeothermy. A scoring system has been developed to evaluate physiological effects of this infection. Although mild pneumonitis has been seen in some bats with WNS, internal organs generally are unremarkable both grossly and histologically.

Diagnosis: Although gross lesions can be suggestive of WNS, histopathologic visualization of lesions (cupping erosion of dermis) using PAS stain is necessary for definitive diagnosis. Biopsies of wing tissue can be taken as nonlethal samples (*vide infra*). Other supportive results include PCR, culture (psychrophilic and slow growing), identification of curved conidia histologically or cytologically with tape impression, and behavioral and clinical evidence. Ultraviolet light can also be used as a screening tool to assist with targeted specimen selection in the field; the cupping dermal erosions fluoresce orange under long-wave (368-385 nm) UV light before visible fungus is present. The unknown specificity of UV fluorescence precludes this technique from being diagnostic.

Material required for laboratory analysis:
Skin tissue from the wing and/or muzzle can be submitted for PCR analysis, fungal culture, and/or histopathology (PAS stain). Areas submitted should preferably demonstrate white fungal growth or abnormal appearance. The use of long-wave UV light can aid in identifying areas likely to be affected, particularly when nonlethal sampling is desired, where paired 3-5mm samples of wing tissue are adequate for both PCR and histopathology. While tape impressions of fungal growth on bats or fecal samples can be mounted on unstained glass slides to search for conidia characteristic of *G. destructans*, suggestive samples should be confirmed by PCR and histopathology.

Relevant diagnostic laboratories:
Work with samples known or suspected to harbor viable *G. destructans* should be conducted in a biosafety

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cabinet in a Biosafety Level 2 laboratory at minimum. Guidelines for personal and equipment decontamination should be followed. http://whitenosesyndrome.org/topics/decontamination

Treatment: At this time, the only effective treatment is supportive care of homeothermic bats. Studies are underway assessing various antifungal treatments, but to date no effective protocol has been documented. Natural recovery of free-ranging bats that survive infection during hibernation and subsequently clear all signs of disease has been documented. However, in wild free-flying bats, wing damage may prevent successful foraging, causing additional mortality.

Prevention and control: Current prevention and control strategies focus on biosecurity and cave closures to limit movement of people and contaminated equipment between hibernacula. Limiting movement of infected bats during hibernation months has been proposed as a method of limiting bat dispersal of the fungus. Other studies assessing artificial caves, fungal biocontrol agents and vaccine possibilities are currently in progress. http://whitenosesyndrome.org/research-and-monitoring

Suggested disinfectant for housing facilities: WNS is only a risk for cave or mine hibernating bats, and at this time no cave disinfection is suggested. To minimize the spread of the organism decontamination protocols should be followed whenever moving bats or equipment that may have been exposed. Equipment decontamination guidelines:
http://whitenosesyndrome.org/topics/decontamination

Notification: Notification of this disease is voluntary at this time. Reports of WNS observations can be sent to your state wildlife resources agency, the U.S. Fish and Wildlife Service, or the USGS National Wildlife Health Center. Instructions for reporting mortality events to the USGS can be found here:
http://www.nwhc.usgs.gov/mortality_events/reporting.jsp

Measures required under the Animal Disease Surveillance Plan: Request bat population and behavioral observations from all hibernacula surveys be reported to the national Bat Population Monitoring Database and WNS Tracking Database (secure-access) currently in development. Data requested can be found in NWHC Bat Submission Guidelines:
http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/

Measures required for introducing animals to infected animal: Not recommended.

Conditions for restoring disease-free status after an outbreak: None.

Experts who may be consulted:

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