PSEUDOGYMNOASCUS DESTRUCTANS

(WHITE-NOSE SYNDROME)

AETIOLOGY

Classification of the causative agent

Pseudogymnoascus destructans (Pd), formerly named *Geomyces destructans*, is the causative agent of White-nose syndrome (WNS), a fungal disease of hibernating bats. White fungal growth is seen on the muzzles, ears, and wings of infected bats. Infection causes an increase in the utilisation of fat stores as well as hyperkalemia and a respiratory acidosis (accumulation of CO_2 in the blood). It is believed that these physiologic disturbances cause an increased frequency of arousal from torpor to allow for compensatory physiologic mechanisms; this simultaneously exacerbates energy requirements and dehydration status and contributes to mortality.

Resistance to physical and chemical action

Temperature:	Pd is psychrophilic and grows optimally between 12.5-15.8°C; it fails to grow at temperatures greater than 20°C. Dispose of contaminated materials and unfixed tissues by incineration or autoclaving at 121°C for 90 minutes.
pH:	Not yet determined
Chemicals/Disinfectants:	Submersion in 55°C water for 20 minutes, application of 60% ethanol or 70% isopropanol solutions, and 3% hydrogen peroxide wipes are effective decontamination methods. Many commercial disinfectants, including chlorine bleach solutions, are effective when used according to manufacturer specifications.
Survival:	Fungal spores persist well within cool, moist locations such as hibernacula and can often be detected in guano collected from these environments.

EPIDEMIOLOGY

It is believed there are three main lineages of Pd: Chinese, Mongolian, and European. European and Asian isolates exhibit a high level of diversity which, when combined with the low levels of mortality observed in bats in those regions, suggests a long history of coevolution. Despite its rapid geographic spread since its introduction, isolates found in North America are still monophyletic - which supports the hypothesis of a recent introduction - and reflect a European origin.

Hosts

- Bats (*Chiroptera*) in North America, Europe, and Asia.
    - Bats in Europe and Asia rarely develop clinical disease as a result of Pd infection, whereas North American bats are experiencing large-scale mortality events due to WNS.

Transmission

- Direct contact with infected bats

- Contact with contaminated surfaces and environments

Sources

- Infected bats
- Spores from contaminated environments and fomites

Occurrence

P. destructans is enzootic in bat species across Europe and Asia. Phylogenetic data suggests a long history of coevolution, which is compatible with the rare incidence of clinical disease and mortality in these regions. Pd was first detected in the United States in 2007 and has been spreading rapidly across North America since; Pd has been detected in the US and Canada as of summer 2019. It is estimated millions of bats have died in North America since the introduction of the fungus.

Over 20 species of bats have tested Pd positive in North America, including 5 endangered species, and over 21 species have tested positive in Europe and Asia. North American bat species are experiencing higher mortality rates due to WNS than Asian and European species.

For up-to-date information about the distribution of *P. destructans* in North America, please visit [https://www.whitenosesyndrome.org/spreadmap].

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE World Animal Health Information System - Wild (WAHIS-Wild) Interface [http://www.oie.int/wahis_2/public/wahidwild.php/Index].

DIAGNOSIS

Lesions caused by Pd can often be detected in bats as they gather to begin hibernation, and clinical disease most often occurs while bats are dormant in their hibernacula. Mortality typically occurs from late January to mid-March, which suggests a 120-180 day course of disease.

Because some bats are capable of carrying Pd spores without developing clinical disease, detection of the fungus is not sufficient for a clinical diagnosis; utilise histopathology to confirm invasive fungal growth in conjunction with fungal isolation.

Clinical diagnosis

White fungal growth on the muzzles and wings of hibernating bats is highly suggestive of *P. destructans* infection. Infected bats experience significant weight loss and frequent bouts of activity due to abnormal arousal from torpor.

WNS is typically fatal without supportive care.

Lesions

- White fungal growth on the muzzle, ears, and wings
- Damage to patagial epithelia ranging from cupping erosions to full-thickness lesions
- Invasion of fungal hyphae into connective tissues
- Abnormalities in blood chemistry, namely electrolyte imbalances and hypoglycaemia

Differential diagnoses

- The physical appearance of *P. destructans* infection is fairly characteristic and indicative of WNS.

Laboratory diagnosis

Samples

For isolation of agent

- Swab of ears, muzzle, and wings
- Biopsy

Serological tests

- Serology is not utilised for detection of *P. destructans.*

Procedures

Identification of the agent

- Histopathology is considered the gold standard (punch biopsy, necropsy).
- Fungal culture and/or polymerase chain reaction (PCR) of skin swabs are effective diagnostic methods.
- UV light can be used as a screening tool, but may yield false negatives.
    - *P. destructans* fluoresces orange under UV light.

Serological tests

- Serology is not utilised for detection of *P. destructans.*

PREVENTION AND CONTROL

Sanitary prophylaxis

- Before performing fieldwork, be aware of the *P. destructans* status of your location as well as any field locations to be visited; contact local government and land management agencies for further guidance and information about *P. destructans* in the area.
- Utilise field equipment that can be easily decontaminated (rubber, synthetic materials, etc.); decontaminate all equipment before departing field locations.
    - Consider porous vs. nonporous materials and subsequent implications for decontamination.
- Use dedicated gear in contaminated hibernacula.
- Enclose all exposed or contaminated equipment and clothing in sealed bags or containers before departing field locations; decontaminate the exterior surface of the bag/container and store separately from unexposed equipment.
- Wash dirt and debris off of vehicles prior to departing field sites.
- Thoroughly wash skin with soap and change into clean clothing and footwear upon leaving field sites.
- Limit transportation of equipment and peoples between infected and non-infected areas.

Medical prophylaxis

- A raccoon poxvirus vectored vaccine is currently in development.

POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

Risks to public health

- There is no known direct risk of *P. destructans* exposure to humans.
- It has been speculated that increased arousals from torpor may increase the frequency at which bats and humans come into contact, but there is insufficient evidence to suggest bats infected with *P. destructans* are more likely to attack or transmit diseases to humans.
- Bats are important regulators of insect populations; it has been speculated that bat die-offs may contribute to an increase of vector-borne disease cases in humans, but this has yet to be investigated.

Risks to agriculture

- Bats ingest many insect species considered to be pests by the agricultural industry and are, in some parts of the world, significant pollinators and seed dispersers. Declines in bat populations may therefore negatively impact agricultural industries.

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Science Department (scientific.dept@oie.int). Last updated 2019. Written by Marie Bucko and Samantha Gieger with assistance from the USGS National Wildlife Health Center.